INTER-CANYON FIRE PROTECTION DISTRICT
MEETING OF DIRECTORS AGENDA
ICFPD Station 3, Zoom Webinar Option
January 12, 2022

1. Call to Order

2. Changes to Agenda

3. Approval of Absences

4. Acknowledge Guests

5. Approval of the minutes of the December 8, 2021, meeting.

6. CFO Report
   a. Financial Reports

7. Chiefs Report

8. Officers Report

9. Building Committee Report

10. Professional Consultants Report - none

11. Unfinished business

12. New business and special orders

13. Executive session, if needed

14. Public input (for matters not otherwise on the agenda/3-minute time limit/no disrupting, pursuant to Section 18 9 108, C.R.S.)
    Consistent with provisions of Section 18 9 108, C.R.S., district residents wishing to make a comment will have three minutes to speak and are asked to keep comments on topic and respectful.

15. Adjournment. (to be followed by signing of documents)

INTER-CANYON FIRE PROTECTION DISTRICT
BOARD OF DIRECTORS MEETING
MINUTES OF MEETING
ICFPD Station 3, Zoom Webinar Option
8445 S Highway 285, Morrison, CO 80465
January 12, 2022

1. **Call to Order:**
   The ICFPD Board meeting was called to order by Mike Swenson at 18:11 hours.

2. **Changes to Agenda**

3. **Approval of Absences**
   Board Members Present:
   Mike Swenson, President
   Kerry Prielipp, Treasurer
   Bob Scott, Secretary
   Jackie White, Director

   Excused Absence:
   Dmitiry Pantyukhin, Director

4. **Guests Present**
   Sharon Trilk
   Deborah Probst, Canyon Courier
   Barbara Davis

   Mike Swenson welcomed guests and Chief Shirlaw provided a brief introduction of Toni Lucero as the new Office Administrator for ICFPD.

5. **Approval of Minutes**
   MOTION: There was a motion by Bob Scott with a second by Kerry Prielipp to approve the minutes from the December 8, 2021, Board Meeting. The motion passed unanimously.

6. **Treasurer's Report**
   a. Kerry Prielipp reviewed the December balance sheet showing the month ended with 1.9 million in the bank. Outstanding Purchase Orders are at approximately $54,000.00 The budget ended positively with more revenue taken in than anticipated and expenses less than expected. Kerry continued with a detail of the financial report with clarification of specific expenses and abbreviated titles thereof.

MOTION: There was a motion by Bob Scott with a second by Jackie White to approve the January 12, 2022, Treasurer's Report. The motion passed unanimously.

7. Chiefs Report

Chief Shirlaw

Communications –

1. Chief Shirlaw indicated his desire to move forward with vendor KNS and explained details of new bid having reviewed them with the board members. Chief requests to approve moving forward with the KNS bid in new business of agenda.
2. The Chief advised of permit difficulties with the tower at Sta. 5 – stating frustration as it is the same tower as Station 4 when it was installed but we are dealing with more red tape with this one.
3. Covid update – The Omicron variant is very contagious and causing progressive PPE precautions. This may include possibly moving away from public access to the stations. There is also an uptick in Covid positive patients.
4. Consolidation update – Notification of a call for preferably 2 board members to volunteer to meet regularly with board members from the other 3 districts. Need notification ASAP please. Will meet two times per month to discuss the higher end strategies needed. The four chiefs who are already meeting regularly every two weeks will continue with a focus on the operational aspects of consolidation.

Staffing –

1. Mechanic Mike Onken retiring has created a need to post a joint fleet mechanic position serving both Elk Creek and Inter-Canyon and with a fleet truck due to it being a very busy position. Will be looking for specific certifications, abilities, etc., not simply the average mechanic.
2. We have 3 new members on team – 1 EMT and 2 Firefighters.

General –

1. Jeffco is close to full adoption of the WUI code.
2. AFG grant in process for two additional vehicles. There is a communications grant also in process.
3. There were fewer fires and more EMS calls for this year with Station 3 being the busiest location.
4. Community CPR & Child car seat attendance has improved and more trainings are anticipated for 2022.
5. Chief gave a detail of response statistics which have been a positive outcome majority.
6. 1 medic team sent to the Marshall Fire. Fire resources were retained in district to provide adequate coverage should it be needed.

Battalion Chief Hatlestad

Chief Hatlestad advised that the Public Crisis Standards of Care have been updated concerning Covid and ability to transport patients has been reduced due to hospital staffing abilities to receive.

8. Officers Report

Captain Mandl

Wildfire home assessments are continuing with great response. Expecting a higher demand this year due to the Marshall Fire. He is preparing a comparison of last year's assessments to list successes with the program.

There is a meeting in January for the ambassador's program education which has a lot of positive feedback and could possibly mean adding more ambassador regions.

The Inter-Canyon and Elk Creek Community Wildland Protection Plan document is being cleaned up now for public review. It should be completed by month's end and ready for receiving feedback.

Fuels Crew – The hiring process for seasonal crew is complete and is full. There will be public sign-ups available later this year. The Elk Creek fuel moisture equipment implementing and indicates a projected $32,000 reimbursement towards fuel crew.

9. Building Committee Report –

Received one bid coming in at approximately $3.6 million dollars for Station 1. Based on that, there is a possible need to look at options to remodel instead of new build and wait for a better budgeting climate. Bob Scott stated there is an expectation of one more bid coming in this month.

10. Professional Consultants Report – None

11. Unfinished Business - None

12. New Business and Special Orders

1. Chief Shirlaw asks for board acceptance and approval of the KNS bid, pending final review by legal. He noted that the bid comes in mid-level, not the highest or lowest. Board members reviewed and discussed the pros and cons of the bid. It was agreed by the board to move forward, and Mike Swenson asked for a motion to approve the bid.

   MOTION: There was a motion by Bob Scott with a second by Kerry Prielipp to approve and accept the KNS quote# 430015 for a total of $415,263.94 to complete the Hilldale Pines Replacement Project, pending review by the lawyers. The motion passed unanimously.

2. EMT class will be moving forward under Centura. Ideally it will be cost neutral and we are already receiving equipment donations.

3. Three new CPR Lucas devices have been received. $43,000 in total cost to purchase was funded from a Covid relief funds grant acquired through the efforts of Chief Hatlestad.

13. Executive session, not needed.

14. Public Input (for matters not otherwise on the agenda/3-minute time limit/no disrupting, pursuant to Section 18 9 108, C.R.S.)

1.Joe Musca –

a. Thank you for service on behalf of the district residents.
b. States urgent need for preventative action due to the Marshall Fire being that our area has similar concerns. There are volunteers available and ready to assist with home inspections. Feels the district needs to capitalize on the current awareness incited by the Marshall Fire events and utilize all resources to prepare the community.
c. Willing to supplement ICFPD in any way and willing to be a contact for community volunteers.

15. Adjournment

MOTION:

There being no further business before the Board, there was a motion to adjourn the meeting by Kerry Prielipp and a second by Jackie White. The meeting was adjourned at 19:28 hours.

Minutes by Toni Lucero, Office Administrator

Submitted by:

Bob Scott
Secretary
ICFPD Board of Directors

Approved by:

Michael Swenson
President
ICFPD Board of Directors

Attachments:

1. Meeting Agenda
2. Treasurer's Report
3. Chief's Report
4. KNS Contract

Inter-Canyon Fire Protection District

Balance Sheet Comparison

As of December 31, 2021

	TOTAL		
	AS OF DEC 31, 2021	AS OF DEC 31, 2020 (PY)	CHANGE
ASSETS			
Current Assets			
Bank Accounts			
100-000 Cash	1,956,981.38	2,117,448.74	-160,467.36
Total Bank Accounts	**$1,956,981.38**	**$2,117,448.74**	**$ -160,467.36**
Accounts Receivable			
120-000 Accounts Receivable	1,411,604.52	1,411,604.52	0.00
Total Accounts Receivable	**$1,411,604.52**	**$1,411,604.52**	**$0.00**
Other Current Assets			
140-143 Prepaid Insurance	19,785.45	19,785.45	0.00
Total Other Current Assets	**$19,785.45**	**$19,785.45**	**$0.00**
Total Current Assets	**$3,388,371.35**	**$3,548,838.71**	**$ -160,467.36**
Fixed Assets			
170-000 Capital Assets	2,769,783.97	2,769,783.97	0.00
Total Fixed Assets	**$2,769,783.97**	**$2,769,783.97**	**$0.00**
Other Assets			
185-000 Deferred Outflow	466,602.00	466,602.00	0.00
Total Other Assets	**$466,602.00**	**$466,602.00**	**$0.00**
TOTAL ASSETS	**$6,624,757.32**	**$6,785,224.68**	**$ -160,467.36**

Inter-Canyon Fire Protection District

Balance Sheet Comparison

As of December 31, 2021

	TOTAL		
	AS OF DEC 31, 2021	AS OF DEC 31, 2020 (PY)	CHANGE
LIABILITIES AND EQUITY			
Liabilities			
Current Liabilities			
Accounts Payable			
200-200 Accounts Payable	54,218.98	21,443.76	32,775.22
Total Accounts Payable	**$54,218.98**	**$21,443.76**	**$32,775.22**
Other Current Liabilities			
200-208 Accrued Interest	0.00	0.00	0.00
200-209 Deferred Revenue	1,382,375.85	1,382,375.85	0.00
200-225 Accrued Liabilities	2,462.91	2,462.91	0.00
200-226 Capital Lease - 3	0.00	0.00	0.00
200-230 Accrued PTO	5,202.83	5,202.83	0.00
Total Other Current Liabilities	**$1,390,041.59**	**$1,390,041.59**	**$0.00**
Total Current Liabilities	**$1,444,260.57**	**$1,411,485.35**	**$32,775.22**
Long-Term Liabilities			
210-360 Captial Lease - 3	0.00	0.00	0.00
210-399 Net Pension Oblgation	786,351.00	786,351.00	0.00
280-000 Deferred Inflows	77,086.00	77,086.00	0.00
Total Long-Term Liabilities	**$863,437.00**	**$863,437.00**	**$0.00**
Total Liabilities	**$2,307,697.57**	**$2,274,922.35**	**$32,775.22**
Equity			
290-291 Equity	3,155,777.20	3,155,777.20	0.00
290-300 Net Assets - Prior Year	1,034,046.52	1,406,656.75	-372,610.23
290-999 Designated-Current	0.00	-372,610.23	372,610.23
320-000 Unrestricted Net Assets	320,478.61	-39,524.12	360,002.73
Net Income	-193,242.58	360,002.73	-553,245.31
Total Equity	**$4,317,059.75**	**$4,510,302.33**	**$ -193,242.58**
TOTAL LIABILITIES AND EQUITY	**$6,624,757.32**	**$6,785,224.68**	**$ -160,467.36**

Inter-Canyon Fire Protection District

Budget vs. Actuals: FY_2021 - FY21 P&L

January - December 2021

	TOTAL			
	ACTUAL	BUDGET	OVER BUDGET	% OF BUDGET
Income				
300-000 Revenues	1,710,998.08	1,406,552.35	304,445.73	121.64 %
300-502 Specific Ownership Taxes		50,000.00	-50,000.00	
300-570 Inter-Governmental Revenues		18,500.00	-18,500.00	
300-660 Donated Funds	29,251.75	0.00	29,251.75	
Total Income	**$1,740,249.83**	**$1,475,052.35**	**$265,197.48**	**117.98 %**
GROSS PROFIT	**$1,740,249.83**	**$1,475,052.35**	**$265,197.48**	**117.98 %**
Expenses				
400-000 Administrative	91,835.49	130,023.00	-38,187.51	70.63 %
425-101 Payroll & Benefits	529,331.78	540,840.00	-11,508.22	97.87 %
500-000 FireFighting	272,751.04	158,068.00	114,683.04	172.55 %
550-550 EMS Services	36,215.81	55,585.81	-19,370.00	65.15 %
600-000 FF Apparatus/Equip Maintenance	78,999.17	111,130.79	-32,131.62	71.09 %
660-000 Firefighter General Expenses	16,646.62	10,300.00	6,346.62	161.62 %
665-000 Auxiliary Operations	2,105.00	10,700.00	-8,595.00	19.67 %
670-000 Station 1	25,587.44	29,185.81	-3,598.37	87.67 %
680-000 Station 2	11,680.11	15,053.36	-3,373.25	77.59 %
690-000 Station 3	18,917.38	25,759.60	-6,842.22	73.44 %
691-000 Station 4	11,999.06	17,295.45	-5,296.39	69.38 %
692-000 Station 5	6,383.49	7,848.41	-1,464.92	81.33 %
700-000 Communications	75,329.03	62,155.99	13,173.04	121.19 %
750-000 Depreciation Expense		0.00	0.00	
800-900 Pension-State Contribution		18,500.00	-18,500.00	
800-902 Pension-Contributuion GOVT-WIDE	105,679.00	105,679.00	0.00	100.00 %
900-000 Capital Expenditures	650,031.99	1,827,040.00	-1,177,008.01	35.58 %
Total Expenses	**$1,933,492.41**	**$3,125,165.22**	**$ -1,191,672.81**	**61.87 %**
NET OPERATING INCOME	**$ -193,242.58**	**$ -1,650,112.87**	**$1,456,870.29**	**11.71 %**
NET INCOME	**$ -193,242.58**	**$ -1,650,112.87**	**$1,456,870.29**	**11.71 %**

Inter-Canyon Fire Protection District

A/P Aging Detail

As of December 31, 2021

DATE	TRANSACTION TYPE	NUM	VENDOR	DUE DATE	PAST DUE	AMOUNT	OPEN BALANCE
91 or more days past due							
01/05/2021	Bill	452	Ridgeline Engineering Company	02/04/2021	336	1,000.00	1,000.00
Total for 91 or more days past due						**$1,000.00**	**$1,000.00**
1 - 30 days past due							
11/01/2021	Bill	918559	Peggy Lucatuorto	12/01/2021	36	78.75	78.75
11/12/2021	Bill	414570	Mike Onken	12/12/2021	25	480.00	480.00
11/17/2021	Bill	414571	Mike Onken	12/17/2021	20	400.00	400.00
11/23/2021	Bill	9893487709	Verizon Wireless	12/23/2021	14	910.43	910.43
11/23/2021	Bill	3140000	SCL Health	12/23/2021	14	393.30	393.30
11/28/2021	Bill	Nov STMT	O'Reilly Auto Parts	12/28/2021	9	363.46	363.46
11/29/2021	Bill	601811	ADPI	12/29/2021	8	566.97	566.97
11/29/2021	Bill	019857076	Galls	12/29/2021	8	105.84	105.84
11/30/2021	Bill	Fuels 113021	Elk Creek Fire Protection District	12/30/2021	7	8,010.77	8,010.77
11/30/2021	Bill	Training 113021	Elk Creek Fire Protection District	12/30/2021	7	4,173.12	4,173.12
11/30/2021	Bill	HA 113021	Elk Creek Fire Protection District	12/30/2021	7	2,842.56	2,842.56
11/30/2021	Bill	109046	Advanced Tower Services Inc.	12/30/2021	7	2,018.76	2,018.76
11/30/2021	Bill	11/30/21 STMT	Collins, Cockrel & Cole	12/30/2021	7	655.96	655.96
Total for 1 - 30 days past due						**$20,999.92**	**$20,999.92**
Current							
12/01/2021	Bill	12/1/21 174B	Century Link	12/31/2021	6	369.04	369.04
12/03/2021	Bill	1987	Interconnected Technologies LLC	01/02/2022	4	676.05	676.05
12/06/2021	Bill	IF-2022-1	Jeffcom 911	01/05/2022	1	3,694.50	3,694.50
12/07/2021	Bill	414573	Mike Onken	01/06/2022	0	400.00	400.00
12/07/2021	Bill	9894550537	Verizon Wireless	01/06/2022	0	25.02	25.02
12/08/2021	Bill	032302555X11209 St 4	Direct TV	01/07/2022	-1	98.23	98.23
12/09/2021	Bill	12/9/21 2	Colorado Natural Gas Inc.	01/08/2022	-2	766.48	766.48
12/09/2021	Bill	12/9/21	Colorado Natural Gas Inc.	01/08/2022	-2	384.03	384.03
12/09/2021	Bill	12/9/21 St 3	CORE Electric Cooperative	01/08/2022	-2	233.79	233.79
12/09/2021	Bill	069375326X211210	Direct TV	01/08/2022	-2	91.98	91.98
12/09/2021	Bill	019954607	Galls	01/08/2022	-2	17.16	17.16
12/10/2021	Bill	037709647X211210	Direct TV	01/09/2022	-3	91.98	91.98
12/11/2021	Bill	164172	Sandy Onken	01/10/2022	-4	70.00	70.00
12/12/2021	Bill	414574	Mike Onken	01/11/2022	-5	480.00	480.00
12/12/2021	Bill	21-007	Rebecca Fuller	01/11/2022	-5	135.00	135.00
12/12/2021	Bill	918563	Peggy Lucatuorto	01/11/2022	-5	78.75	78.75
12/12/2021	Bill	12/12/21	Rachel Shirlaw	01/11/2022	-5	70.00	70.00
12/13/2021	Bill	414575	Mike Onken	01/12/2022	-6	240.00	240.00
12/14/2021	Bill	73296	Subcarrier Communications Inc.	01/13/2022	-7	371.32	371.32
12/14/2021	Bill	414572	Mike Onken	01/13/2022	-7	240.00	240.00
12/15/2021	Bill	F-4800	Pat Lombardi	01/14/2022	-8	535.00	535.00
12/17/2021	Bill	POL 0010843 Q1 2022	CSDPL	01/16/2022	-10	9,331.50	9,331.50
12/17/2021	Bill	00007241	Pericle Communications Co	01/16/2022	-10	7,616.93	7,616.93
12/17/2021	Bill	136003	Mountain Broadband	01/16/2022	-10	49.00	49.00
12/19/2021	Bill	12/19/21	Holly Shirlaw	01/18/2022	-12	70.00	70.00
12/20/2021	Bill	918564	Peggy Lucatuorto	01/19/2022	-13	52.28	52.28
12/20/2021	Bill	ICDec2021 FM	Elk Creek Fire Protection District	01/19/2022	-13	44.50	44.50
12/20/2021	Bill	30326105	Rocky Mountain Air Solutions	01/19/2022	-13	25.10	25.10
12/24/2021	Bill	12/24/21	First Bank	01/23/2022	-17	1,912.93	1,912.93
12/25/2021	Bill	0535-005197893	Republic Services #535	01/24/2022	-18	246.41	246.41
12/26/2021	Bill	414576	Mike Onken	01/25/2022	-19	160.00	160.00
12/26/2021	Bill	918565	Peggy Lucatuorto	01/25/2022	-19	78.75	78.75
12/26/2021	Bill	12/26/21	Rachel Shirlaw	01/25/2022	-19	70.00	70.00
12/27/2021	Bill	12/27/21 Sta 2	CORE Electric Cooperative	01/26/2022	-20	142.90	142.90
12/28/2021	Bill	761458728 4&5	Xcel Energy	01/27/2022	-21	337.88	337.88
12/29/2021	Bill	12/29/21 RR	John Mandl	01/28/2022	-22	516.68	516.68
12/30/2021	Bill	IN1661237	MES Rocky Mountains	01/29/2022	-23	3,315.00	3,315.00
12/30/2021	Bill	201806472	EBS of Colorado (A COMVRS CO)	01/29/2022	-23	153.60	153.60
12/31/2021	Bill	12/31/21	Ken Caryl Ranch Water	01/30/2022	-24	27.27	27.27
Total for Current						**$33,219.06**	**$33,219.06**
TOTAL						**$55,218.98**	**$55,218.98**

Inter-Canyon Fire Protection District

Open Purchase Orders Detail

January - December 2021

DATE	NUM	VENDOR	PRODUCT/SERVICE	ACCOUNT	QTY	RECEIVED QTY	BACKORDERED QTY	TOTAL AMT	RECEIVED AMT	OPEN BALANCE
BK KNG2 P25 VHF Portable Radio										
11/08/2021	1007	First Responder Communications	BK KNG2 P25 VHF Portable Radio	700-753 Communications:Portable Radio New/Replace	1.00	0.00	1.00	95.00	0.00	95.00
11/08/2021	1007	First Responder Communications	BK KNG2 P25 VHF Portable Radio	700-753 Communications:Portable Radio New/Replace	10.00	0.00	10.00	18,750.00	0.00	18,750.00
Total for BK KNG2 P25 VHF Portable Radio					**11.00**	**0.00**	**11.00**	**$18,845.00**	**$0.00**	**$18,845.00**
Not Specified										
09/20/2021	1002	Rocky Mountain Generator		900-375 Capital Expenditures:Station 5 Radio Tower				13,107.00	0.00	13,107.00
09/20/2021	1002	Rocky Mountain Generator		900-372 Capital Expenditures:Station 4 Radio Tower				13,107.00	0.00	13,107.00
12/09/2021	1010	Daniel Hatlestad		550-551 EMS Services:EMS Training/Certification				1,110.00	0.00	1,110.00
12/09/2021	1009	Stryker Medical		900-377 Capital Expenditures:Apparatus:Medical Equipment				43,500.00	0.00	43,500.00
12/17/2021	1011	Advanced Tower Services Inc.		900-376 Capital Expenditures:Communications Tower Mt Lindo				10,220.00	0.00	10,220.00
Total for Not Specified								**$81,044.00**	**$0.00**	**$81,044.00**
TOTAL					**11.00**	**0.00**	**11.00**	**$99,889.00**	**$0.00**	**$99,889.00**

INTER-CANYON FIRE PROTECTION DISTRICT

ICFPD BANK STATEMENTS

ARE AVAILABLE BY REQUEST

PLEASE CONTACT

DISTRICT ADMINISTRATOR KELLEY WOOD

303-697-4413

kwood@icfpd.net

303-697-4413 office 303-697-6770 fax www.intercanyonfire.org
7939 South Turkey Creek Rd., Morrison, CO 80465

Inter-Canyon Fire Protection District

100-105 ColoTrust Account, Period Ending 12/31/2021

RECONCILIATION REPORT

Reconciled on: 01/05/2022

Reconciled by: kwood@icfpd.net

Any changes made to transactions after this date aren't included in this report.

Summary USD

Statement beginning balance	1,832,753.75
Interest earned	26.87
Checks and payments cleared (1)	-100,000.00
Deposits and other credits cleared (0)	0.00
Statement ending balance	1,732,780.62
Register balance as of 12/31/2021	1,732,780.62

Details

Checks and payments cleared (1)

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
12/14/2021	Transfer			-100,000.00
Total				-100,000.00

Inter-Canyon Fire Protection District

100-106 First Bank Checking, Period Ending 12/31/2021

RECONCILIATION REPORT

Reconciled on: 01/05/2022

Reconciled by: kwood@icfpd.net

Any changes made to transactions after this date aren't included in this report.

Summary

	USD
Statement beginning balance	399,329.68
Checks and payments cleared (85)	-257,070.30
Deposits and other credits cleared (11)	139,846.36
Statement ending balance	282,105.74
Uncleared transactions as of 12/31/2021	-77,643.63
Register balance as of 12/31/2021	212,936.47
Cleared transactions after 12/31/2021	-8,474.36
Uncleared transactions after 12/31/2021	-36,566.79
Register balance as of 01/05/2022	167,895.32

Details

Checks and payments cleared (85)

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
10/29/2021	Bill Payment			-78.75
11/01/2021	Bill Payment			-21,018.12
11/23/2021	Bill Payment			-329.40
11/23/2021	Bill Payment			-70.00
11/23/2021	Bill Payment			-525.15
11/23/2021	Bill Payment			-48,028.50
11/23/2021	Bill Payment			-500.00
11/23/2021	Bill Payment			-25.02
11/23/2021	Bill Payment			-2,080.00
11/23/2021	Bill Payment			-70.00
12/01/2021	Bill Payment			-25.57
12/01/2021	Bill Payment			-105,679.00
12/02/2021	Expense			-25.04
12/03/2021	Expense			-91.98
12/03/2021	Expense			-91.98
12/03/2021	Expense			-91.98
12/06/2021	Expense			-55.74
12/06/2021	Expense			-573.22
12/06/2021	Check			-4,289.79
12/07/2021	Expense			-535.54
12/07/2021	Expense			-242.81
12/07/2021	Expense			-451.88
12/07/2021	Expense			-4,271.75
12/08/2021	Bill Payment			-70.00
12/08/2021	Expense			-100.00
12/08/2021	Bill Payment			-70.00
12/08/2021	Bill Payment			-4,895.73
12/08/2021	Bill Payment			-1,237.50
12/08/2021	Bill Payment			-382.50
12/08/2021	Bill Payment			-597.70
12/08/2021	Bill Payment			-375.76
12/08/2021	Bill Payment			-70.00
12/08/2021	Bill Payment			-2,263.11
12/08/2021	Bill Payment			-3,684.04
12/08/2021	Bill Payment			-49.00
12/08/2021	Bill Payment			-78.75
12/08/2021	Bill Payment			-34.34
12/09/2021	Expense			-55.25
12/10/2021	Expense			-545.40

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
12/10/2021	Expense			-88.87
12/10/2021	Expense			-784.00
12/13/2021	Expense			-2,593.99
12/13/2021	Expense			-8,641.48
12/13/2021	Expense			-611.50
12/13/2021	Expense			-143.75
12/13/2021	Expense			-59.20
12/13/2021	Expense			-3,413.83
12/13/2021	Expense			-95.83
12/14/2021	Bill Payment			-246.57
12/14/2021	Check			-4,246.59
12/14/2021	Bill Payment			-131.77
12/14/2021	Bill Payment			-690.30
12/14/2021	Bill Payment			-27.27
12/14/2021	Bill Payment			-465.27
12/14/2021	Bill Payment			-58.60
12/14/2021	Bill Payment			-119.00
12/14/2021	Bill Payment			-5,765.32
12/14/2021	Bill Payment			-70.00
12/14/2021	Bill Payment			-465.60
12/14/2021	Bill Payment			-500.00
12/17/2021	Bill Payment			-70.00
12/20/2021	Expense			-91.98
12/20/2021	Expense			-98.23
12/20/2021	Expense			-91.98
12/24/2021	Check			-218.55
12/27/2021	Expense			-766.48
12/27/2021	Check			-9,697.24
12/27/2021	Expense			-384.03
12/27/2021	Check			-2,776.01
12/27/2021	Expense			-566.97
12/29/2021	Expense			-910.43
12/31/2021	Expense			-45.00
01/03/2022	Bill Payment			-49.00
01/03/2022	Bill Payment			-233.79
01/03/2022	Bill Payment			-70.00
01/03/2022	Bill Payment			-3,694.50
01/03/2022	Bill Payment			-369.04
01/03/2022	Bill Payment			-655.96
01/03/2022	Bill Payment			-535.00
01/03/2022	Bill Payment			-157.50
01/03/2022	Bill Payment			-1,280.00
01/03/2022	Bill Payment			-393.30
01/03/2022	Bill Payment			-363.46
01/03/2022	Bill Payment			-566.97
01/03/2022	Bill Payment			-105.84
Total				-257,070.30

Deposits and other credits cleared (11)

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
12/06/2021	Deposit			11,646.86
12/10/2021	Deposit			15,250.43
12/10/2021	Deposit			344.24
12/14/2021	Transfer			100,000.00
12/14/2021	Transfer			4,741.00
12/15/2021	Deposit			1,365.55
12/16/2021	Deposit			150.00
12/20/2021	Deposit			802.89
12/21/2021	Deposit			917.82
12/22/2021	Deposit			4,119.22
12/30/2021	Deposit			508.35

Total	139,846.36

Additional Information

Uncleared checks and payments as of 12/31/2021

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
12/31/2020	Expense			-175.00
06/28/2021	Bill Payment	41067		-119.00
09/23/2021	Bill Payment	5		-112.44
09/23/2021	Bill Payment	4		-359.58
10/08/2021	Bill Payment			-140.00
10/08/2021	Bill Payment			-133.50
10/08/2021	Bill Payment			-501.83
10/22/2021	Bill Payment			-122.50
10/22/2021	Bill Payment			-188.98
10/22/2021	Bill Payment			-103.64
10/22/2021	Bill Payment			-52.50
10/29/2021	Bill Payment			-10,050.00
10/29/2021	Bill Payment			-212.36
10/29/2021	Bill Payment			-472.00
10/29/2021	Bill Payment			-275.94
10/31/2021	Journal	AJE 1		-175.00
11/01/2021	Bill Payment			-960.00
11/09/2021	Bill Payment			-289.25
11/09/2021	Bill Payment			-4,371.84
11/09/2021	Bill Payment			-18,113.88
11/09/2021	Bill Payment			-14,007.84
11/19/2021	Bill Payment			-97.86
11/19/2021	Bill Payment			-443.14
11/23/2021	Bill Payment			-55.74
11/23/2021	Bill Payment			-78.75
11/23/2021	Bill Payment			-275.94
11/23/2021	Bill Payment			-778.35
11/23/2021	Bill Payment			-460.83
12/01/2021	Bill Payment			-611.50
12/01/2021	Bill Payment			-451.88
12/01/2021	Bill Payment			-573.22
12/01/2021	Bill Payment			-88.87
12/01/2021	Bill Payment			-55.25
12/01/2021	Bill Payment			-784.00
12/01/2021	Bill Payment			-4,271.75
12/01/2021	Bill Payment			-100.00
12/08/2021	Bill Payment			-3,413.83
12/08/2021	Bill Payment			-545.40
12/08/2021	Bill Payment			-202.95
12/08/2021	Bill Payment			-95.83
12/13/2021	Check			-8,641.48
12/13/2021	Check			-2,593.99
12/14/2021	Bill Payment			-87.34
12/14/2021	Bill Payment			-1,480.00
12/14/2021	Bill Payment			-407.40
12/14/2021	Bill Payment			-111.25

Total	-77,643.63

Uncleared checks and payments after 12/31/2021

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
01/03/2022	Bill Payment		Colorado Natural Gas Inc.	-1,150.51
01/03/2022	Bill Payment		Rachel Shirlaw	-70.00
01/03/2022	Bill Payment		Rebecca Fuller	-135.00
01/03/2022	Bill Payment		CSDPL	-9,331.50
01/03/2022	Bill Payment		Direct TV	-282.19

DATE	TYPE	REF NO.	PAYEE	AMOUNT (USD)
01/03/2022	Bill Payment		Pericle Communications Co	-7,616.93
01/03/2022	Bill Payment		Advanced Tower Services Inc.	-2,018.76
01/03/2022	Bill Payment		Verizon Wireless	-935.45
01/03/2022	Bill Payment		Elk Creek Fire Protection District	-15,026.45
Total				-36,566.79

Inter-Canyon Fire Protection District

100-107 First Bank Savings, Period Ending 12/31/2021

RECONCILIATION REPORT

Reconciled on: 01/05/2022

Reconciled by: kwood@icfpd.net

Any changes made to transactions after this date aren't included in this report.

Summary	USD
Statement beginning balance	11,264.19
Interest earned	0.10
Checks and payments cleared (0)	0.00
Deposits and other credits cleared (0)	0.00
Statement ending balance	11,264.29
Register balance as of 12/31/2021	11,264.29

Chief Skip Shirlaw
Chief's Report to the Inter-Canyon Fire Protection Board Meeting
January 12, 2022

Current Membership	Firefighters 28 (24 EMS are Included) Rookies 3 Total Membership 31

Call Comparisons:

Year to date: 462 12/31/21 **Last Year to date: 462 12/31/20**

For the Month of December 2021	**For the Month of December 2020**
Fire 2	Fire 1
Rescue & Emergency Medical 28	Rescue & Emergency Medical 24
Good Intent Calls 9	Good Intent Calls 7
False Alarm 7	False Alarm 1
Mutual Aid: 1 received 9 given	Mutual Aid: 1 received 3 given
TOTAL for the Month: 46	**TOTAL for the Month: 33**
Total Members Responding 271	Total Members Responding 239
Total Incident Hours 151.09	Total Incident Hours 131.41
Average Turnout Per Call 6.9	Average Turnout Per Call 7.2

We have prepared a quote for you

Hilldale Pines Replacement Project - Modified - Final

Quote # 430015
Version 2

Prepared for:

Inter-Canyon Fire Rescue

Skip Shirlaw
sshirlaw@icfpd.net

Prepared by:

Bruce Riley

3 Inverness Drive East
Suite 100
Englewood, CO 80122
www.knsinternational.com
(303) 987-2680

Wednesday, January 26, 2022

Inter-Canyon Fire Rescue
Skip Shirlaw
7939 South Turkey Creek Road
Morrison, CO 80465
sshirlaw@icfpd.net

Dear Skip,

Chief Shirlaw,

Thank you for the opportunity to bid on this project.

Based on conversations with Brian Singer, we have included the options from the November 2021 quote as part of this final quote..

Please refer to the Executive Summary of the attached PDF. This KNS Microwave Link Design Report attachment is an integral part of this quote.

Due to continual changes in pricing of labor and materials, this pricing can only be honored for 30 days. After that prices may or may not change.

Please note that this quote does not include inbound or outbound freight or taxes. Those charges will be added at time of invoice.

Please contact me with any questions related to this RFP.

BRiley

Bruce Riley
Director, Business Development
KNS Communications Consultants

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Ceragon Microwave Equipment, Antennas, Licenses

Description	Price	Qty	Ext. Price
Ceragon Microwave Equipment	**$48,715.60**	**1**	**$48,715.60**
IP-20S 11GHz Channel 1-6 (High Band) TX High With 80MHz Support 11185-11485MHz Quantity changed to 7 to accommodate the change from 2' to 3' dish sizes		8	
IP-20S 11GHz Channel 1-6 (Low Band) TX Low With 80MHz Support 10695-10955MHz		8	
Antennas and Hardware	**$18,121.06**	**1**	**$18,121.06**
(82-9103R11) 3ft Antenna 11GHz Radiowaves		7	
(82-9104R11) 4ft Antenna 11GHz Radiowaves		1	
Side Struts - Stabilizer Arms with 4ft pipe length for HP2, SP2, HP3 & SP3 Antenna		7	
Side Struts - Stabilizer Arms with 5ft pipe length for HP4, SP4, HP6 & SP6 Antenna		1	
Ceragon License Keys and AES 256-bit Encryption	**$23,249.92**	**1**	**$23,249.92**
SL - Capacity 100M, per carrier		16	
Adaptive Coding & Modulation, per carrier		16	
Link Aggregation Control Protocol, per device		16	
AES 256-bit Encryption, per carrier		16	

Subtotal: **$90,086.58**

Power Supply and Racks

Description	Price	Qty	Ext. Price
Power Supply and Racks	**$29,074.36**	**1**	**$29,074.36**
2-Post Open Frame Rack		3	

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Power Supply and Racks

Description	Price	Qty	Ext. Price
Vertical Ground Bar for Hammond Rack		3	
Horizontal Rack Mount Copper Busbar with 10 Ground Points		1	
Hammond 50PK 10-32 Clipnuts & Screws		3	
24U SmartRack Deep Rack Enclosure Cabinet		1	
Sentinel 48V shelf/Includes SNMP module and two 30 amp battery breakers		6	
48 V volt rectifier 600 watt rectifier		12	
6 Amp Breaker		18	
30 Amp Breaker		2	
Blank Plate		5	
Fuse distribution panel		1	
Unity GMT Fuse 5 Amp		6	
Unity GMT Fuse 7.5 Amp		6	
Power Cord Adapter, NEMA L5-20P to NEMA 5-15R, 6"		5	
Deka - 12V 75 Ah AGM Sealed Lead Acid Battery		20	
19" Battery Shelf. Rated for 400 lbs		5	
Battery Wiring Harness		5	
Power Limited Tray Cable, 16 AWG, 1 pairs (per foot)		160	

Subtotal: **$29,074.36**

Cisco Switches - Mt. Morrison Only

Description	Price	Qty	Ext. Price
Cisco Equipment - Mt. Morrison Only Switches included per Brian Singer's request.	**$12,454.94**	**1**	**$12,454.94**

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Cisco Switches - Mt. Morrison Only

Description	Price	Qty	Ext. Price
Catalyst 9200 24-port 1G copper with modular uplinks, Network Advantage		2	
Catalyst 9200 Series 4x 1G Uplink,Network Module		2	
Cisco 1000BASE-SX SFP transceiver module. MMF. 850nm, 1 x LC/PC Duplex		4	
Two data stack adapters and one data stack cable		2	
AC Power Cord for Cisco Catalyst (North America)		2	
Accessory Kit with 19" Type 1 Rack Mount		2	
Samlex PSR-1200-48, 1200 Watt DC-AC Power Inverter with Transfer Relay		1	
Cisco Smart Net Total Care Extended Service - Service - 8 x 5 Next Business Day - Exchange - Parts - Physical, Electronic 9200 24PORT DATA ONLY NTWRK		2	
C9200 Cisco DNA Advantage 24-port, 3 Year Term license		2	

Subtotal: **$12,454.94**

FCC Licenses

Description	Price	Qty	Ext. Price
FCC Licenses	**$3,803.60**	**1**	**$3,803.60**

Subtotal: **$3,803.60**

Installation Hardware

Description	Price	Qty	Ext. Price
Installation Hardware	**$30,748.64**	**1**	**$30,748.64**

Subtotal: **$30,748.64**

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Engineering and Installation Labor

Description	Price	Qty	Ext. Price
Engineering and Installation Labor Includes • Link Evaluations • Interaction with Pericle and ICFR to coordinate installation • Project Management • FCC Licensing • Installation at each tower • Path Profile verification • RSSI and TX Power level verification • Ethernet data rate demonstration • Jitter verification • Hot Standby automatic switching demonstrated • As-built Documentation • 24-hour testing and results • Radio configuration files • Photos of complete installation • Site coordinate information • Serial numbers documented • ICFD training (4 hours) • ICFD walk-through of completed project	**$145,128.12**	**1**	**$145,128.12**
Manlift rental for Mt. Lindo install		1	

Subtotal: **$145,128.12**

PRTG Remote Network Management

Description	Price	Qty	Ext. Price
PRTG Remote Network Management Equipment	**$8,307.96**	**1**	**$8,307.96**
PRTG Network Monitoring Tool, Perpetual license, 500 sensors, 1 server installation		1	
ThinkCentre M70a All-in-One PC with 21.5" FHD display		1	

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PRTG Remote Network Management

Description	Price	Qty	Ext. Price
USB 3.0 male A to RJ45 female Gigabit ethernet adapter		2	
Teamviewer, Single User License, One seat, 1 Session (Yearly)		1	
Sierra Wireless AirLink® RV55 Industrial LTE-A Pro Router		1	
AC Power Adapter FOR RV50/RV50X		1	
698-960 / 1710-2700MHz MIMO Panel Antenna		1	
N/F 698 - 2700 MHz Ligthning Protector		2	
N Male Hex/Knurl LMR-400		6	
LMR400 Coaxial Cable		120	
6' LMR195 Jumper with N Male to SMA Male connectors		2	
Sliding Tuniversal Tapered Pipe Mount with 1' standoff		1	
10' x 1.5" Galvanized Pipe Schedule 40		1	
Weather Proofing Kit		1	
Cat5e Blue Ethernet Patch Cable, Snagless/Molded Boot,5 foot		2	
Ty-Rap 8" x 1/8 Cable Tie 100 ct		1	
Data Sim Card from a mobile operator - MUST BE PROVIDED BY CUSTOMER		1	
PRTG Laptop Option - OPTIONAL: NOT INCLUDED IN QUOTE TOTALS. REPLACEMENT FOR SPECIFIED PC IF CHOSEN HP ZBook Firefly 15 G8 Mobile Workstation - 15.6" - Core i7 1165G7 - 16 GB	**$0.00**	**1***	**$0.00**

Subtotal: **$8,307.96**

Cisco Switches (Other 4 locations)

Description	Price	Qty	Ext. Price
Cisco LACP switches for the 4 sites other than Mt. Morrison	**$45,850.56**	**1**	**$45,850.56**

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Cisco Switches (Other 4 locations)

Description	Price	Qty	Ext. Price
Catalyst 9200 24-port 1G copper with modular uplinks, Network Advantage		8	
Catalyst 9200 Series 4x 1G Uplink,Network Module 		8	
Cisco 1000BASE-SX SFP transceiver module. MMF. 850nm, 1 x LC/PC Duplex 		16	
Two data stack adapters and one data stack cable		8	
AC Power Cord for Cisco Catalyst (North America)		8	
Accessory Kit with 19" Type 1 Rack Mount		8	
Cisco Smart Net Total Care Extended Service - Service - 8 x 5 Next Business Day - Exchange - Parts - Physical, Electronic 9200 24PORT DATA ONLY NTWRK		8	
C9200 Cisco DNA Advantage 24-port, 3 Year Term license		8	

Subtotal: **$45,850.56**

On-Site Spares for Ceragon Radios and Cisco Switches

Description	Price	Qty	Ext. Price
Cisco On-Site Spares (2) & Spares Warranty Switches included per Brian Singer's request.	**$10,367.06**	**1**	**$10,367.06**
Catalyst 9200 24-port 1G copper with modular uplinks, Network Advantage		2	
Catalyst 9200 Series 4x 1G Uplink,Network Module		2	
Cisco 1000BASE-SX SFP transceiver module. MMF. 850nm, 1 x LC/PC Duplex		4	
Samlex PSR-1200-48, 1200 Watt DC-AC Power Inverter with Transfer Relay		1	
Cisco Smart Net Total Care Extended Service - Service - 8 x 5 Next Business Day - Exchange - Parts - Physical, Electronic 9200 24PORT DATA ONLY NTWRK		2	
C9200 Cisco DNA Advantage 24-port, 3 Year Term license		2	

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On-Site Spares for Ceragon Radios and Cisco Switches

Description	Price	Qty	Ext. Price
Ceragon On-Site Spares (2 pair) & Spares Warranty	**$17,293.48**	**1**	**$17,293.48**
IP-20S 11GHz Channel 1-6 (High Band) TX High With 80MHz Support 11185-11485MHz		2	
IP-20S 11GHz Channel 1-6 (Low Band) TX Low With 80MHz Support 10695-10955MHz		2	
PoE Injector all outdoor -48VDC for IP20		4	
"SLA-PRM_24x7_IP20(7D) (24x7) Tech Support 24x7 Hardware Repair Software Repair license swap IP20 Price per ODU per year. Advanced Replacement (7 days). SLA Covers 1 Year Per RFU. SLA covers 1 IDU per RFU, if applicable		12	

Subtotal: **$27,660.54**

Standard Advanced Replacement Warranty Choices

Description	Price	Qty	Ext. Price
Standard Advanced Replacement Warranty Option for the installed Ceragon Radios	**$22,148.64**	**1**	**$22,148.64**
(24x7) Tech Support 24x7 Hardware Repair Software Repair license swap IP20 Price per ODU per year. Advanced Replacement . (3 Years)		48	

Subtotal: **$22,148.64**

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Hilldale Pines Replacement Project - Modified - Final

Prepared by:

KNS Communications Consultants

Bruce Riley
+1 (303) 987-2680
bruceriley@knsdenver.com

Prepared for:

Inter-Canyon Fire Rescue

7939 South Turkey Creek Road
Morrison, CO 80465
Skip Shirlaw
(303) 697-4413
sshirlaw@icfpd.net

Quote Information:

Quote #: 430015

Version: 2
Delivery Date: 01/26/2022
Expiration Date: 02/14/2022

Quote Summary

Description	Amount
Ceragon Microwave Equipment, Antennas, Licenses	$90,086.58
Power Supply and Racks	$29,074.36
Cisco Switches - Mt. Morrison Only	$12,454.94
FCC Licenses	$3,803.60
Installation Hardware	$30,748.64
Engineering and Installation Labor	$145,128.12
PRTG Remote Network Management	$8,307.96
Cisco Switches (Other 4 locations)	$45,850.56
On-Site Spares for Ceragon Radios and Cisco Switches	$27,660.54
Standard Advanced Replacement Warranty Choices	$22,148.64
Total:	**$415,263.94**

Taxes, shipping, handling and other fees may apply. We reserve the right to cancel orders arising from pricing or other errors.

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KNS Communications Consultants

Signature: BRiley

Name: Bruce Riley

Title: Director, Business Development

Date: 01/26/2022

Inter-Canyon Fire Rescue

Signature:

Name: Skip Shirlaw

Date:

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Terms and Conditions

By approving the attached KNS quote or proposal the customer agrees that:

(1) You have the authority to sign the quote;

(2) The proposal is accepted and approved;

(3) All terms, including payment terms, are accepted and approved;

(4) KNS retains a purchase money security interest in the equipment until payment in full has been received by KNS;

(5) Equipment is shipped EWX (Incoterms 2010). Transfer of ownership is at the shipping point of origin. Customer agrees that all equipment will be fully insured for replacement value, and will document this insurance prior to its release at the shipping point of origin to the freight carrier. Customer agrees that they are responsible for payment in full for any loss or damage to any equipment which occurs after the freight carrier receives the equipment at shipping point of origin. It is the responsibility of the customer to verify the completeness of the shipment.

(6) KNS retains the right to remove the equipment at buyer's expense, if payment in full is not made in accordance with the terms provided herein.

(7) KNS assumes no liability resulting from the removal of the equipment.

Upon receipt of the equipment at KNS facilities for staging: KNS will immediately bill the customer in accordance with the terms described herein.

This quote is valid for 15 days: Quotes not accepted within 15 days shall be subject to re-pricing at the sole discretion of KNS.

International Shipments: From time to time, US customs may limit/modify the shipment of certain goods to specific locations/countries. In the event goods are unable to be shipped to your specific location, returns of such equipment shall be dictated by the return privileges of the various vendors. In any case customer is responsible for paying for all goods and services up to and including goods that have been held due to customs. Returns and refunds will be managed with the customer after KNS receives the held goods. KNS shall make its best effort to confirm the ability to ship goods to the destination prior to ordering such equipment.

Equipment Returns: Equipment returned to KNS is governed primarily by the respective manufacturers. SOME EQUIPMENT IS NON-RETURNABLE. Any items returned to KNS for credit shall be freight prepaid and are subject to the following conditions: Equipment shall be new, unused and in factory sealed containers; Equipment is subject to inspection by KNS; KNS reserves the right to reject any return; return credits shall be issued within 30 days less any applicable restocking fees, repackaging fees (if applicable) or any fees charged by the manufacturer.

Equipment Substitutions: From time to time there may be a need to replace one piece of equipment with another. KNS reserves the right to substitute one brand or model of equipment for another so long as the performance, functionality and technical specifications of the new equipment are no less than the specifications of the equipment being substituted. KNS shall make its best effort to notify the customer of a potential substitution.

Progress Billing: Customer shall be billed every 2 weeks based upon progress on job under contract or upon completing pre-defined milestones.

Payment terms: All amounts represented in US Dollars. All payments are due according to the terms stated in the quote from date of invoice unless specified otherwise. Payments not received within the proposed terms shall bear interest at the rate of 1.5% per month compounded monthly. In the event of non-payment, KNS reserves the right to pursue the full amounts owed it in addition to interest, court costs, attorney's fees and all collection costs allowable by law. KNS reserves all rights and remedies allowable by law for the settlement of all amounts due to KNS.

Limited warranty: All parts and labor are warranted by the manufacturer and, as such, carry the manufacturer's limited warranty. KNS warrants all labor on the installation of the materials installed herein for 90 days. KNS makes no other warranties expressed or implied, and its technicians and employees are not authorized to make such warranties on behalf of the company. All shipping costs associated with warranty claims will be the responsibility of the customer. Labor warranty does not include expenses incurred for travel to or from customer site. Warranty does not cover 3rd party installed parts, equipment or services. Any expenses will be billed as described below.

Expenses and Freight: All expenses shall be billed net 20 twice monthly at cost plus 15%. Expenses paid beyond net 20 terms will incur a 10% surcharge. Expenses include but are not limited to the following: travel (includes, food, hotel, airfare, rental vehicles and other customary charges) freight, insurance and equipment rental.

Taxes and Duties: There will be added to the quoted price any import, sales or other tax or duty which KNS may be required to collect or pay upon the sale of products quoted. If such matter is not included in the invoice for the products, it may be invoiced separately later. Customers who are not in the State of Colorado shall be responsible for paying any local use taxes. Customers agree to pay all such duties and taxes referred to herein. Customer shall provide a statement to KNS showing that they accept full responsibility for paying regulatory use taxes for the equipment purchased.

Governing Law/Jurisdiction: These terms and conditions are governed by the laws of the State of Colorado, without regard to conflicts of law principles that would provide for

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Terms and Conditions

application of the law of a jurisdiction outside the United States. The Parties agree that the United Nations Convention on Contracts for International Sale of Goods (CISG) does not apply to these terms and conditions. The parties irrevocably submit to the jurisdiction of the state and federal courts of Denver, Colorado USA.

Waiver of Objection: Each party hereby irrevocably waives any objection which it may now or hereafter have to the laying of venue of any suit, action, or proceedings relating to this Agreement in Denver, Colorado and further irrevocably waives any claim that Denver, Colorado is not a convenient forum for any such suit, action or proceeding.

Change Orders: Subject to the limitations set forth below, Customer may change the configuration of any Equipment on order or Project Specifications by delivering to KNS a written Change Order notice.

Change orders must be received by KNS at least 14 business days prior to the scheduled delivery date or 5 business days prior to the scheduled implementation date of the affected change. The change order shall not be effective unless agreed to in writing by KNS. Any expenses already incurred prior to receipt of a change order and any non-returnable items or items with a restocking fee will be due and payable as originally agreed upon. Customer agrees to pay KNS a Contract Price adjustment, which shall be agreed upon in writing by KNS and Customer, which adjustment shall be agreed based on any properly accepted Change Orders.

Proposal: The proposal (quote) is not a binding agreement until signed, and shall not be deemed to create any legal obligations on either KNS or the Customer. No such obligation shall be created, except by the execution and delivery of a Purchase Order or a Final Project & Services Agreement containing such terms and condition, and then only in accordance with the terms and conditions of such Final Project & Services.

Non-Disclosure: All parties agree that separate non-disclosure and confidentiality agreements shall be executed.

Rev 20150521R6WS

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Hilldale Pines Replacement Project

Microwave Link Design Report

Inter Canyon Fire Rescue (ICFR)
7939 South Turkey Creek Road
Morrison, CO 80465

January 2022

Table of Contents

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Executive Summary

Inter Canyon Fire Rescue has asked KNS Communications Consultants to design a microwave system solution to support its updated voice radio system. The district selects 3 new sites, ICFD Station 5, Critchell Tower, and ICFD Station 4, for its voice network upgrade with four new microwave hops, which would provide some alternate paths to the existing microwave backhaul. The network design consists of a high capacity, redundant, licensed 11 GHz microwave links with 10 MHz channel bandwidth to provide the maximum data rate of 73-89 Mbps and 53 Mbps throughput at 99.999% availability (<5.26 minutes of downtime per year) per link.

The report focuses on the design and technical aspects of the network with high capacity, redundant, licensed Point to Point microwave links to support its voice radio systems. After reviewing the available hardware options that exist for this type of solution, KNS determined that a Point to Point Ceragon IP-20S Microwave Radios will meet the requirements of this network to deliver the data service.

KNS recommends using a total of 4 Ceragon Licensed Microwave links with the Newmar 48VDC backup power system. The proposed system consists of:

- A Ceragon IP-20S 11 GHz 1+1 Hot Standby link with 3ft Dish Antennas between ICFD Station 5 and Mt. Lindo site
- A Ceragon IP-20S 11 GHz 1+1 Hot Standby link with 3ft Dish Antennas between Critchell Tower and Mt Lindo
- A Ceragon IP-20S 11 GHz 1+1 Hot Standby link with 3ft Dish Antenna at Mt. Morrison and 4ft Dish Antenna at Critchell Tower
- A Ceragon IP-20S 11 GHz 1+1 Hot Standby link with 3ft Dish Antennas from Mt. Morrison to ICFD Station 4
- Newmar Power Supply Rectifier 48VDC 1200 Watt at all sites with 4 Batteries
- 2 New Cisco C9200 Stackable Switches at each site

The KNS team has leveraged our extensive experience in designing and deploying these networks in developing this design and report for the Microwave Link Replacement Project. KNS feels the design provided in this document and supporting information will meet the requirements. The PtP microwave links are based on a critical balance of availability and performance metrics coupled with Federal Communications Commission (FCC) licensing requirements while providing redundancy. Furthermore, the basis for the proposed network design relies on high resolution, 2019 1/3 arc second terrain data obtained from the USGS.

Please note that the study is strictly a software-based evaluation. On-site visit and testing at all sites must be conducted before installation to confirm assumptions which were made in this path evaluation.

Previous Options Included

The original RFP Response and Quote indicated several options to be decided on. In discussions with Brian Singer, the Pericle Consultant, we were asked to include those options and their associated costs in this response and quote.

- **Ceragon Spares and Advanced Replacement Warranty**
- **Cisco Switches at all locations**
- **Cisco Switch Spares**
- **PRTG Remote Network Management**
- **Replacement of the 2-2' dishes with 2-3' dishes for a Class A license (Mt. Lindo to Station 5)**

Ceragon Spares and Advanced Replacement Warranty - This "combined" approach is the most cost effective and guarantees the fastest way to get the network back up and available and has been added to this quote. Each link uses one High and one Low Ceragon Radio. KNS recommends having 2 High and 2 Low Spare Ceragon Radios on hand in case of a lightning strike or some other failure. 3 Years of Advanced Replacement and SLA coverage is the most cost-effective advanced replacement warranty. Replacement products ships from overseas within 2-4 weeks and the SLA allows license keys to transfer to the replacement spares.

Cisco Switches at all locations - Our original RFP Response and Quote was for a stackable pair of Cisco Catalyst 9200 switches with LACP functionality at Mt. Morrison ONLY. We were asked to provide that same solution for the other 4 sites. 2 Cisco Catalyst 9200 switches with LACP will provide reliable connectivity between the links. 8 additional switches (2 at each of the other 4 sites) with the associated hardware, labor, Smart Net and DNA warranty have been added to this quote.

Cisco Spares - a pair of Cisco Catalyst 9200 switches will be stored as spares in case of an installed switch failure and has been added to this quote.

PRTG Remote Network Management – the PRTG solution and its associated cost have been included in the quote. **NOTE: Once ICFR has decided which cellular carrier will work best for Station 5 (where the PRTG solution will reside), a Cellular SIM card will have to be purchased by ICFR to be placed in the Sierra Wireless modem.**

Replacement of the 2-2' dishes with 2-3' dishes for a Class A license (Mt. Lindo to Station 5) - In order for a 11GHz Class A license to be granted for this link, we recommended that the dish size change to achieve the Class A rating. That change and its associated cost have been included in the quote.

Maintenance (Cost not included in this quote)

- KNS recommends an on-going PMP (Preventative Maintenance Program) for this new network.
    - KNS recommends twice yearly preventive maintenance to be performed at each site and on each link. This would include: Inspection of cabling, antennas, radios, performance

testing of radios and links and, documentation of the inspections. Additionally, KNS will make recommendations regarding any changes or repairs that should occur.
    - Repairs beyond basic tightening of connections, strapping of cables would be billed separately at standard rates with the approval of ICFR.
    - Emergency service would be billed at standard rates.
- Due to the number of variables involved with a PMP contract, a separate discussion will be required to determine pricing, at a later date.
    - Pricing is based on SLA required (how fast ICFR will require service request responses).
    - Bulk labor hours purchases available allowing for price discounts on service labor.

Assumptions:

- The proposed towers and structures can support the additional equipment proposed in the KNS response.
- KNS assumes the decisions made for the construction of new towers and overall technical design called out in the RFP will support the network that KNS was asked to quote.
- ICFR will ensure access to each tower and escorts to the locations as appropriate during installation.
- ICFR will provide contacts or arrange for the power reduction by broadcasters at the Mt. Morrison site or, other sites, where broadcast antennas exist during installation and maintenance operations. Should the work need to be performed during non-business hours, additional charges may apply.
- The Coordinates provided in the quote are accurate.
- The height of the towers / buildings is accurate.
- ICFR and Voice System Contractor will provide all necessary configuration information for the new Cisco switches.
- ICFR will provide all required configuration information for microwave radios.
- ICFR will be responsible for the system Integration with the voice radio system.
- ICFR will provide a data SIM card with Internet Connectivity for remote management.
- 120 VAC power is available in/close to the new cabinets and racks at all locations.
- Grounding systems are available in/close to the new cabinets and racks and antenna mounting locations on the towers at all locations.
- This RFP proposes an 11 GHz network that requires FCC licenses to operate. KNS has assumed that the licenses will be granted and have designed the network assuming the links will all be in the same channels and that all of the spares selected will be appropriate in those channels. If the FCC does not grant ICFR approval to operate in this 11GHz frequency or if the links are granted but in different channels, this pricing may change and the recommended spares or quantity of spares may also change.

KNS will be responsible for:

- Microwave System Design
- Configuration of microwave radios. This includes the Ceragon microwave radios and new Cisco switches.
- Microwave radio and radio installation, antenna alignment, system commissioning, and testing.
- Remote management system integration, including configuration, customization, and tests of PRTG monitor.
- FCC Licensing for all new links.

Risks:

- Interference from broadcast antennas and radios at Mt. Morrison with the ICFR network.

Exclusions:

- Structural and loading analysis of existing or proposed towers

FibeAir IP-20S Radio Redundancy (Hot Standby Description)

1+1 HSB protection utilizes two IP-20S units with a single antenna, to provide hardware redundancy for Ethernet traffic. One IP-20S operates in active mode and the other operates in standby mode. If a protection switchover occurs, the roles are switched. The active unit goes into standby mode and the standby unit goes into active mode. The standby unit is managed by the active unit. The standby unit's transmitter is muted, but the standby unit's receiver is kept "on" in order to monitor the link.

The microwave links will use Line Protection mode, and traffic is routed from two GbE ports on dual stacked external switches to a GbE port on the active and a GbE port on the standby IP-20S unit. LACP (Link Aggregation Control Protocol) protocol is used to determine which IP-20S port is active and which port is standby, and traffic is only forwarded to the active port.

To note, the external switches must be stackable and support LACP protocol between the network switches. IP-20S supports LACP for purposes of line protection only.

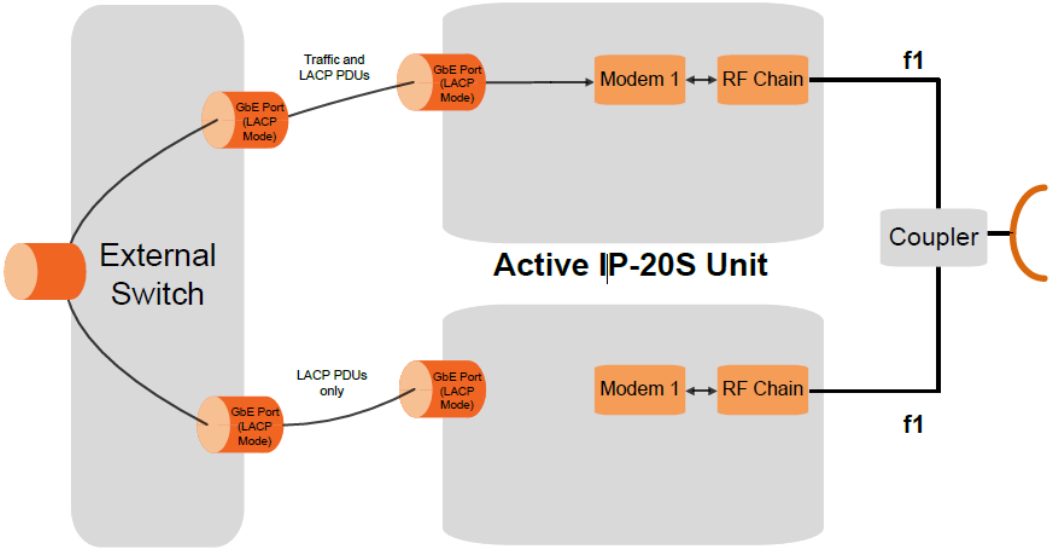

Figure 1 – IP-20S 1+1 Hot Standby Protection – Line Protection Mode

FibeAir IP-20S Radio Management

Every IP-20S network element includes an HTTP web-based element manager that enables the operator to perform element configuration, performance monitoring, remote diagnostics, alarm reports, and so on. FibeAir IP-20S can be managed either In-Band or Out-of-Band, via its radio, ethernet interfaces, and two dedicated management ports. In addition, Ceragon radio provides an SNMP v1/v2c/v3 northbound interface to communicate with other management systems.

KNS recommends using dedicated Out-of-Band management ports of IP-20S Radios and configuring radios to forward traps to the PRTG network management tool, which is one of the widely used network

monitor systems. All radio alarms and events, from all sites will be monitored at the ICFD Station 5 site using SNMP Trap messages.

PRTG Network Monitor is an on-premise and cloud-based network monitoring solution, which is a very flexible, customizable and cost-effective management tool. Primary features of the tool include network monitoring, bandwidth monitoring, alerts, data publishing, customization support and reporting. PRTG Network Monitor monitors network devices, traffic, and applications on the IT infrastructure. It helps administrators and technical staff to monitor network outages, analyze network connections, monitor network quality, and comply with service level agreements using a single console.

PRTG is the monitoring tool that offers multiple methods to relay system notifications, including SMTP mail relay and SMS text messages. For the SMS notifications, a SMS gateway, either proper external software or a HTTP-enabled 3G or 4G cellular modem with an active SIM card is required.

Pricing is a one-time fee for an on-premise solution and monthly subscription for a cloud solution.

For remote management, KNS suggests using a Sierra Wireless router with an active data SIM card from one of the mobile operators and TeamViewer Pro, a good point-to-point monitoring/control tool that uses a meet-in-the middle cloud server. This solution provides GUI to GUI interaction. Proper configuration on the modem should be required for the wireless modem. The remote end would need to have a persistent password configured into its TeamViewer and be automatically started if that end reboots.

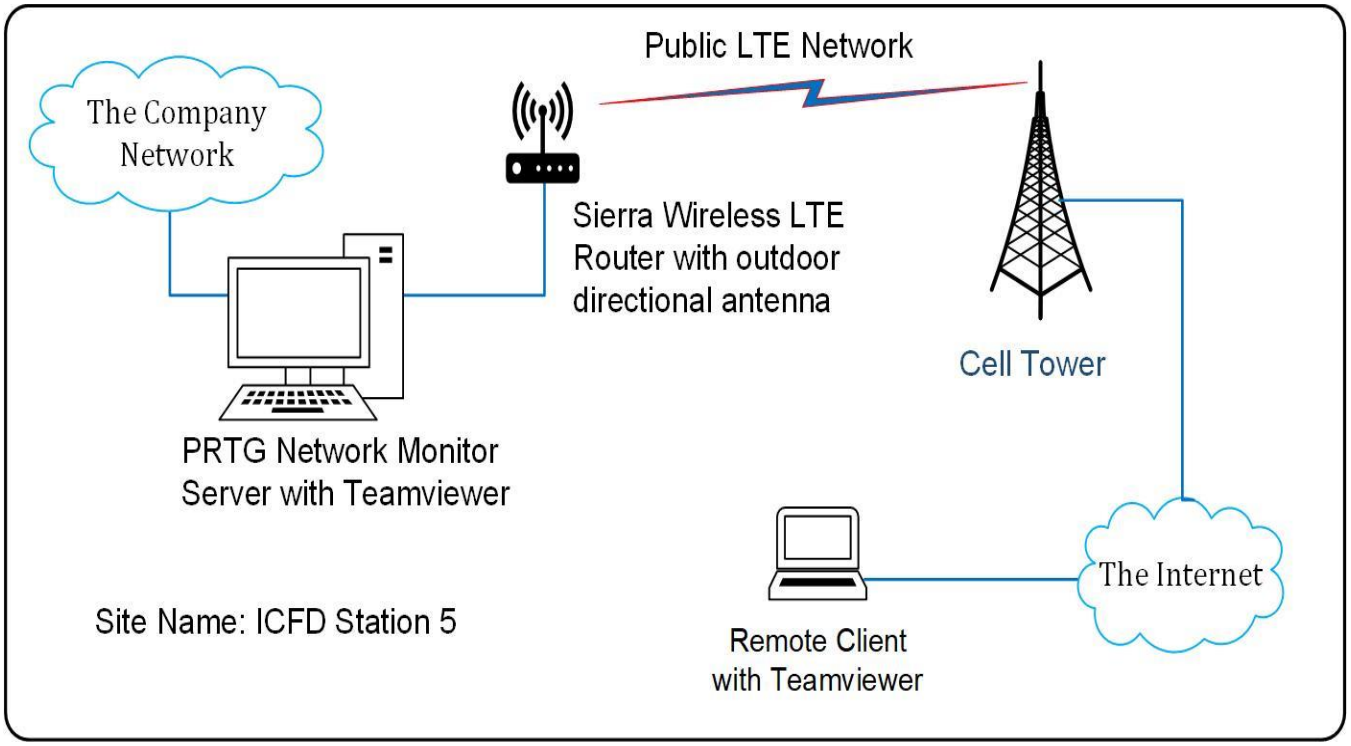

Figure 2 – Diagram for Remote Network Management with PRTG Network Monitor System

Microwave Analysis

The wireless network will use 4 (Four) new licensed 11GHz Point to Point (PTP) radio links. The Ceragon IP-20S series of radios will be used for the PTP backhaul at all locations. The Ceragon links have been designed to provide 99.999% availability at 53 Mbps of predicted throughput and the maximum data rate of 73-89 Mbps.

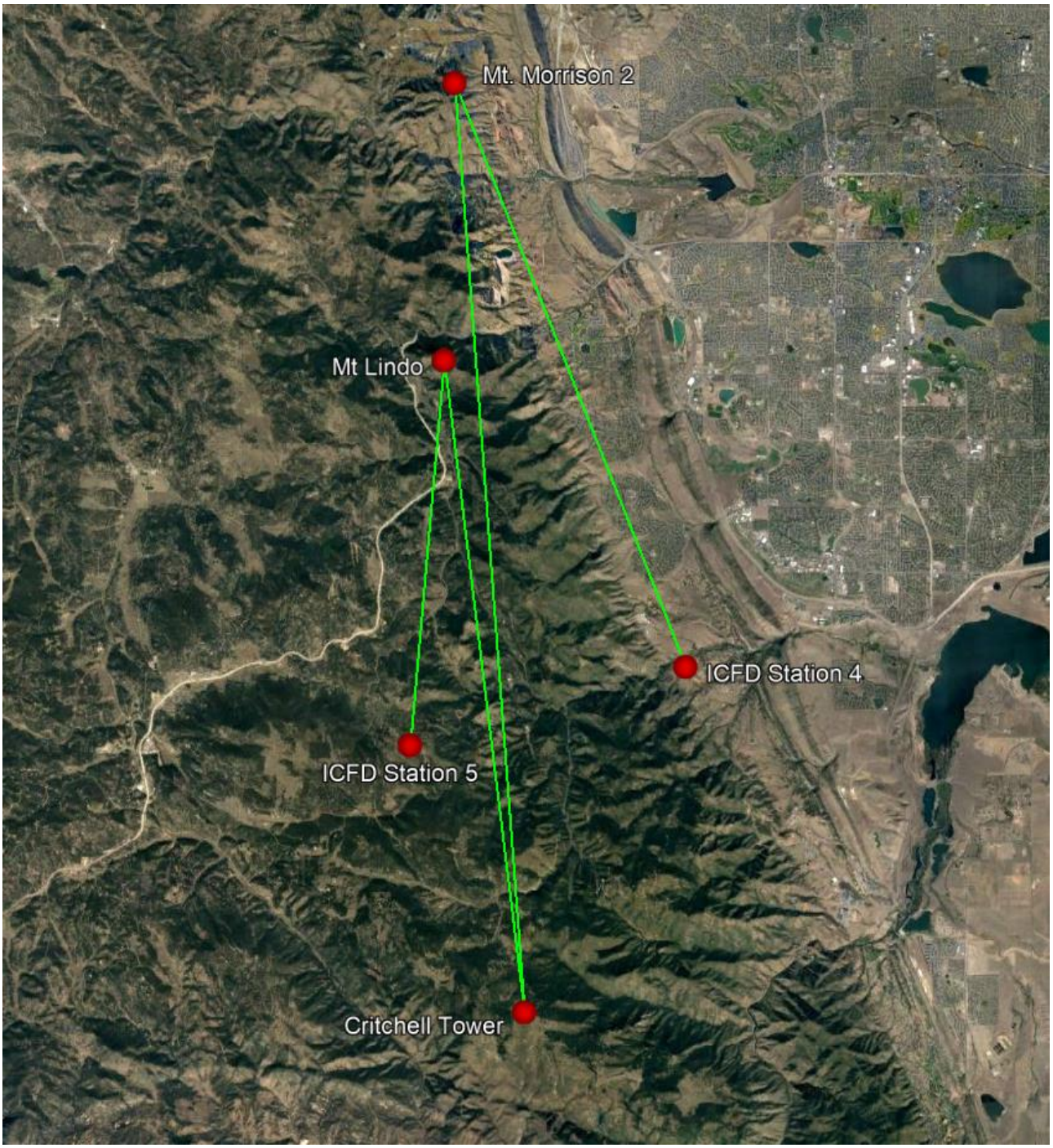

Figure 3 – New Ceragon Links Aerial Overview

Overall Network Diagram

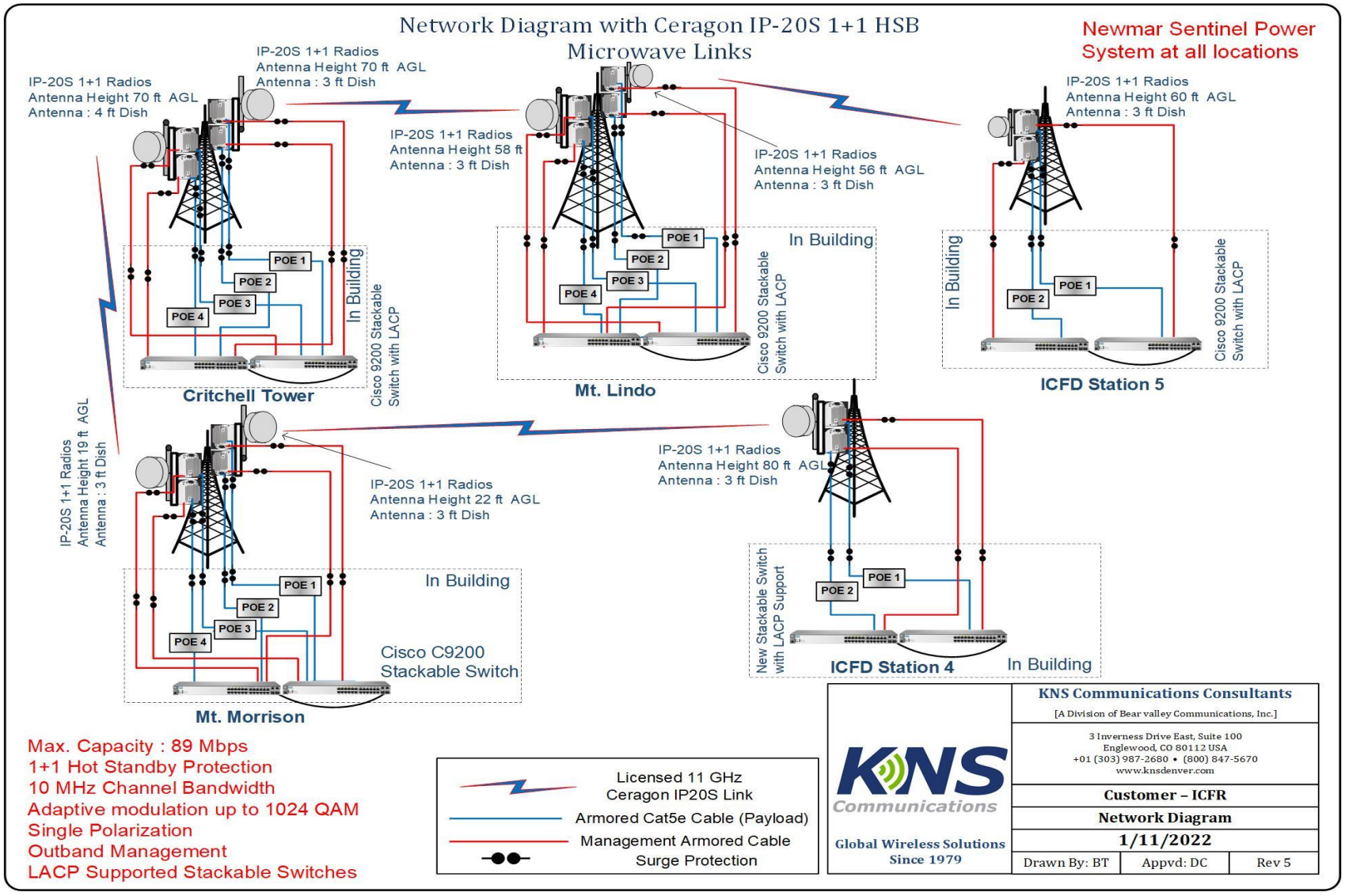

Figure 4 – Overall Network Diagram

Summary of Microwave Sites

Site Number	Site Name	Latitude	Longitude	Existing/New Site	Site Type	Primary Power	Backhaul	Point to Point Radio Count
1	Critchell Tower	39.470280°	-105.198140°	Existing	Existing Freestanding Tower	New AC Power	Licensed PTP Microwave	2 Licensed
2	Mt. Lindo	39.612830°	-105.220920°	Existing	Existing Freestanding Tower	New AC Power	Licensed PTP Microwave	2 Licensed
3	ICFD Station 4	39.545780°	-105.152370°	New Tower	New Tower	New AC Power	Licensed PTP Microwave	1 Licensed
4	Mt. Morrison	39.673480°	-105.217960°	Existing	Existing Freestanding Tower	New AC Power	Licensed PTP Microwave	2 Licensed
5	ICFD Station 5	39.528680°	-105.230530°	New Tower	New Tower	New AC Power	Licensed PTP Microwave	1 Licensed

Table 1 – Microwave Site Summary

Summary of Microwave Links

Link #	Site A	Site B	Radio Model	TX/RX Frequency	Predicted Max Throughput
1	Mt. Lindo PTP Radio 1	IFCD Station 5 PTP Radio	Ceragon IP20-S 1+1	11 GHz Licensed	89 Mbps
2	Critchell Tower PTP Radio 1	Mt. Lindo PTP Radio 2	Ceragon IP20-S 1+1	11 GHz Licensed	89 Mbps
3	Critchell Tower PTP Radio 2	Mt. Morrison PTP Radio 1	Ceragon IP20-S 1+1	11 GHz Licensed	89 Mbps
4	Mt. Morrison PTP Radio 2	ICFD Station 4 PTP Radio	Ceragon IP20-S 1+1	11 GHz Licensed	89 Mbps

Table 2 – Microwave Link Summary

Link by Link Engineering Evaluations

Mt. Lindo to ICFD Station 5

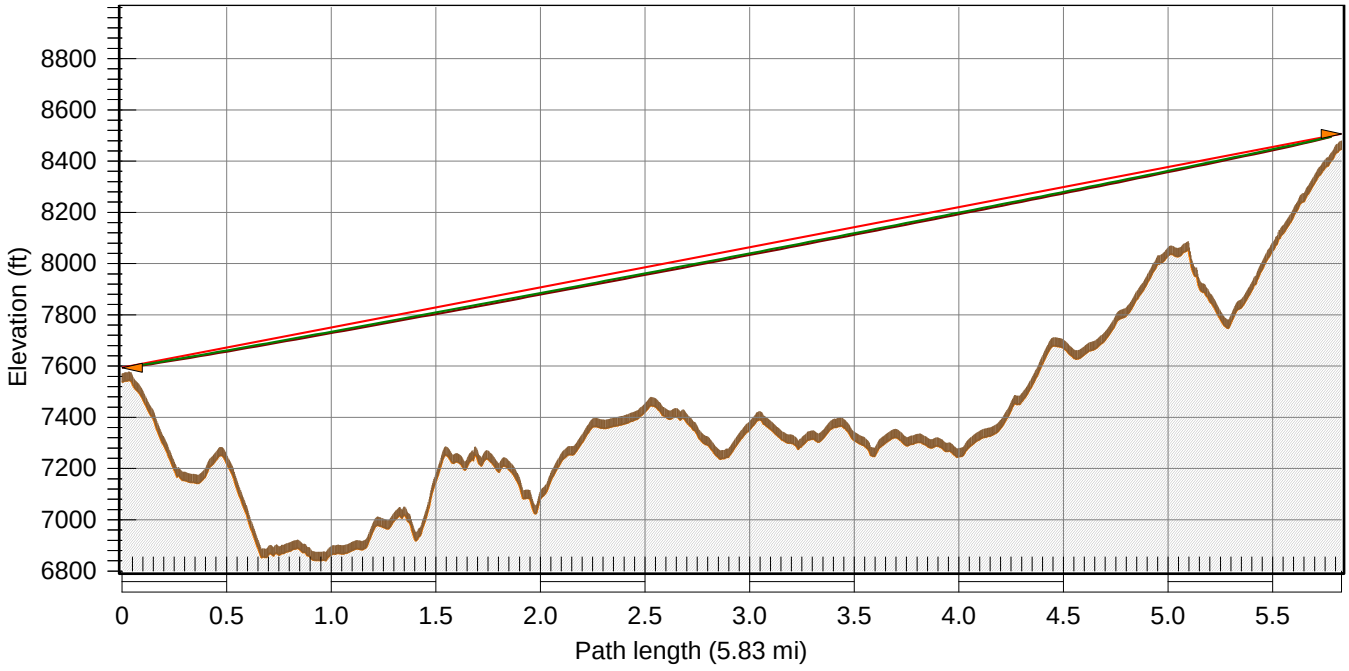

Figure 5 – Mt. Lindo to ICFD Station 5 Ceragon Link Path Profile

Frequency = 11000.00 MHz K = 1.33, 0.67 % F1 = 100.0, 60.0, 60.0, 30.0

	Mt Lindo	**ICFR Station 5**
Latitude	39 36 46.19 N	39 31 43.25 N
Longitude	105 13 15.31 W	105 13 49.91 W
Azimuth (°)	185.05	5.05
Tower Height (ft)	60 ft AGL	80 ft AGL
Elevation (ft)	7537.39	8446.14

	Mt Lindo	**ICFR Station 5**
Latitude	39 36 46.19 N	39 31 43.25 N
Longitude	105 13 15.31 W	105 13 49.91 W
True azimuth (°)	185.05	5.05
Vertical angle (°)	1.67	-1.73
Elevation (ft)	7537.39	8446.14
Antenna model	HP3-11 (TR)	HP3-11 (TR)
Antenna file name	hp3-11-nsma	hp3-11-nsma
Antenna gain (dBi)	38.50	38.50
Antenna height (ft)	56.00	56.00
Connector loss (dB)	0.1	0.1
Miscellaneous loss (dB)	1.50	1.50
Frequency (MHz)	11700.00	
Polarization	Horizontal	
Path length (mi)	5.83	
Free space loss (dB)	132.74	
Atmospheric absorption loss (dB)	0.14	
Net path loss (dB)	58.89	58.89
Radio model	IP20S-11-10-A_1520	IP20S-11-10-A_1520
Radio file name	ip20s-11-10-a	ip20s-11-10-a
Emission designator	10M0D7W	10M0D7W
Climatic factor	0.50	
Terrain roughness (ft)	140.00	
C factor	0.13	
Average annual temperature (°F)	39.49	
Fade occurrence factor (Po)	7.154E-004	
Polarization	Horizontal	
Rain region	Denver, Colorado	

Table 3 – Mt. Lindo to ICFD Station 5 Transmission Details

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1KHQAM 73-89Mbps	23.00	23.00	-62.25	-62.25	60.00	60.00	-35.89	-35.89	26.36	26.36	26.36	26.36
1KLQAM 68-83Mbps	23.00	23.00	-62.75	-62.75	60.00	60.00	-35.89	-35.89	26.86	26.86	26.86	26.86
512QAM 65-79Mbps	24.00	24.00	-65.75	-65.75	61.00	61.00	-34.89	-34.89	30.86	30.86	30.86	30.86
256QAM 59-72Mbps	25.00	25.00	-68.25	-68.25	62.00	62.00	-33.89	-33.89	34.36	34.36	34.36	34.36
128QAM 52-63Mbps	**25.00**	**25.00**	**-71.25**	**-71.25**	**62.00**	**62.00**	**-33.89**	**-33.89**	**37.36**	**37.36**	**37.36**	**37.36**
64QAM 43-53Mbps	25.00	25.00	-74.75	-74.75	62.00	62.00	-33.89	-33.89	40.86	40.86	40.86	40.86
32QAM 35-43Mbps	25.00	25.00	-77.75	-77.75	62.00	62.00	-33.89	-33.89	43.86	43.86	43.86	43.86
16QAM 26-32Mbps	26.00	26.00	-81.25	-81.25	63.00	63.00	-32.89	-32.89	48.36	48.36	48.36	48.36
8PSK 19-23Mbps	26.00	26.00	-82.75	-82.75	63.00	63.00	-32.89	-32.89	49.86	49.86	49.86	49.86
QPSK 13-15Mbps	26.00	26.00	-92.00	-92.00	63.00	63.00	-32.89	-32.89	59.11	59.11	59.11	59.11

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1KHQAM 73-89Mbps	99.9998	99.9998	99.9999	99.9999	99.9995	99.9995	99.9995	99.9995
1KLQAM 68-83Mbps	99.9999	99.9999	99.9999	99.9999	99.9996	99.9996	99.9995	0.0000
512QAM 65-79Mbps	99.9999	99.9999	99.9999	99.9999	99.9997	99.9997	99.9997	0.0002
256QAM 59-72Mbps	99.9999	99.9999	99.9999	99.9999	99.9998	99.9998	99.9998	0.0001
128QAM 52-63Mbps	**99.9999**	**99.9999**	**99.9999**	**99.9999**	**99.9999**	**99.9999**	**99.9999**	**0.0001**
64QAM 43-53Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
32QAM 35-43Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
16QAM 26-32Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
8PSK 19-23Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000
QPSK 13-15Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0000

Table 4 – Mt. Lindo to ICFD Station 5 Link Availability Details

Multipath fading method - Vigants - Barnett
Rain fading method – Crane

Critchell Tower to Mt. Lindo

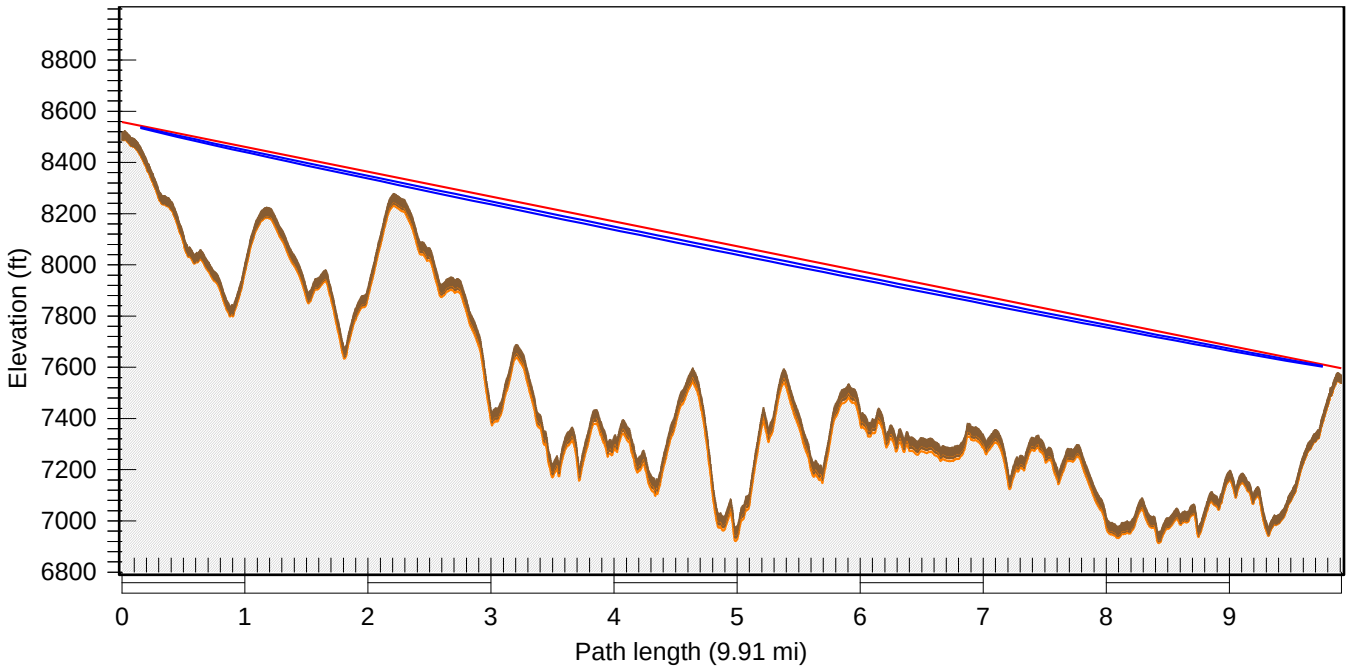

Figure 6 – Critchell Tower to Mt. Lindo Ceragon Link Path Profile

Frequency = 11700.00 MHz K = 1.33, 0.67 % F1 = 100.0, 60.0, 60.0, 30.0

	Critchell Tower	**Mt Lindo**
Latitude	39 28 13.01 N	39 36 46.19 N
Longitude	105 11 53.30 W	105 13 15.31 W
Azimuth (°)	352.95	172.94
Tower Height (ft)	140 ft AGL	60 ft AGL
Elevation (ft)	8487.29	7537.39

	Critchell Tower	**Mt Lindo**
Latitude	39 28 13.01 N	39 36 46.19 N
Longitude	105 11 53.30 W	105 13 15.31 W
True azimuth (°)	352.95	172.94
Vertical angle (°)	-1.11	1.00
Elevation (ft)	8487.29	7537.39
Antenna model	HP3-11 (TR)	HP3-11 (TR)
Antenna file name	hp3-11-nsma	hp3-11-nsma
Antenna gain (dBi)	38.50	38.50
Antenna height (ft)	70.00	58.00
Connector loss (dB)	0.1	0.1
Miscellaneous loss (dB)	1.50	1.50
Frequency (MHz)	11700.00	
Polarization	Horizontal	
Path length (mi)	9.91	
Free space loss (dB)	137.89	
Atmospheric absorption loss (dB)	0.27	
Net path loss (dB)	64.16	64.16
Radio model	IP20S-11-10-A_1520	IP20S-11-10-A_1520
Radio file name	ip20s-11-10-a	ip20s-11-10-a
Emission designator	10M0D7W	10M0D7W
Climatic factor	0.50	
Terrain roughness (ft)	140.00	
C factor	0.13	
Average annual temperature (°F)	39.55	
Fade occurrence factor (Po)	3.737E-003	
Polarization	Horizontal	
Rain region	Denver, Colorado	

Table 5 – Critchell Tower to Mt. Lindo Transmission Details

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1KHQAM 73-89Mbps	23.00	23.00	-62.25	-62.25	60.00	60.00	-41.16	-41.16	21.09	21.09	21.09	21.09
1KLQAM 68-83Mbps	23.00	23.00	-62.75	-62.75	60.00	60.00	-41.16	-41.16	21.59	21.59	21.59	21.59
512QAM 65-79Mbps	24.00	24.00	-65.75	-65.75	61.00	61.00	-40.16	-40.16	25.59	25.59	25.59	25.59
256QAM 59-72Mbps	25.00	25.00	-68.25	-68.25	62.00	62.00	-39.16	-39.16	29.09	29.09	29.09	29.09
128QAM 52-63Mbps	**25.00**	**25.00**	**-71.25**	**-71.25**	**62.00**	**62.00**	**-39.16**	**-39.16**	**32.09**	**32.09**	**32.09**	**32.09**
64QAM 43-53Mbps	25.00	25.00	-74.75	-74.75	62.00	62.00	-39.16	-39.16	35.59	35.59	35.59	35.59
32QAM 35-43Mbps	25.00	25.00	-77.75	-77.75	62.00	62.00	-39.16	-39.16	38.59	38.59	38.59	38.59
16QAM 26-32Mbps	26.00	26.00	-81.25	-81.25	63.00	63.00	-38.16	-38.16	43.09	43.09	43.09	43.09
8PSK 19-23Mbps	26.00	26.00	-82.75	-82.75	63.00	63.00	-38.16	-38.16	44.59	44.59	44.59	44.59
QPSK 13-15Mbps	26.00	26.00	-92.00	-92.00	63.00	63.00	-38.16	-38.16	53.84	53.84	53.84	53.84

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1KHQAM 73-89Mbps	99.9971	99.9971	99.9994	99.9994	99.9983	99.9983	99.9971	99.9971
1KLQAM 68-83Mbps	99.9974	99.9974	99.9995	99.9995	99.9983	99.9983	99.9973	0.0002
512QAM 65-79Mbps	99.9990	99.9990	99.9998	99.9998	99.9988	99.9988	99.9984	0.0011
256QAM 59-72Mbps	99.9995	99.9995	99.9999	99.9999	99.9991	99.9991	99.9990	0.0005
128QAM 52-63Mbps	**99.9998**	**99.9998**	**99.9999**	**99.9999**	**99.9993**	**99.9993**	**99.9992**	**0.0003**
64QAM 43-53Mbps	99.9999	99.9999	99.9999	99.9999	99.9995	99.9995	99.9995	0.0002
32QAM 35-43Mbps	99.9999	99.9999	99.9999	99.9999	99.9996	99.9996	99.9996	0.0001
16QAM 26-32Mbps	99.9999	99.9999	99.9999	99.9999	99.9997	99.9997	99.9997	0.0001
8PSK 19-23Mbps	99.9999	99.9999	99.9999	99.9999	99.9998	99.9998	99.9998	0.0000
QPSK 13-15Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001

Table 6 – Critchell Tower to Mt. Lindo Link Availability Details

Multipath fading method - Vigants - Barnett
Rain fading method – Crane

Critchell Tower to Mt. Morrison

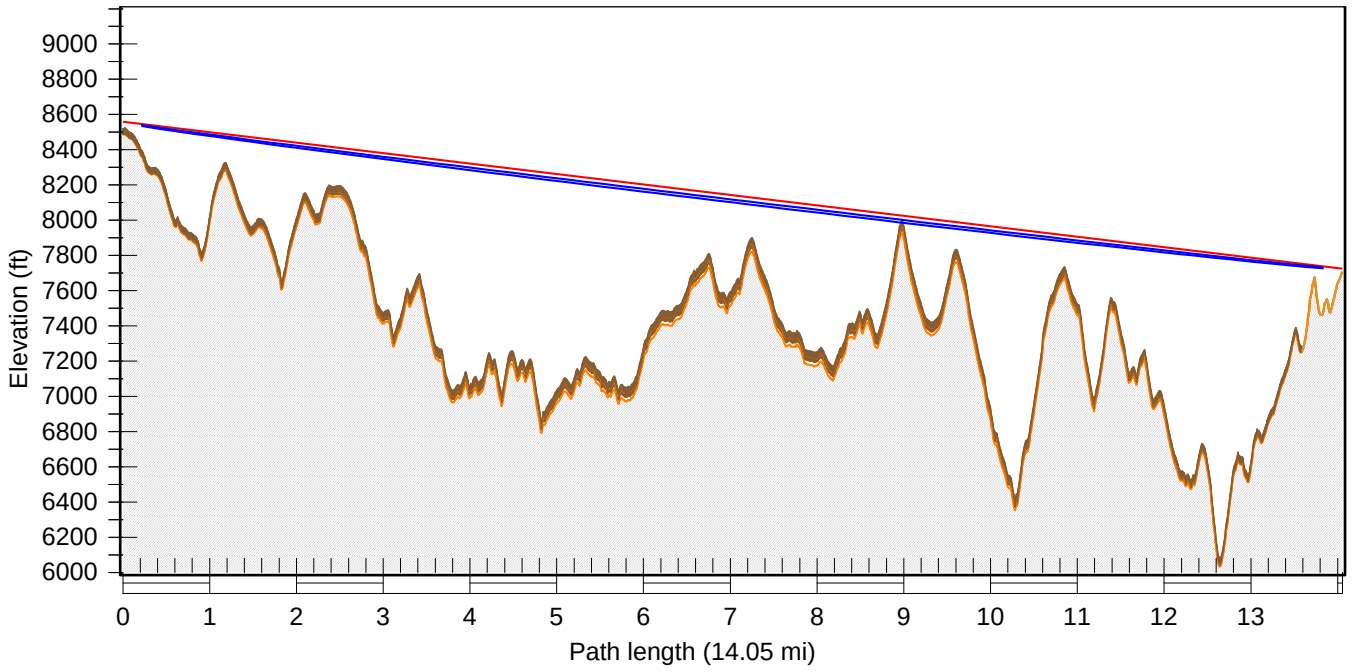

Figure 7 – Critchell Tower to Mt. Morrison Ceragon Link Path Profile

Frequency = 11000.00 MHz K = 1.33, 0.67 % F1 = 100.0, 60.0, 60.0, 30.0

	Critchell Tower	Mt. Morrison
Latitude	39 28 13.01 N	39 40 24.53 N
Longitude	105 11 53.30 W	105 13 04.66 W
Azimuth (°)	355.70	175.68
Tower Height (ft)	140 ft AGL	44 ft AGL
Elevation (ft)	8487.29	7704.41

	Critchell Tower	Mt. Morrison
Latitude	39 28 13.01 N	39 40 24.53 N
Longitude	105 11 53.30 W	105 13 04.66 W
True azimuth (°)	355.70	175.68
Vertical angle (°)	-0.72	0.57
Elevation (ft)	8487.29	7704.41
Antenna model	HP4-11 (TR)	HP3-11 (TR)
Antenna file name	hp4-11-nsma	hp3-11-nsma
Antenna gain (dBi)	41.00	38.50
Antenna height (ft)	70.00	19.00
Connector loss (dB)	0.1	0.1
Miscellaneous loss (dB)	1.50	1.50
Frequency (MHz)	11000.00	
Polarization	Horizontal	
Path length (mi)	14.05	
Free space loss (dB)	140.39	
Atmospheric absorption loss (dB)	0.35	
Net path loss (dB)	64.23	64.23
Radio model	IP20S-11-10-A_1520	IP20S-11-10-A_1520
Radio file name	ip20s-11-10-a	ip20s-11-10-a
Emission designator	10M0D7W	10M0D7W
Climatic factor	0.50	
Terrain roughness (ft)	140.00	
C factor	0.13	
Average annual temperature (°F)	39.63	
Fade occurrence factor (Po)	1.002E-002	
Polarization	Horizontal	
Rain region	Denver, Colorado	

Table 7 – Critchell Tower to Mt. Morrison Transmission Details

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1KHQAM 73-89Mbps	23.00	23.00	-62.25	-62.25	62.50	60.00	-41.23	-41.23	21.02	21.02	21.02	21.02
1KLQAM 68-83Mbps	23.00	23.00	-62.75	-62.75	62.50	60.00	-41.23	-41.23	21.52	21.52	21.52	21.52
512QAM 65-79Mbps	24.00	24.00	-65.75	-65.75	63.50	61.00	-40.23	-40.23	25.52	25.52	25.52	25.52
256QAM 59-72Mbps	25.00	25.00	-68.25	-68.25	64.50	62.00	-39.23	-39.23	29.02	29.02	29.02	29.02
128QAM 52-63Mbps	**25.00**	**25.00**	**-71.25**	**-71.25**	**64.50**	**62.00**	**-39.23**	**-39.23**	**32.02**	**32.02**	**32.02**	**32.02**
64QAM 43-53Mbps	25.00	25.00	-74.75	-74.75	64.50	62.00	-39.23	-39.23	35.52	35.52	35.52	35.52
32QAM 35-43Mbps	25.00	25.00	-77.75	-77.75	64.50	62.00	-39.23	-39.23	38.52	38.52	38.52	38.52
16QAM 26-32Mbps	26.00	26.00	-81.25	-81.25	65.50	63.00	-38.23	-38.23	43.02	43.02	43.02	43.02
8PSK 19-23Mbps	26.00	26.00	-82.75	-82.75	65.50	63.00	-38.23	-38.23	44.52	44.52	44.52	44.52
QPSK 13-15Mbps	26.00	26.00	-92.00	-92.00	65.50	63.00	-38.23	-38.23	53.77	53.77	53.77	53.77

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1KHQAM 73-89Mbps	99.9921	99.9921	99.9984	99.9984	99.9983	99.9983	99.9952	99.9952
1KLQAM 68-83Mbps	99.9929	99.9929	99.9986	99.9986	99.9984	99.9984	99.9956	0.0004
512QAM 65-79Mbps	99.9972	99.9972	99.9994	99.9994	99.9989	99.9989	99.9978	0.0022
256QAM 59-72Mbps	99.9987	99.9987	99.9998	99.9998	99.9992	99.9992	99.9987	0.0009
128QAM 52-63Mbps	**99.9994**	**99.9994**	**99.9999**	**99.9999**	**99.9994**	**99.9994**	**99.9992**	**0.0004**
64QAM 43-53Mbps	99.9997	99.9997	99.9999	99.9999	99.9996	99.9996	99.9995	0.0003
32QAM 35-43Mbps	99.9999	99.9999	99.9999	99.9999	99.9997	99.9997	99.9996	0.0002
16QAM 26-32Mbps	99.9999	99.9999	99.9999	99.9999	99.9998	99.9998	99.9998	0.0002
8PSK 19-23Mbps	99.9999	99.9999	99.9999	99.9999	99.9998	99.9998	99.9998	0.0000
QPSK 13-15Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001

Table 8 – Critchell Tower to Mt. Morrison Link Availability Details

Multipath fading method - Vigants - Barnett
Rain fading method – Crane

Mt. Morrison to ICFD Station 4

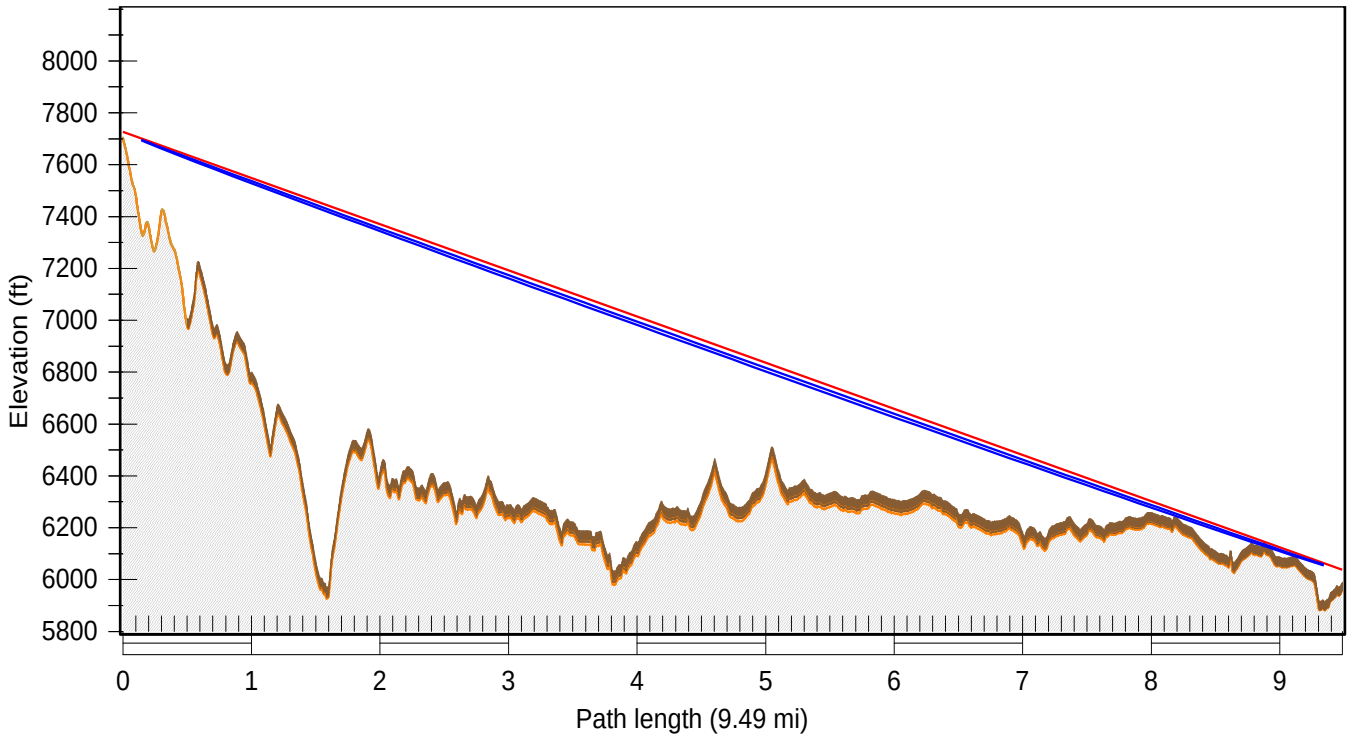

Figure 8 – Mt. Morrison to ICFD Station 4 Ceragon Link Path Profile

Frequency = 11000.00 MHz K = 1.33, 0.67 % F1 = 100.0, 60.0, 60.0, 30.0

	Mt. Morrison	**ICFD St4**
Latitude	39 40 24.53 N	39 32 44.81 N
Longitude	105 13 04.66 W	105 09 08.53 W
Azimuth (°)	158.31	338.35
Tower Height (ft)	44 ft AGL	80 ft AGL
Elevation (ft)	7704.41	5956.71

	Mt. Morrison	**ICFD St4**
Latitude	39 40 24.31 N	39 32 44.02 N
Longitude	39 40 24.53 N	39 32 44.81 N
True azimuth (°)	105 13 04.66 W	105 09 08.53 W
Vertical angle (°)	158.31	338.35
Elevation (ft)	-1.98	1.88
Antenna model	7704.41	5956.71
Antenna file name	HP3-11 (TR)	HP3-11 (TR)
Antenna gain (dBi)	hp3-11-nsma	hp3-11-nsma
Antenna height (ft)	38.50	38.50
Connector loss (dB)	22.00	80.00
Miscellaneous loss (dB)	0.1	0.1
Frequency (MHz)	1.50	
Polarization	11000.00	
Path length (mi)	Horizontal	
Free space loss (dB)	9.49	
Atmospheric absorption loss (dB)	136.98	
Net path loss (dB)	4.04	
Radio model	67.25	67.25
Radio file name	IP20S-11-10-A_1520	IP20S-11-10-A_1520
Emission designator	ip20s-11-10-a	ip20s-11-10-a
Climatic factor	10M0D7W	
Terrain roughness (ft)	0.50	
C factor	124.84	
Average annual temperature (°F)	0.15	
Fade occurrence factor (Po)	39.89	
Polarization	3.580E-003	
Rain region	Horizontal	

Table 9 – Mt. Morrison to ICFD Station 4 Transmission Details

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
1KHQAM 73-89Mbps	23.00	23.00	-62.25	-62.25	60.00	60.00	-44.25	-44.25	18.00	18.00	18.00	18.00
1KLQAM 68-83Mbps	23.00	23.00	-62.75	-62.75	60.00	60.00	-44.25	-44.25	18.50	18.50	18.50	18.50
512QAM 65-79Mbps	24.00	24.00	-65.75	-65.75	61.00	61.00	-43.25	-43.25	22.50	22.50	22.50	22.50
256QAM 59-72Mbps	25.00	25.00	-68.25	-68.25	62.00	62.00	-42.25	-42.25	26.00	26.00	26.00	26.00
128QAM 52-63Mbps	**25.00**	**25.00**	**-71.25**	**-71.25**	**62.00**	**62.00**	**-42.25**	**-42.25**	**29.00**	**29.00**	**29.00**	**29.00**
64QAM 43-53Mbps	25.00	25.00	-74.75	-74.75	62.00	62.00	-42.25	-42.25	32.50	32.50	32.50	32.50
32QAM 35-43Mbps	25.00	25.00	-77.75	-77.75	62.00	62.00	-42.25	-42.25	35.50	35.50	35.50	35.50
16QAM 26-32Mbps	26.00	26.00	-81.25	-81.25	63.00	63.00	-41.25	-41.25	40.00	40.00	40.00	40.00
8PSK 19-23Mbps	26.00	26.00	-82.75	-82.75	63.00	63.00	-41.25	-41.25	41.50	41.50	41.50	41.50
QPSK 13-15Mbps	26.00	26.00	-92.00	-92.00	63.00	63.00	-41.25	-41.25	50.75	50.75	50.75	50.75

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
1KHQAM 73-89Mbps	99.9943	99.9943	99.9989	99.9989	99.9982	99.9982	99.9960	99.9960
1KLQAM 68-83Mbps	99.9949	99.9949	99.9990	99.9990	99.9983	99.9983	99.9963	0.0003
512QAM 65-79Mbps	99.9980	99.9980	99.9996	99.9996	99.9989	99.9989	99.9981	0.0018
256QAM 59-72Mbps	99.9991	99.9991	99.9998	99.9998	99.9992	99.9992	99.9988	0.0008
128QAM 52-63Mbps	**99.9995**	**99.9995**	**99.9999**	**99.9999**	**99.9994**	**99.9994**	**99.9992**	**0.0004**
64QAM 43-53Mbps	99.9998	99.9998	99.9999	99.9999	99.9996	99.9996	99.9995	0.0003
32QAM 35-43Mbps	99.9999	99.9999	99.9999	99.9999	99.9997	99.9997	99.9996	0.0002
16QAM 26-32Mbps	99.9999	99.9999	99.9999	99.9999	99.9998	99.9998	99.9998	0.0001
8PSK 19-23Mbps	99.9999	99.9999	99.9999	99.9999	99.9998	99.9998	99.9998	0.0000
QPSK 13-15Mbps	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	99.9999	0.0001

Table 10 – Mt. Morrison to ICFD Station 4 Link Availability Details

Multipath fading method - Vigants - Barnett
Rain fading method – Crane

Site by Site Details

Critchell Tower

This site will host two (2) new Point to Point 11 GHz radios. KNS Recommends installing a 4ft dish antenna with Ceragon IP-20S radios to Mt. Morrison and another 3ft dish to Mt. Lindo Tower on the same pipe at 70 feet on the NE leg of the tower. 2 new Cisco Catalyst 9200 switches will provide reliable connectivity between 2 links. The power injectors with a Newmar sentinel power system will be installed in the new 19" rack. ICFR will need to provide a single phase AC Supply of 16.5A (@ 110VAC) to the Newmar power system and to 2 new Cisco switches from its UPS power system. Use the existing ground system in the room for new rack grounding with #2 AWG ground wire.

Figure 9 – Critchell Tower Site

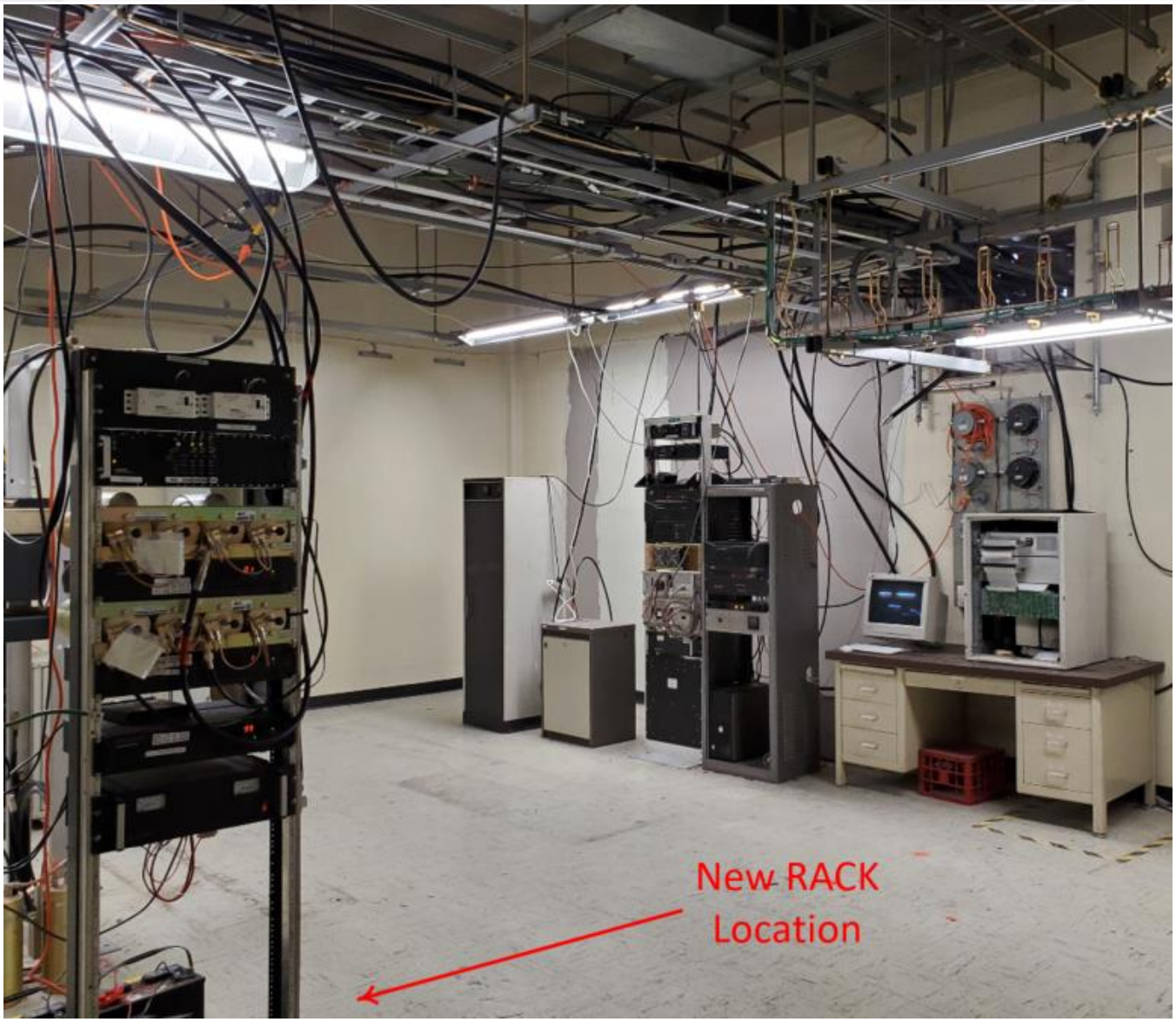

Figure 10 – Critchell Tower New Rack Location

Site Details	
Site Number	1
Site Name	Critchell Tower
Latitude	39.470280°
Longitude	-105.198140°
Existing/New Site	Existing
Site Type	Existing Freestanding Tower
Mounting Structure Total Height	140
Enclosure Type	New Rack
Primary Power	New AC Power
Back up Power	Battery
Site Power Consumption	130 Watts
Backhaul	Licensed PTP Microwave
Switch Model	2 Cisco Stackable 9200 Switches
Point to Point Radio Count	2 Licensed

Table 11 – Critchell Tower Site Details

Point to Point Radio Details		
Local End	Critchell Tower PTP Radio 1	Critchell Tower PTP Radio 2
Remote End	Mt. Lindo PTP Radio 2	Mt. Morrison PTP Radio 1
Radio Model	Ceragon IP20-S 1+1	Ceragon IP20-S 1+1
TX/RX Frequency	11 GHz Licensed	11 GHz Licensed
Channel Bandwidth	10 MHz	10 MHz
Polarization	H	H
Predicted Throughput	89 Mbps	89 Mbps
Mounting Height	70 ft	70 ft
Power Method	DC POE Injector	DC POE Injector
TX Power	26 dBm	26 dBm
Antenna Model	HP3-11 (3' Dish)	HP4-11 (4' Dish)
Antenna Azimuth	352.95°	355.70°
Antenna Tilt	-1.11°	-072°

Table 12 – Critchell Tower Point to Point Radio Details

Mt Lindo

This site will host two (2) new Point to Point 11 GHz radios with an existing 4.9 GHz Cambium PTP 670 radio. A 3 ft dish antenna with Ceragon IP-20S radios to ICFD Station 5 will be installed on the same leg with the 4.9 GHz radio at 56 feet. Another 3ft dish to Critchell tower will be mounted on the south east leg of the tower at 58 feet. A structure analysis for the tower is highly recommended.

The power injectors with a Newmar sentinel power system will be installed in the new 19" rack. 2 new Cisco Catalyst 9200 switches will provide reliable connectivity between 2 links. ICFR will need to provide a single phase AC Supply of 16.5A (@ 110VAC) to the Newmar power system and to 2 new Cisco switches from its UPS power system. Use the existing indoor and outdoor ground systems and the existing equipment racks.

Figure 11 – Mt. Lindo Tower

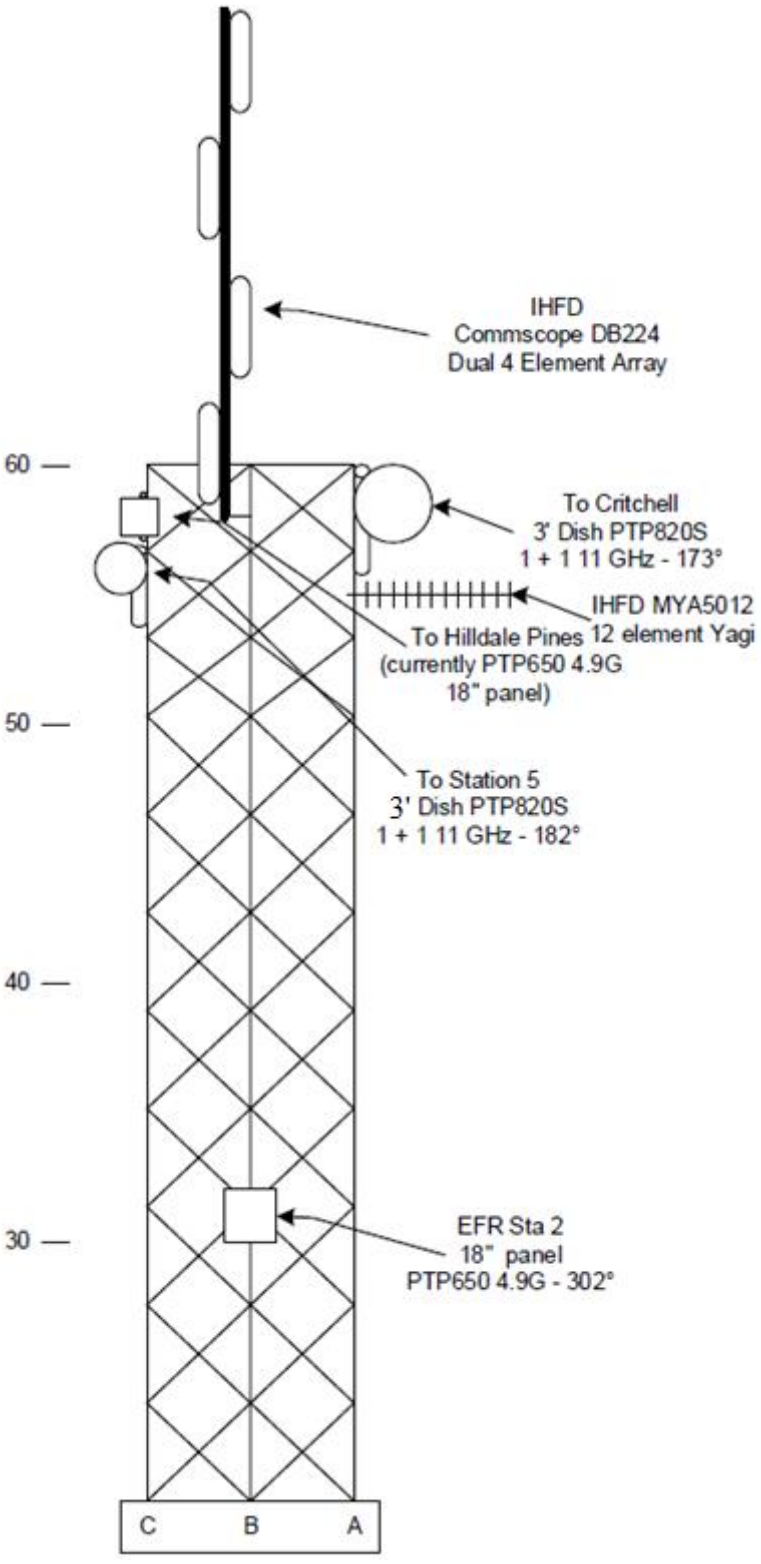

Figure 12 – Mt. Lindo Tower Antenna Location

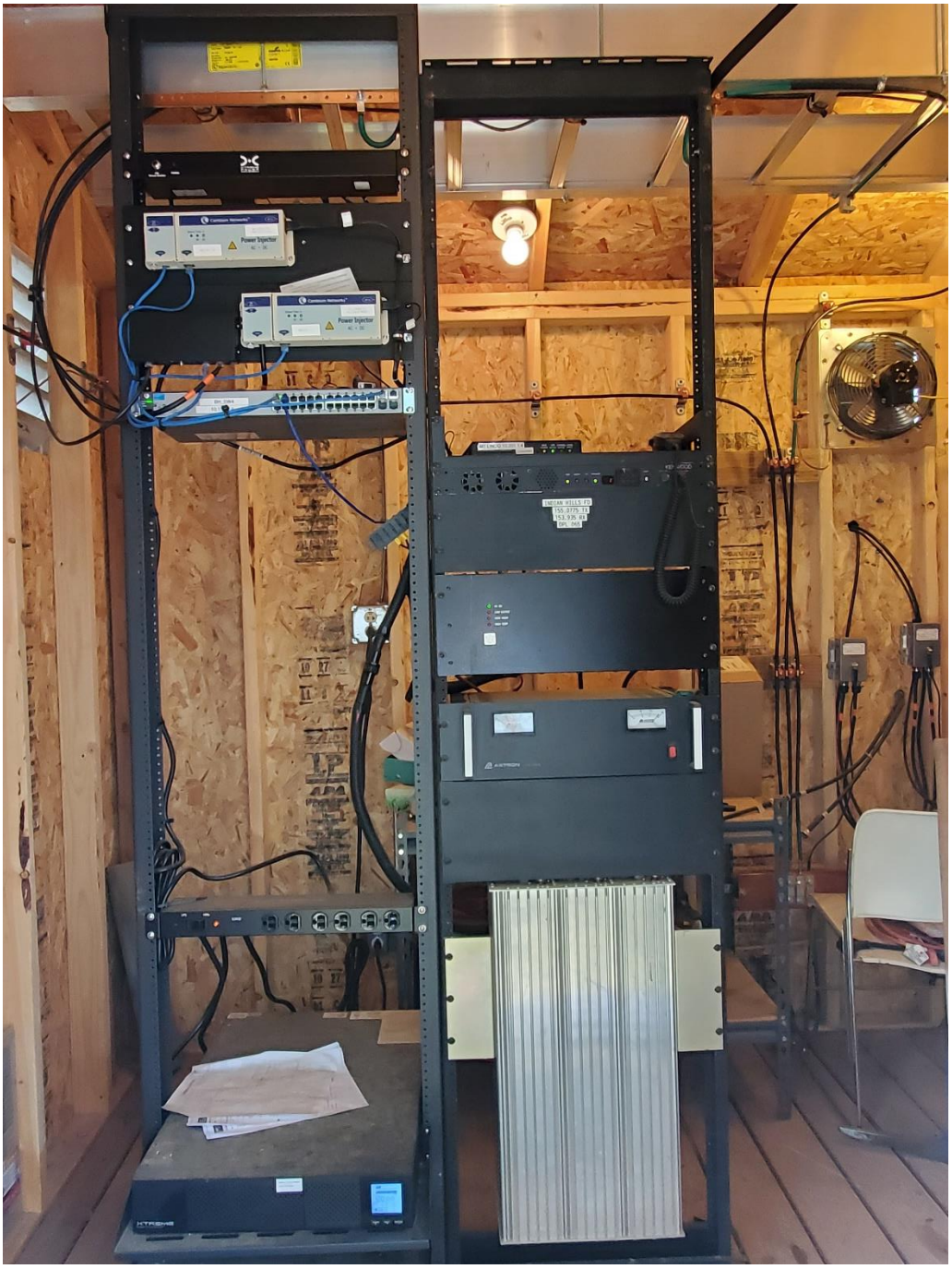

Figure 13 – Mt. Lindo – Site Building

Site Details	
Site Number	2
Site Name	Mt. Lindo
Latitude	39.612830°
Longitude	-105.220920°
Existing/New Site	Existing
Site Type	Existing Freestanding Tower
Mounting Structure Total Height	60 ft
Enclosure Type	Existing Racks
Primary Power	New AC Power
Back up Power	Battery
Site Power Consumption	130 Watts
Backhaul	Licensed PTP Microwave
Switch Model	2 Cisco Stackable 9200 Switches
Point to Point Radio Count	2 Licensed

Table 13 – Mt. Lindo Site Details

Point to Point Radio Details		
Local End	Mt. Lindo PTP Radio 1	Mt. Lindo PTP Radio 2
Remote End	IFCD Station 5 PTP Radio	Critchell Tower PTP Radio 1
Radio Model	Ceragon IP20-S 1+1	Ceragon IP20-S 1+1
TX/RX Frequency	11 GHz Licensed	11 GHz Licensed
Channel Bandwidth	10 MHz	10 MHz
Polarization	H	H
Predicted Throughput	89 Mbps	89 Mbps
Mounting Height	56 ft	58 ft
Power Method	DC POE Injector	DC POE Injector
TX Power	26 dBm	26 dBm
Antenna Model	HP3-11 (3' Dish)	HP3-11 (3' Dish)
Antenna Azimuth	185.5°	172.94°
Antenna Tilt	1.67°	1.00°

Table 14 – Mt. Lindo Point to Point Radio Details

ICFD Station 4

This site will host one (1) new Point to Point 11 GHz radio. KNS Recommends installing 3’ dish antenna with a pipe to pipe bracket at 80 feet and pointed to an azimuth of 338°. 2 new Cisco Catalyst 9200 switches will provide reliable connectivity between 2 links. The power injectors with a Newmar sentinel power system will be installed in the new 19” rack. ICFR will need to provide a single phase AC Supply of 16.5A (@ 110VAC) to the Newmar power system and to 2 new Cisco switches from its UPS power system. Use the new ground system in the room for new rack grounding with #2 AWG ground wire.

Figure 14 – ICFD Station 4 - Tower Location

Figure 15 – ICFD Station 4 - Rack Location

Site Details	
Site Number	3
Site Name	ICFD Station 4
Latitude	39.545780°
Longitude	-105.152370°
Existing/New Site	New Tower
Site Type	New Tower
Mounting Structure Total Height	80 ft
Enclosure Type	New Rack
Primary Power	New AC Power
Back up Power	Battery
Site Power Consumption	65 Watts
Backhaul	Licensed PTP Microwave
Switch Model	2 Cisco Stackable 9200 Switches
Point to Point Radio Count	1 Licensed

Table 15 – ICFD Station 4 Site Details

Point to Point Radio Details	
Site A	ICFD Station 4 PTP Radio
Site B	Mt. Morrison PTP Radio 2
Radio Model	Ceragon IP20-S 1+1
TX/RX Frequency	11 GHz Licensed
Channel Bandwidth	10 MHz
Polarization	H
Predicted Throughput	89 Mbps
Mounting Height	80 ft
Power Method	DC POE Injector
TX Power	26 dBm
Antenna Model	HP3-11 (3' Dish)
Antenna Azimuth	338.45°
Antenna Tilt	1.88°

Table 16 – ICFD Station 4 Point to Point Radio Details

Mt. Morrison

This site will host two (2) new Point to Point 11 GHz radios. KNS Recommends installing 3ft dish antennas with Ceragon IP-20S radios on the same pipe at 19 feet. The power injectors with a Newmar sentinel power system will be installed in the new indoor cabinet. 2 new Cisco Catalyst 9200 switches will provide reliable connectivity between 2 links. ICFR will need to provide a single phase AC Supply of 16.5A (@ 110VAC) to the Newmar power system. Use the existing ground system in the room for new cabinet grounding with #2 AWG ground wire.

Figure 16 – Mt. Morrison – Antenna Location

Figure 17 – Mt. Morrison – New Rack Location

Site Details	
Site Number	4
Site Name	Mt. Morrison
Latitude	39.673480°
Longitude	-105.217960°
Existing/New Site	Existing
Site Type	Existing Freestanding Tower
Mounting Structure Total Height	44 ft
Enclosure Type	New Indoor Cabinet
Primary Power	New AC Power
Back up Power	Battery
Site Power Consumption	166 Watts
Backhaul	Licensed PTP Microwave
Switch Model	2 Cisco Stackable 9200 Switches
Point to Point Radio Count	2 Licensed

Table 17 – Mt. Morrison Site Details

Point to Point Radio Details		
Site A	Mt. Morrison PTP Radio 1	Mt. Morrison PTP Radio 2
Site B	Critchell Tower PTP Radio 2	ICFD Station 4 PTP Radio 1
Radio Model	Ceragon IP20-S 1+1	Ceragon IP20-S 1+1
TX/RX Frequency	11 GHz Licensed	11 GHz Licensed
Channel Bandwidth	10 MHz	10 MHz
Polarization	H	H
Predicted Throughput	89 Mbps	89 Mbps
Mounting Height	19 ft	22 ft
Power Method	DC POE Injector	DC POE Injector
TX Power	26 dBm	26 dBm
Antenna Model	HP3-11 (3' Dish)	HP3-11 (3' Dish)
Antenna Azimuth	175.69°	158.41°
Antenna Tilt	0.57°	-1.98°

Table 18 – Mt. Morrison Point to Point Radio Details

ICFD Station 5

This site will host (1) Point to Point 11 GHz radio. KNS Recommends installing 3ft dish antenna with a pipe to pipe bracket at 60 feet and pointed to an azimuth of 5.05°. 2 new Cisco Catalyst 9200 switches will provide reliable connectivity between 2 links. The power injectors with a Newmar sentinel power system will be installed in the new 19" rack. ICFR will need to provide a single phase AC Supply of 16.5A (@ 110VAC) to the Newmar power system and to 2 new Cisco switches from its UPS power system. Use the new ground system in the room for new rack grounding with #2 AWG ground wire.

Figure 18 – ICFD Station 5

Figure 19 – ICFD Station 5 - Rack Location

Site Details	
Site Number	5
Site Name	ICFD Station 5
Latitude	39.528680°
Longitude	-105.230530°
Existing/New Site	New Tower
Site Type	New Tower
Mounting Structure Total Height	80 ft
Enclosure Type	New Rack
Primary Power	New AC Power
Back up Power	Battery
Site Power Consumption	65 Watts
Backhaul	Licensed PTP Microwave
Switch Model	2 Cisco Stackable 9200 Switches
Point to Point Radio Count	1 Licensed

Table 19 – ICFD Station 5 Site Details

Point to Point Radio Details	
Site A	IFCD Station 5 PTP Radio
Site B	Mt. Lindo PTP Radio 1
Radio Model	Ceragon IP20-S 1+1
TX/RX Frequency	11 GHz Licensed
Channel Bandwidth	10 MHz
Polarization	H
Predicted Throughput	89 Mbps
Mounting Height	60 ft
Power Method	DC POE Injector
TX Power	26 dBm
Antenna Model	HP3-11 (3' Dish)
Antenna Azimuth	5.05°
Antenna Tilt	-1.73°

Table 20 – ICFD Station 5 Point to Point Radio Details

Table of Figures

Table of Tables

Appendices

Appendix 1 - Ceragon IP-20S Radio Data Sheet

Appendix 2 - Newmar Power Supply Rectifier Data Sheet

Appendix 3 - Cisco Catalyst 9200 Stackable Switch Data Sheet

Appendix 4 - Sierra Wireless Airlink RV55 Data Sheet

Appendix 5 - PRTG Manual

Appendix 6 - PRTG System-Requirements

Appendix 7 - Cisco Bulletin with Software Update Programs

Appendix 1

CERAGON

Data Sheet ANSI

Release 7.7

FibeAir® IP-20S

Compact All-Outdoor Node

Data Sheet ANSI

FibeAir® IP-20S

Compact All-Outdoor Node

FibeAir IP-20S is an all-outdoor backhaul solution for access sites. It runs under CeraOS, the high-performance, internetworking operating system, and supports all common features of the IP-20 platform in a compact, environmentally friendly architecture.

With the proliferation of all-outdoor sites, operators require a compact backhaul solution to provide high capacity and the optimal mix of functionality and performance while minimizing cost of ownership. With the rapid pace of technological advancement, solutions implemented today must be versatile and flexible to continue to deliver cost-effective performance that can evolve with the demands of tomorrow. Operators need to know that their investment can cope with future standards and requirements. Ceragon's wireless, all-outdoor edge node, FibeAir IP-20S, is designed to meet all of the challenges.

FibeAir IP-20S boosts performance in today's networks while providing a cost-effective path to future network requirements. With an integrated programmable network processor, it offers a rich set of advanced Carrier Ethernet services providing a wide range of new capabilities that address the diverse and evolving needs of mobile operators, ISPs, utilities, government and private networks.

Compact, low power consuming FibeAir IP-20S is simple to install and maintain. Employing the common features of the IP-20 platform provided by CeraOS, the IP-20S is a cost-effective, reliable solution for the hauling of outdoor edge nodes.

Compact All-Outdoor Node

- **Single-core radio node**

  Integrated Ethernet switch, MEF Carrier Ethernet 2.0-compliant, MPLS-TP-ready

- **High radio capacity and spectral efficiency**

  Up to 2048QAM modulation

- **Multi-purpose platform, ideal for versatile deployment scenarios**

  Compact form-factor, easily deployed in urban and rural locations

- **High service granularity enables rollout of new business models**

  Intelligent service-centric management utilizing Hierarchical QoS and advanced OA&M capabilities

- **Common OS & software-defined engine simplify network modernization**

  Unified CeraOS across entire FibeAir IP-20 platform

  Powered by a programmable network processor

CERAGON

Radio

Supported Frequency Range

- 6-38 GHz

Configurations

- 1+0, 1+1

Radio Features

- Protection: 1+1 HSB*
- High spectral utilization: QPSK to 2048 QAM w/ACM

Ethernet

Ethernet Interfaces

- Traffic Interfaces – 1 x 10/100/1000Base-T (RJ-45) and 2x1000base-X (Optical SFP) or 10/100/1000Base-T (Electrical SFP)
- Management Interface - 1 x 10/100 Base-T (RJ-45)
- SFP Types - Optical 1000Base-LX (1310 nm) or SX (850 nm)

Note: SFP devices must be of industrial grade (-40°C to +85°C)

Ethernet Features

- MTU – 9600 Bytes
- Quality of Service
  - Multiple Classification criteria (VLAN ID, p-bits, IP-DSCP, MPLS EXP, CoS)
  - Eight priority queues
  - Deep buffering (configurable up to 64 Mbit per queue)
  - WRED
  - Hierarchical QoS – high service granularity *
  - P-bit marking/remarking
- 4K VLANs
- VLAN add/remove/translate
- Frame Cut Through – controlled latency and PDV for delay sensitive applications
- Header DeDuplication – Capacity boosting by eliminating inefficiency in all layers (L2,MPLS, L3,L4, Tunneling – GTP for LTE, GRE)
- Ethernet OAM – EFM (IEEE 802.3ah), CFM (IEEE 802.1ag), ITU-T Y.1731*

Synchronization

Synchronization Distribution

- Sync Distribution over any traffic interface (GE/FE)
- SyncE (ITU-T G.8261, G.8262)
- SSM/ESMC Support for ring/mesh applications (ITU-T G.8264)
- SyncE Regenerator mode, providing PRC grade (ITU-T G.811) performance for smart pipe applications.

IEEE-1588

- Optimized Transport for reduced PDV
- IEEE-1588 TC*

Standards

MEF

- Carrier Ethernet 2.0 (CE 2.0)**

Supported Ethernet Standards

- 10/100/1000base-T/X (IEEE 802.3)
- Ethernet VLANs (IEEE 802.3ac)
- Virtual LAN (VLAN, IEEE 802.1Q)
- Class of service (IEEE 802.1p)
- Provider bridges (QinQ – IEEE 802.1ad)
- Link aggregation (IEEE 802.3ad)
- Auto MDI/MDIX for 1000baseT
- RFC 1349: IPv4 TOS
- RFC 2474: IPv4 DSCP
- RFC 2460: IPv6 Traffic Classes

Standards Compliance

- EMC: EN 301 489-1, EN 301 489-4, Class B (Europe), FCC 47 CFR, part 15, class B (US), ICES-003, Class B (Canada), TEC/EMI/TEL-001/01, Class B (India)
- Surge: EN61000-4-5, Class 4 (for PWR and ETH1/PoE ports)
- Safety: EN 60950-1, IEC 60950-1, UL 60950-1, CSA-C22.2 No.60950-1, EN 60950-22, UL 60950-22, CSA C22.2.60950-22
- Storage: ETSI EN 300 019-1-1 Class 1.2
- Transportation: ETSI EN 300 019-1-2 Class 2.3

Technical Specifications

Mechanical Specifications

- Dimensions – 230mm(H), 233mm(W), 98mm(D), 6kg
- Pole Diameter Range (for Remote Mount Installation) – 8.89 cm – 11.43 cm

Environmental Specifications

- -33°C to +55°C (-45°C to +60°C extended)

Power Input Specifications

- Standard Input: -48 VDC
- DC Input range: -40 to -60 VDC

Power Consumption Specifications

- Maximum Power Consumption – 32W

PoE Injector Mechanical Specifications

- Dimensions – 134mm(H), 190mm(W), 62mm(D), 1 kg

PoE Injector Environmental Specifications

- 33°C to +55°C (-45°C to +60°C extended)

PoE Injector Power Input Specifications

- Standard Input: -48 or +24 VDC (Optional)
- DC Input range: ±(18/40.5 to 60) VDC (+18VDC extended range is supported as part of the nominal +24VDC support)

PoE Injector Interfaces

- GbE Data Port supporting 10/100/1000Base-T
- Power-Over-Ethernet (PoE) Port
- DC Power Port –40V to -60V (a PoE supporting two redundant DC feeds each supporting ±(18-60)V is available)

* Planned for future release.

** Certification pending.

Transmit Power (dBm) (Standard)	Frequency (GHz)	6	7-8	10-11	13-15	18-23	24 UL	26	28-38
QPSK		26	25	24	24	22	-17	21	18
8 QAM		26	25	24	24	22	-18	21	18
16 QAM		25	24	23	23	21	-19	20	17
32 – 256 QAM		24	23	22	22	20	-19	19	16
512 QAM		22	21	21	20	18	-21	17	14
1024 QAM		22	21	20	20	18	-21	17	14
2048 QAM		20	19	18	18	16	-23	15	12
Transmit Power (dBm) (High Power)	Frequency (GHz)								
QPSK – 8 QAM		29	28	27					
16 QAM		28	27	26					
32 – 256 QAM		27	26	25					
512 QAM		25	24	24					
1024 QAM		25	24	23					
2048 QAM		23	22	21					

	Capacity (Mbps)	Capacity (Mbps)	Capacity (Mbps)	Capacity De-Dup	Capacity (Mbps)	Capacity De-Dup
	30 MHz		40 MHz		50 MHz	
QPSK	43-52	45-162	58-71	61-220	70-86	74-267
8 PSK	62-76	65-236	86-105	90-328	109-133	114-415
16 QAM	87-107	92-332	117-143	123-446	148-181	155-563
32 QAM	115-140	121-437	154-189	162-588	186-227	195-707
64 QAM	141-173	149-538	190-232	199-722	240-293	252-913
128 QAM	170-208	179-648	229-280	241-873	280-342	294-1000
256 QAM	196-239	206-745	247-301	259-939	332-406	348-1000
512 QAM	209-255	219-794	270-330	284-1000	360-440	378-1000
1024 QAM Strong	228-278	239-866	306-375	322-1000	392-479	411-1000
1024 QAM Light	241-295	253-917	325-398	342-1000	416-509	437-1000
2048 QAM	263-321	276-1000	352-430	370-1000	449-548	471-1000

	Capacity (Mbps)	Capacity De-Dup	Capacity (Mbps)	Capacity De-Dup
	60 MHz		80 MHz*	
QPSK	87-106	91-331	114-140	120-435
8 PSK	127-155	133-482	162-198	170-617
16 QAM	176-215	185-670	230-283	243-880
32 QAM	232-283	243-881	302-371	319-1000
64 QAM	284-348	299-1000	369-454	390-1000
128 QAM	344-420	361-1000	435-536	461-1000
256 QAM	397-485	416-1000	501-618	531-1000
512 QAM	426-521	448-1000	551-679	583-1000
1024 QAM Strong	464-567	487-1000	599-738	634-1000
1024 QAM Light	493-602	517-1000		
2048 QAM	534-653	561-1000		

Notes: The total capacity (including Header De-Duplication) of an IP-20C unit is double the figures in the tables below. It should be noted that there are two IP-20C models, with a different limitation of the top capacity per terminal (unit). An IP-20C model that supports 80 MHz channels will support a total capacity of 1.3 Gbps (per terminal), whereas other models support 1 Gbps.

* Planned for future release.

Receiver Threshold (RSL) (dBm @ BER = 10-6)															
Frequency (GHz)	6	7	8	10	11	13	15	18	23	24UL	26	28-31	32	36	38
30 MHz															
QPSK	-87.5	-85.5	-85.0	-85.5	-86.5	-86.0	-85.0	-86.0	-84.5	-84.0	-84.0	-84.5	-85.5	-83.0	-82.5
8 PSK	-82.5	-80.5	-80.0	-80.5	-81.5	-81.0	-80.0	-81.0	-79.5	-79.0	-79.0	-79.5	-80.5	-78.0	-77.5
16 QAM	-81	-79.0	-78.5	-79.0	-80	-79.5	-78.5	-79.5	-78.0	-77.5	-77.5	-78.0	-79.0	-76.5	-76.0
32 QAM	-77	-75.0	-74.5	-75.0	-76	-75.5	-74.5	-75.5	-74.0	-73.5	-73.5	-74.0	-75.0	-72.5	-72.0
64 QAM	-74.5	-72.5	-72.0	-72.5	-73.5	-73.0	-72.0	-73.0	-71.5	-71.0	-71.0	-71.5	-72.5	-70.0	-69.5
128 QAM	-71.5	-69.0	-68.5	-69.0	-70.5	-69.5	-68.5	-69.5	-68.0	-67.5	-67.5	-68.0	-69.0	-66.5	-66.0
256 QAM	-68.5	-66.0	-65.5	-66.0	-67.5	-66.5	-65.5	-66.5	-65.0	-64.5	-64.5	-65.0	-66.0	-63.5	-63.0
512 QAM	-66.5	-64.0	-63.5	-64.0	-65.5	-64.5	-63.5	-64.5	-63.0	-62.5	-62.5	-63.0	-64.0	-61.5	-61.0
1024 QAM Strong	-63	-61.0	-60.5	-61.0	-62	-61.5	-60.5	-61.5	-60.0	-59.5	-59.5	-60.0	-61.0	-58.5	-58.0
1024 QAM Light	-62	-60.0	-59.5	-60.0	-61	-60.5	-59.5	-60.5	-59.0	-58.5	-58.5	-59.0	-60.0	-57.5	-57.0
2048 QAM	-58.5	-56.0	-55.5	-56.0	-57.5	-56.5	-55.5	-56.5	-55.0	-54.5	-54.5	-55.0	-56.0	-53.5	-53.0
40 MHz															
QPSK	-85.5	-84.0	-83.5	-84.0	-85	-84.5	-83.5	-84.5	-83.0	-82.5	-82.5	-83.0	-84.0	-81.5	-81.0
8 PSK	-80.5	-79.0	-78.5	-79.0	-79.5	-79.5	-78.5	-79.5	-78.0	-77.5	-77.5	-78.0	-79.0	-76.5	-76.0
16 QAM	-79.0	-77.5	-77.0	-77.5	-78.5	-78.0	-77.0	-78.0	-76.5	-76.0	-76.0	-76.5	-77.5	-75.0	-74.5
32 QAM	-75.5	-74.0	-73.5	-74.0	-75	-74.5	-73.5	-74.5	-73.0	-72.5	-72.5	-73.0	-74.0	-71.5	-71.0
64 QAM	-72.5	-71.0	-70.5	-71.0	-72	-71.5	-70.5	-71.5	-70.0	-69.5	-69.5	-70.0	-71.0	-68.5	-68.0
128 QAM	-69.5	-68.0	-67.5	-68.0	-69.5	-68.5	-67.5	-68.5	-67.0	-66.5	-66.5	-67.0	-68.0	-65.5	-65.0
256 QAM	-66.5	-65.0	-64.5	-65.0	-67	-65.5	-64.5	-65.5	-64.0	-63.5	-63.5	-64.0	-65.0	-62.5	-62.0
512 QAM	-63.5	-62.0	-61.5	-62.0	-64.5	-62.5	-61.5	-62.5	-61.0	-60.5	-60.5	-61.0	-62.0	-59.5	-59.0
1024 QAM Strong	-61.0	-59.5	-59.0	-59.5	-61	-60.0	-59.0	-60.0	-58.5	-58.0	-58.0	-58.5	-59.5	-57.0	-56.5
1024 QAM Light	-60.0	-58.5	-58.0	-58.5	-60	-59.0	-58.0	-59.0	-57.5	-57.0	-57.0	-57.5	-58.5	-56.0	-55.5
2048 QAM	-57.5	-56.0	-55.5	-56.0	-57	-56.5	-55.5	-56.5	-55.0	-54.5	-54.5	-55.0	-56.0	-53.5	-53.0
50 MHz															
QPSK	-85.0	-83.5	-83.0	-83.5	-84.5	-84.0	-83.0	-84.0	-82.5	-79.0	-82.0	-82.5	-83.5	-81.0	-80.5
8 PSK	-79.5	-78.0	-77.5	-78.0	-79.0	-78.5	-77.5	-78.5	-77.0	-73.5	-76.5	-77.0	-78.0	-75.5	-75.0
16 QAM	-78.0	-76.5	-76.0	-76.5	-77.5	-77.0	-76.0	-77.0	-75.5	-72.0	-75.0	-75.5	-76.5	-74.0	-73.5
32 QAM	-74.0	-72.5	-72.0	-72.5	-73.5	-73.0	-72.0	-73.0	-71.5	-68.0	-71.0	-71.5	-72.5	-70.0	-69.5
64 QAM	-71.0	-69.5	-69.0	-69.5	-70.5	-70.0	-69.0	-70.0	-68.5	-65.0	-68.0	-68.5	-69.5	-67.0	-66.5
128 QAM	-68.0	-66.5	-66.0	-66.5	-67.5	-67.0	-66.0	-67.0	-65.5	-62.0	-65.0	-65.5	-66.5	-64.0	-63.5
256 QAM	-65.5	-64.0	-63.5	-64.0	-65.0	-64.5	-63.5	-64.5	-63.0	-59.5	-62.5	-63.0	-64.0	-61.5	-61.0
512 QAM	-63.0	-61.5	-61.0	-61.5	-62.5	-62.0	-61.0	-62.0	-60.5	-57.0	-60.0	-60.5	-61.5	-59.0	-58.5
1024 QAM Strong	-59.5	-58.0	-57.5	-58.0	-59.0	-58.5	-57.5	-58.5	-57.0	-53.5	-56.5	-57.0	-58.0	-55.5	-55.0
1024 QAM Light	-58.5	-57.0	-56.5	-57.0	-58.0	-57.5	-56.5	-57.5	-56.0	-52.5	-55.5	-56.0	-57.0	-54.5	-54.0
2048 QAM	-56.5	-55.0	-54.5	-55.0	-56.0	-55.5	-54.5	-55.5	-54.0	-50.5	-53.5	-54.0	-55.0	-52.5	-52.0

Frequency (GHz)	6	7	8	10	11	13	15	18	23	24UL	26	28-31	32	36	38
60 MHz															
QPSK	-84.5	-82.5	-82.0	-82.5	-83.5	-83.0	-82.0	-83.0	-81.5	-81.0	-81.0	-81.5	-82.5	-80.0	-79.5
8 PSK	-80	-78.0	-77.5	-78.0	-79.0	-78.5	-77.5	-78.5	-77.0	-76.5	-76.5	-77.0	-78.0	-75.5	-75.0
16 QAM	-77.5	-75.5	-75.0	-75.5	-76.5	-76.0	-75.0	-76.0	-74.5	-74.0	-74.0	-74.5	-75.5	-73.0	-72.5
32 QAM	-74	-72.0	-71.5	-72.0	-73.0	-72.5	-71.5	-72.5	-71.0	-70.5	-70.5	-71.0	-72.0	-69.5	-69.0
64 QAM	-70.5	-68.5	-68.0	-68.5	-69.5	-69.0	-68.0	-69.0	-67.5	-67.0	-67.0	-67.5	-68.5	-66.0	-65.5
128 QAM	-68	-66.0	-65.5	-66.0	-67.0	-66.5	-65.5	-66.5	-65.0	-64.5	-64.5	-65.0	-66.0	-63.5	-63.0
256 QAM	-65	-62.5	-62.0	-62.5	-63.5	-63.0	-62.0	-63.0	-61.5	-61.0	-61.0	-61.5	-62.5	-60.0	-59.5
512 QAM	-63	-60.5	-60.0	-60.5	-61.5	-61.0	-60.0	-61.0	-59.5	-59.0	-59.0	-59.5	-60.5	-58.0	-57.5
1024 QAM Strong	-59.5	-57.0	-56.5	-57.0	-58.0	-57.5	-56.5	-57.5	-56.0	-55.5	-55.5	-56.0	-57.0	-54.5	-54.0
1024 QAM Light	-58.5	-56.0	-55.5	-56.0	-57.0	-56.5	-55.5	-56.5	-55.0	-54.5	-54.5	-55.0	-56.0	-53.5	-53.0
2048 QAM	-55.5	-53.5	-53.0	-53.5	-54.5	-54.0	-53.0	-54.0	-52.5	-52.0	-52.0	-52.5	-53.5	-51.0	-50.5
80 MHz*															
QPSK	-83.0	-81.5	-81.0	-81.5	-82.5	-82.0	-81.0	-82.0	-80.5	-77.0	-80.0	-80.5	-81.5	-79.0	-78.5
8 PSK	-78.0	-76.5	-76.0	-76.5	-77.5	-77.0	-76.0	-77.0	-75.5	-72.0	-75.0	-75.5	-76.5	-74.0	-73.5
16 QAM	-76.0	-74.5	-74.0	-74.5	-75.5	-75.0	-74.0	-75.0	-73.5	-70.0	-73.0	-73.5	-74.5	-72.0	-71.5
32 QAM	-72.5	-71.0	-70.5	-71.0	-72.0	-71.5	-70.5	-71.5	-70.0	-66.5	-69.5	-70.0	-71.0	-68.5	-68.0
64 QAM	-69.5	-68.0	-67.5	-68.0	-69.0	-68.5	-67.5	-68.5	-67.0	-63.5	-66.5	-67.0	-68.0	-65.5	-65.0
128 QAM	-67.0	-65.5	-65.0	-65.5	-66.5	-66.0	-65.0	-66.0	-64.5	-61.0	-64.0	-64.5	-65.5	-63.0	-62.5
256 QAM	-64.0	-62.5	-62.0	-62.5	-63.5	-63.0	-62.0	-63.0	-61.5	-58.0	-61.0	-61.5	-62.5	-60.0	-59.5
512 QAM	-61.0	-59.5	-59.0	-59.5	-60.5	-60.0	-59.0	-60.0	-58.5	-55.0	-58.0	-58.5	-59.5	-57.0	-56.5
1024 QAM Strong	-58.5	-57.0	-56.5	-57.0	-58.0	-57.5	-56.5	-57.5	-56.0	-52.5	-55.5	-56.0	-57.0	-54.5	-54.0
1024 QAM Light	-57.5	-56.0	-55.5	-56.0	-57.0	-56.5	-55.5	-56.5	-55.0	-51.5	-54.5	-55.0	-56.0	-53.5	-53.0
2048 QAM	-55.5	-54.0	-53.5	-54.0	-55.0	-54.5	-53.5	-54.5	-53.0	-49.5	-52.5	-53.0	-54.0	-51.5	-51.0

* Planned for future release.

Sentinel Power System: 48 Volt

Incredible Functionality, Scalability and Web Monitoring in a 1 RU, 600 Watt to 1.8 Kw, 48V DC Power System

- 19", 1U rackmount shelf with integrated power distribution and SNMP digital controller
- 90-250 VAC input, power factor corrected
- 3 power bays accept 600 watt modular rectifiers, -48V
- 33 amp, 1800 watt total max. output capacity
- Output temperature compensated for precise battery charging
- 4 DC circuit breaker distribution capacity, with tripped breaker alarm
- Master disconnect breaker for two battery strings, with tripped breaker alarm
- Controller with digital display of system parameters with TCP/IP Web interface and SNMP monitoring/logging
- Alarm contacts monitor major system functions
- General Purpose Digital Inputs for user configured external alarms
- Low voltage disconnect built-in
- Easily configures to meet site power requirements

Complete system design and assembly to your application parameters: rectifier configuration, distribution circuit breaker installation and programming of alarms and monitors. Installation in a relay rack with batteries and wiring also available.

Rectifier	Input Amps @ Full Load 115/230V	Output Voltage	Output Amps Cont.	Watts	Weight
RM-648	5.8/2.9	-54.4 VDC, adjustable 54 - 58 VDC	11A	600	1.9 lbs.

Shelf	Input Voltage Range	Configuration	Size	Weight
SRS-48	90-300V, 45-65 Hz.	3 Sentinel Rectifiers (-48 V bays), Controller, 4 DC Circuit Breaker Distribution, 2 x 30A Battery Breakers	19/23"*, 1 RU	19.84 lbs.

** 23" adapters required, model SRS-1U*

Smart Power Features

Newmar power systems embed the latest technology in smart software to provide the ultimate in intelligent system functionality.

Elements include:

- **Smart Set-Up:** An extensive menu of system parameters for customization per site
- **Smart On-Site Data Viewing:** All system data accessible on-site by laptop via USB
- **Smart Viewing by Web:** Voltages, load, and battery performance data (Ethernet, RJ45)
- **Smart Automatic System Adjustments:** Temperature Compensated charging, low voltage disconnect, battery equalization, fast charging
- **Smart Alarm Notifications:** Voltage, temperature as well as several user defined

General Specifications

AC Input
Nominal: 115 or 230VAC (power cord with NEMA-5-20 plug attached

DC Distribution
Load: 4 breaker position capacity, available amperages (specify) 6A, 10A, 20A, 30 amp, with tripped breaker alarm
Battery: 2 x 30A battery circuit breakers, with tripped breaker alarm
Low Voltage Battery Disconnect: 80A battery LVD installed, with disconnect alarm

Wiring Option: Battery Cable, 8 AWG, 7' Length (P/N: 433-8007-0)

NEWMAR Powering the Network

The bridge to possible

Data sheet
Cisco public

Cisco Catalyst 9200 Series Switches

Contents

Extend intent-based networking everywhere

Cisco® Catalyst® 9200 Series switches extend the power of intent-based networking and Catalyst 9000 hardware and software innovation to a broader set of deployments. With its family pedigree, **Catalyst 9200 Series switches offer simplicity without compromise – it is secure, always on, and IT simplified.**

As foundational building blocks for the Cisco Digital Network Architecture, Catalyst 9200 Series switches help customers simplify complexity, optimize IT, and reduce operational costs by leveraging intelligence, automation and human expertise that no other vendor can deliver regardless of where you are in the intent-based networking journey.

Catalyst 9200 Series switches provide security features that protect the integrity of the hardware as well as the software and all data that flows through the switch. It provides resiliency that keeps your business up and running seamlessly. Combine that with open APIs of Cisco IOS XE and programmability of the UADP ASIC technology, Catalyst 9200 Series switches give you what you need now with investment protection on future innovations.

With full PoE+ capability, power and fan redundancy, stacking bandwidth up to 160 Gbps, modular uplinks, Layer 3 feature support, and cold patching, Catalyst 9200 Series switches are the industry's unparalleled solution with differentiated resiliency and progressive architecture for cost-effective branch-office access.

Product overview

Product highlights

- Up to 48 ports of full **Power over Ethernet Plus** (PoE+) capability
- Resiliency with **Field-Replaceable Units** (FRU) and redundant power supply, fans, and modular uplinks
- Flexible downlink options with data, PoE+ or mGig
- Operational efficiency with optional **backplane stacking**, supporting stacking bandwidth up to 160 Gbps
- **UADP 2.0 Mini** with integrated CPU offers customers optimized scale with better cost structure
- Enhanced security with AES-128 **MACsec** encryption, **policy-based segmentation, and trustworthy systems**
- **Layer 3** capabilities, including OSPF, EIGRP, ISIS, RIP, and routed access
- Advanced network monitoring using **Full Flexible NetFlow**
- **Cisco Software-Defined Access** (SD-Access):
  - Simplified operations and deployment with policy-based automation from edge to cloud managed with **Cisco Identity Services Engine** (ISE)
  - Network assurance and improved resolution time through Cisco DNA Center
- **Plug and Play** (PnP) enabled: A simple, secure, unified, and integrated offering to ease new branch or campus device rollouts or updates to an existing network

- **Cisco IOS XE:** A Common Licensing based operating system for the enterprise Cisco Catalyst 9000 product family with support for model-driven programmability and streaming telemetry
- ASIC with programmable pipeline and micro-engine capabilities, along with template-based, configurable allocation of Layer 2 and Layer 3 forwarding, Access Control Lists (ACLs), and Quality of Service (QoS) entries

Features and benefits

Platform details

Switch models and configurations

Models	FRU Power Supply	FRU Fans	Modular Uplinks	Stacking Bandwidth Support	SD-Access Support [1]
Modular uplink models (C9200 Enhanced VN SKUs)	✓	✓	✓	160 Gbps	Yes (32 Virtual Networks)2
Modular uplink models (C9200 SKUs)	✓	✓	✓	160 Gbps	Yes (4 Virtual Networks)
Fixed uplink Models (C9200L SKUs)	✓	✗	✗	80 Gbps	Limited (1 Virtual Network)

[1] Catalyst 9200 standalone and stack can support 25 Access Tunnels (for fabric enabled APs). Note: Over the top fabric deployments eventually migrating to fabric wireless architecture should consider this limit during design/deployment

[2] Catalyst 9200-24PB-A, C9200-48PB-A PIDs supports 32 Virtual Networks. These skus cannot be stacked with C9200 SKUs with 4VNs

The Cisco Catalyst 9200 Series is made up of modular (C9200) and fixed (C9200L) switch models.

Figure 1.
Cisco Catalyst 9200 Series switches

Table 1. Cisco Catalyst 9200 Series Switch configurations

Switch model	Downlinks total 10/100/1000 or PoE+ copper ports	Uplink configuration	Default primary AC power supply	Fans
Modular uplink models				
C9200-24T	24 ports data	Modular uplink options	PWR-C6-125WAC	FRU redundant
C9200-24P	24 ports full PoE+	Modular uplink options	PWR-C6-600WAC	FRU redundant
C9200-24PB	24 ports full PoE+	Modular uplink options	PWR-C6-600WAC	FRU redundant
C9200-24PXG	24 ports full PoE+ (8 mGig ports up to 10G, 16 ports up to 1G)	Modular uplink options	PWR-C6-600WAC	FRU redundant
C9200-48T	48 ports data	Modular uplink options	PWR-C6-125WAC	FRU redundant
C9200-48P	48 ports full PoE+	Modular uplink options	PWR-C6-1KWAC	FRU redundant
C9200-48PL	48 Ports partial PoE+	Modular uplink options	PWR-C6-600WAC	FRU redundant
C9200-48PB	48 ports full PoE+	Modular uplink options	PWR-C6-1KWAC	FRU redundant
C9200-48PXG	48 ports full PoE+ (8 mGig ports up to 10G, 40 ports up to 1G)	Modular uplink options	PWR-C6-1KWAC	FRU redundant
Fixed uplink models				
C9200L-24T-4G	24 ports data	4x 1G fixed uplinks	PWR-C5-125WAC	Fixed redundant
C9200L-24P-4G	24 ports full PoE+	4x 1G fixed uplinks	PWR-C5-600WAC	Fixed redundant
C9200L-48T-4G	48 ports data	4x 1G fixed uplinks	PWR-C5-125WAC	Fixed redundant
C9200L-48P-4G	48 ports full POE+	4x 1G fixed uplinks	PWR-C5-1KWAC	Fixed redundant
C9200L-48PL-4G	48 Ports partial PoE+	4X 1G Fixed uplinks	PWR-C5-600WAC	Fixed redundant
C9200L-24T-4X	24 ports data	4x 1/10G fixed uplinks	PWR-C5-125WAC	Fixed redundant
C9200L-24P-4X	24 ports full PoE+	4x 1/10G fixed uplinks	PWR-C5-600WAC	Fixed redundant
C9200L-48T-4X	48 ports data	4x 1/10G fixed uplinks	PWR-C5-125WAC	Fixed redundant
C9200L-48P-4X	48 ports full PoE+	4x 1/10G fixed uplinks	PWR-C5-1KWAC	Fixed redundant
C9200L-48PL-4X	48 Port partial PoE+	4X 1/10G Fixed Uplinks	PWR-C5-600WAC	Fixed redundant
C9200L-24PXG-4X	24 ports full PoE+ (8 mGig ports up to 10G, 16 ports up to 1G)	4x 1/10G fixed uplinks	PWR-C5-600WAC	Fixed redundant
C9200L-48PXG-4X	48 ports full POE+ (12 mGig ports up to 10G, 36 ports up to 1G)	4x 1/10G fixed uplinks	PWR-C5-1KWAC	Fixed redundant
C9200L-24PXG-2Y	24 ports full PoE+ (8 mGig ports up to 10G, 16 ports up to 1G)	2x 1/10/25G fixed uplinks	PWR-C5-600WAC	Fixed redundant

Switch model	Downlinks total 10/100/1000 or PoE+ copper ports	Uplink configuration	Default primary AC power supply	Fans
C9200L-48PXG-2Y	48 ports full POE+ (8 mGig ports up to 10G, 40 ports up to 1G)	2x 1/10/25G fixed uplinks	PWR-C5-1KWAC	Fixed redundant

Network modules

Cisco Catalyst 9200 Series switches come with modular or fixed uplinks as indicated in Table 1. With modular SKUs, the field-replaceable network modules provide infrastructure investment protection by allowing a nondisruptive migration from 1G to 10G and beyond. When you purchase the switch, you can choose from the network modules described in Table 2.

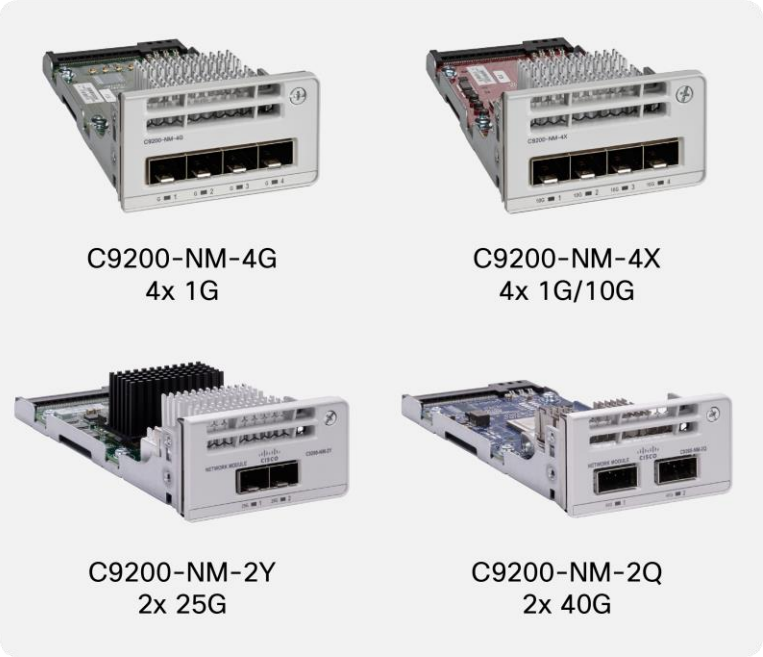

Figure 2.
Cisco Catalyst 9200 Series Switch network modules

Table 2. Network module part numbers and descriptions

Network module	Description
C9200-NM-2Y[1]	2 x 25G Network Module
C9200-NM-2Q[1]	2 x 40G Network Module
C9200-NM-4G[2]	4x 1G network module
C9200-NM-4X	4x 1G/10G network module
C9200-NM-BLANK	No network module

[1] Supported only on C9200-24PXG, C9200-48PXG

[2] Not supported on C9200-24PXG, C9200-48PXG

For additional details, please read our FAQ: https://www.cisco.com/c/dam/en/us/products/collateral/switches/catalyst-9000/nb-09-cat-9k-faq-cte-en.pdf.

Platform resiliency

Power supplies

Cisco Catalyst 9200 Series switches support dual field-replaceable power supplies (Figure 3). Each switch ships with one default power supply, and a second identical power supply can be purchased with the initial order or can be added at a later time. The second power supply can provide redundancy or additional power to PoE+ ports as needed.

Intelligent PoE+

- **IEEE 802.3at PoE+ (up to 30W per port)** is supported on Cisco Catalyst 9200 Series switches to lower the total cost of ownership for deployments that incorporate Cisco IP phones, Cisco Aironet® wireless access points, or other standards-compliant PoE+ end devices. PoE+ removes the need to supply wall power to PoE-enabled devices and eliminates the cost of adding electrical cabling and circuits that would otherwise be necessary in IP phone and WLAN deployments. With Cisco Catalyst 9200 Series switches, PoE+ power allocation is dynamic, and power mapping scales up to a maximum of 1440W of PoE+ power.
- **Perpetual PoE** is supported on Cisco Catalyst 9200 Series switches, and maintains the PoE+ power during a switch reload. This is important for critical endpoints such as medical devices and for Internet of Things (IoT) endpoints such as PoE-powered lights, so that there is no disruption during a switch reboot.
- **Fast PoE:** When power is restored to a switch, Fast PoE starts delivering power to endpoints without waiting for the operating system to fully load, thereby speeding up the time for the endpoint to start up.

Figure 3.
Cisco Catalyst 9200 Series Switch dual redundant power supplies

Table 3 lists the PoE+ power availability for each model.

Table 3. PoE+ Power with primary and secondary power supplies

Model	Default primary power supply	Available PoE power with single primary power supply only*	Optional secondary power supply	Available PoE power with additional secondary power supply*
C9200-24P	PWR-C6-600WAC	370W	PWR-C6-600WAC	740W
C9200-24PB	PWR-C6-600WAC	370W	PWR-C6-600WAC	740W
C9200-24PXG	PWR-C6-600WAC	370W	PWR-C6-600WAC	740W
C9200-48P	PWR-C6-1KWAC	740W	PWR-C6-1KWAC	1440W
C9200-48PL	PWR-C6-600WAC	370W	PWR-C6-600WAC	740W
C9200-48PB	PWR-C6-1KWAC	740W	PWR-C6-1KWAC	1440W
C9200-48PXG	PWR-C6-1KWAC	740W	PWR-C6-1KWAC	1440W
C9200L-24P-4G	PWR-C5-600WAC	370W	PWR-C5-600WAC	740W
C9200L-24P-4X	PWR-C5-600WAC	370W	PWR-C5-600WAC	740W
C9200L-48P-4G	PWR-C5-1KWAC	740W	PWR-C5-1KWAC	1440W
C9200L-48PL-4G	PWR-C5-600WAC	370W	PWR-C5-600WAC	740W
C9200L-48P-4X	PWR-C5-1KWAC	740W	PWR-C5-1KWAC	1440W
C9200L-48PL-4X	PWR-C5-600WAC	370W	PWR-C5-600WAC	740W
C9200L-24PXG-4X	PWR-C5-600WAC	370W	PWR-C5-600WAC	740W
C9200L-48PXG-4X	PWR-C5-1KWAC	740W	PWR-C5-1KWAC	1440W

Model	Default primary power supply	Available PoE power with single primary power supply only*	Optional secondary power supply	Available PoE power with additional secondary power supply*
C9200L-24PXG-2Y	PWR-C5-600WAC	370W	PWR-C5-600WAC	740W
C9200L-48PXG-2Y	PWR-C5-1KWAC	740W	PWR-C5-1KWAC	1440W

* Limited by port number and port rating (for example, 24 PoE+ 30W ports = 720W)

Stacking

Cisco Catalyst 9200 Series switch models are designed for stacking switches as a single virtual switch, enabling customers to have a single management plane and control plane for up to 384 access ports.

Table 4 lists the supported stacking options.

Table 4. Supported stacking options

Model	Stacking support	Stacking bandwidth support	Stacking hardware	Number of members	Supported stack members
Modular models (C9200 SKUs)	StackWise®-160	160 Gbps	C9200-STACK-KIT	8	Other C9200 models with same license level
Fixed models (C9200L SKUs)	StackWise-80	80 Gbps	C9200L-STACK-KIT	8	Other C9200L models with same license level

Mixed stacking is **not supported**. You cannot stack fixed (C9200L SKUs) with modular (C9200 SKUs) models, or other Catalyst switches, e.g. Cisco Catalyst 2960-X and 2960-XR Series.

The optional StackWise-160 and StackWise-80 kits consist of two adapters and a stacking cable. The default stacking cable is 0.5 m, but options of 1 m and 3 m are also available. Table 5 lists the stacking accessories.

Table 5. Stacking accessories

Model	Description
C9200-STACK-KIT	Stack kit for C9200 SKUs only: Two data stack adapters and one data stack cable
C9200L-STACK-KIT	Stack kit for C9200L SKUs only: Two data stack adapters and one data stack cable
STACK-T4-50CM	Data stack 50 cm cable (default cable with Stack Kit)
STACK-T4-1M	Data stack 1 m cable
STACK T4-3M	Data stack 3 m cable

Figure 4.
Cisco Catalyst 9200 Series Switch stacked units

Fan

Cisco Catalyst 9200 Series switches also come with dual fans and support redundancy. Cisco Catalyst 9200 Series switches support redundancy with dual fans. On the C9200 SKUs, the fan units are field-replaceable, whereas on the fixed C9200L SKUs, the fan units are fixed. Table 5 lists the fan module part number.

Table 6. Fan modules

Model	Description
C9200-FAN=	Fan module

Performance and scalability

Table 7 lists performance and scalability metrics for Cisco Catalyst 9200 Series switches. Table 8 lists the bandwidth specifications.

Table 7. Performance specifications

Description	C9200-24T, C9200-24P, C9200-48T, C9200-48P, C9200-24PB, C9200-48PB, C9200-24PXG,C9200-48PXG, C9200-48PL	C9200L-24T-4G, C9200L-24P-4G, C9200L-48T-4G, C9200L-48P-4G, C9200L-24T-4X, C9200L-24P-4X C9200L-48T-4X, C9200L-48P-4X, C9200L-24PXG-4X, C9200L-48PXG-4X, C9200L-24PXG-2Y, C9200L-24PXG-4X, C9200L-48PL-4X, C9200L-48PL-4G
Virtual Networks	4 for C9200-24T, C9200-24P, C9200-48T, C9200-48P, C9200-24PXG, C9200-48PXG, C9200-48PL 32 for C9200-24PB, C9200-48PB	1
Stacking bandwidth	160 Gbps	80 Gbps
Total number of MAC addresses	32,000	16,000
Total number of IPv4 routes (ARP plus learned routes)	14,000 (10,000 direct routes and 4,000 indirect routes)	11,000 (8,000 direct routes and 3,000 indirect routes)
IPv4 routing entries	4,000	3,000

Description	C9200-24T, C9200-24P, C9200-48T, C9200-48P, C9200-24PB, C9200-48PB, C9200-24PXG,C9200-48PXG, C9200-48PL	C9200L-24T-4G, C9200L-24P-4G, C9200L-48T-4G, C9200L-48P-4G, C9200L-24T-4X, C9200L-24P-4X C9200L-48T-4X, C9200L-48P-4X, C9200L-24PXG-4X, C9200L-48PXG-4X, C9200L-24PXG-2Y, C9200L-24PXG-4X, C9200L-48PL-4X, C9200L-48PL-4G
IPv6 routing entries	2,000	1,500
Multicast routing scale	1,000	1,000
QoS scale entries	1,000	1,000
ACL scale entries	1,600	1,500
Packet buffer per SKU	6 MB buffers for 24- or 48-port Gigabit Ethernet models , 12MB buffers for 24 or 48 port multigigabit models	6 MB buffers for 24- or 48-port Gigabit Ethernet models, 12 MB buffers for 24 or 48 port multigigabit models
Flexible NetFlow (FNF) entries	16,000 flows on 24- and 48-port Gigabit Ethernet models	16,000 flows on 24- and 48-port Gigabit Ethernet models, 32,000 flows on 24 or 48 port multigigabit models
DRAM	4 GB	2 GB
Flash	4 GB	4 GB
VLAN IDs	4096	4096
PVST Instances	128	128
STP Virtual Ports (Port * VLANs) for PVST	13,000	13,000
STP Virtual Ports (Port * VALNs) for MST	13,000	13,000
Total Switched Virtual Interfaces (SVIs)	1000	512
Jumbo frames	9198 bytes	9198 bytes
Wireless bandwidth per switch	Up to 48 Gbps on 24-port and 48-port Gigabit Ethernet model	N/A
IP SGT binding scale	8K	10K
Number of IPv4 bindings	8K	10K
Number of SGT/DGT policies	2K	2K
Number of SXP Sessions	200	200

Table 8. Bandwidth specifications

Description	Switching capacity	Switch capacity with Stacking	Forwarding rate	Forwarding rate with Stacking
C9200-24T	128 Gbps	288 Gbps	95.23 Mpps	214 Mpps
C9200-24P	128 Gbps	288 Gbps	95.23 Mpps	214 Mpps
C9200-24PB	128 Gbps	288 Gbps	95.23 Mpps	214 Mpps
C9200-24PXG	352 Gbps	532 Gbps	261.90 Mpps	395 Mpps
C9200-48T	176 Gbps	336 Gbps	130.95 Mpps	250 Mpps
C9200-48P	176 Gbps	336 Gbps	130.95 Mpps	250 Mpps
C9200-48PL	176 Gbps	336 Gbps	130.95 Mpps	250 Mpps
C9200-48PB	176 Gbps	336 Gbps	130.95 Mpps	250 Mpps
C9200-48PXG	400 Gbps	580 Gbps	297.61 Mpps	431 Mpps
C9200L-24T-4G	56 Gbps	136 Gbps	41.66 Mpps	101 Mpps
C9200L-24P-4G	56 Gbps	136 Gbps	41.66 Mpps	101 Mpps
C9200L-48T-4G	104 Gbps	184 Gbps	77.38 Mpps	137 Mpps
C9200L-48P-4G	104 Gbps	184 Gbps	77.38 Mpps	137 Mpps
C9200L-48PL-4G	104 Gbps	184 Gbps	77.38 Mpps	137 Mpps
C9200L-24T-4X	128 Gbps	208 Gbps	95.23 Mpps	155 Mpps
C9200L-24P-4X	128 Gbps	208 Gbps	95.23 Mpps	155 Mpps
C9200L-48T-4X	176 Gbps	256 Gbps	130.95 Mpps	190 Mpps
C9200L-48P-4X	176 Gbps	256 Gbps	130.95 Mpps	190 Mpps
C9200L-48PL-4X	176 Gbps	256 Gbps	130.95 Mpps	190 Mpps
C9200L-24PXG-4X	272 Gbps	352 Gbps	214.28 Mpps	262 Mpps
C9200L-24PXG-2Y	292 Gbps	372 Gbps	229.16 Mpps	277 Mpps
C9200L-48PXG-4X	392 Gbps	472 Gbps	291.66 Mpps	351 Mpps
C9200L-48PXG-2Y	340 Gbps	420 Gbps	252.97 Mpps	313 Mpps

* Measured with 64 byte packets

Software

Platform software benefits

Cisco IOS XE

Cisco IOS XE Software opens a completely new paradigm in network configuration, operation, and monitoring through network automation. Cisco's automation solution is open, standards-based, and extensible across the entire lifecycle of a network device. The various automation mechanisms are outlined below.

- **Automated device provisioning** is the ability to automate the process of upgrading software images and installing configuration files on Cisco Catalyst switches when they are being deployed in the network for the first time. Cisco provides turnkey solutions such as Plug and Play and Preboot Execution Environment (PXE) that enable an effortless and automated deployment.
- **API-driven configuration** is available with modern network switches such as Cisco Catalyst 9200 Series switches. It supports a wide range of automation features and provides robust open APIs over NETCONF and RESTCONF using YANG data models for external tools, both off the shelf and custom built, to automatically provision network resources.
- **Granular visibility** enables model-driven telemetry to stream data from a switch to a destination. The data to be streamed is identified through subscription to a data set in a YANG model. The subscribed data set is streamed to the destination at specified intervals. Additionally, Cisco IOS XE enables the push model. It provides near-real-time monitoring of the network, leading to quick detection and rectification of failures.
- **Seamless software upgrades and patching** supports OS resilience. On Cisco Catalyst 9200 Series switches Cisco IOS XE supports cold patching with reboot, which provides fixes for critical bugs and security vulnerabilities between regular maintenance releases. This support lets you add patches without having to wait for the next maintenance release. Cold patching requires the switch to be rebooted after patching to allow the changes to take effect.
- **Trustworthy solutions built with Cisco Trust Anchor Technologies** provide a highly secure foundation for Cisco products. With Cisco Catalyst 9200 Series switches, these technologies enable hardware and software authenticity assurance for supply chain trust and strong mitigation against man-in-the-middle attacks that compromise software and firmware. Trust Anchor capabilities include image signing, Secure Boot, and Cisco Trust Anchor module.
- **High availability:** Cisco Catalyst 9200 Series switches support high-availability features, including the following:
  - Cross-stack EtherChannel provides the ability to configure Cisco EtherChannel technology across different members of the stack for high resiliency.
  - IEEE 802.1s Multiple Spanning Tree Protocol (MSTP) provides rapid spanning tree convergence independent of spanning tree timers and also offers the benefit of Layer 2 load balancing and distributed processing.
  - Per-VLAN Rapid Spanning Tree (PVRST+) allows rapid spanning tree (IEEE 802.1w) reconvergence on a per-VLAN spanning tree basis, providing simpler configuration than MSTP. In both MSTP and PVRST+ modes, stacked units behave as a single spanning tree node.
  - Switch-port auto-recovery ("err-disable" recovery) automatically attempts to reactivate a link that is disabled because of a network error.

- The Catalyst 9200 Series platform delivers the best SSO resiliency architecture in a stackable solution with sub-50-ms failover.

The Foundation of Software-Defined Access

Secure Segmentation with SD-Access

The enterprise network lies at the heart of digital transformation. A network that is open, programmable, integrated, and secure maximizes business agility, allowing new business opportunities to be pursued and captured.

Cisco DNA with SD-Access is the network fabric that powers business. It is an open and extensible software-driven architecture that accelerates and simplifies your enterprise network operations. The programmable architecture frees your IT staff from time-consuming, repetitive network configuration tasks so they can focus instead on innovation that positively transforms your business. SD-Access enables policy-based automation from edge to cloud with foundational capabilities. These include:

- Simplified device deployment
- Unified management of wired and wireless networks
- Network virtualization and segmentation
- Group-based policies
- Context-based analytics
- **SD-Access:** Cisco Catalyst 9200 Series switches are the entry-level devices for SD-Access, Cisco's lead enterprise architecture, with policy-based automation from edge to cloud.
  - Simplified segmentation and micro-segmentation, with predictable performance and scalability
  - Automation through Cisco DNA Center
  - Policy handled through the Cisco Identity Services Engine (ISE)
  - Faster launch of new business services and significantly improved issue resolution time
- **Assurance**
  - Full network visibility and monitoring
  - End-to-end Quality of Experience (QoE)
  - Fast issue resolution and network remediation
- Plug and Play (PnP) enabled: A simple, secure, unified, and integrated offering to ease new branch or campus device rollouts or updates to an existing network

Cloud Security

- **Umbrella Integration:**

  Small to midsize networks reliant on managed service providers can now host Cisco Umbrella agent directly on their Catalyst 9200 series switches. This allows the business to easily customize their DNS filtering policies to prevent BYOD or IoT guest or corporate users from accessing malicious or inappropriate websites, without having to rely on the MSP to push the policies out. It also lets them optimize use of bandwidth by allowing direct cloud access for trusted apps. Requires DNA-Advantage License and Umbrella License per device.

Full Flexible NetFlow

- **Full Flexible NetFlow (FNF):** Cisco IOS FNF is the next generation in flow visibility technology. It enables optimization of the network infrastructure, reduces operation costs, and improves capacity planning and security incident detection with increased flexibility and scalability. Catalyst 9200 Series switches are capable of up to 16,000 flow entries on 48-port and 24 port models.

QoS

- **Superior QoS:** Cisco Catalyst 9200 Series switches offer Gigabit Ethernet speeds with intelligent services that keep traffic flowing smoothly, even at 10 times the normal network speed. Industry-leading mechanisms for cross-stack marking, classification, and scheduling deliver superior performance for data, voice, and video traffic at wire speed. Superior QoS includes granular wireless bandwidth management and fair sharing, 802.1p Class of Service (CoS) and Differentiated Services Code Point (DSCP) field classification, Shaped Round Robin (SRR) scheduling, Committed Information Rate (CIR), and eight egress queues per port.

Smart operation

- **WebUI:**

  WebUI is an embedded GUI-based device-management tool that provides the ability to provision the device, to simplify device deployment and manageability, and to enhance the user experience. It comes with the default image, so there is no need to enable anything or install any license on the device. You can use WebUI to build configurations, and to monitor and troubleshoot the device without having CLI expertise.

- **RFID tags:**

  Cisco Catalyst 9200 Series switches have an embedded RFID tag that facilitates easy asset and inventory management using commercial RFID readers.

- **Blue beacon:**

  Cisco Catalyst 9200 Series switches support both front and back blue beacon LEDs for easy identification of the switch being accessed.

- **Efficient switch operation*:**

  Cisco Catalyst 9200 Series switches provide optimum power saving with Energy Efficient Ethernet (EEE) on the RJ-45 ports and low-power operations for industry best-in-class power management and power consumption capabilities. The ports support reduced power modes so that ports not in use can move into a lower power utilization state. Other efficient switch operation features are as follows:

  - Per-port power consumption command allows customers to specify a maximum power setting on an individual port.
  - Per-port PoE power sensing measures actual power being drawn, enabling more intelligent control of powered devices. The PoE MIB provides proactive visibility into power usage and allows you to set different power-level thresholds.

- **Bluetooth ready:**

  Cisco Catalyst 9200 Series switches have hardware support to connect a Bluetooth dongle to your switch, enabling you to use this wireless interface as an IP management port interface. The port can be used for configuration and troubleshooting using WebUI or the Command-Line Interface (CLI), and to transfer images and configurations.

High-performance ip routing

The Cisco Express Forwarding hardware routing architecture delivers extremely high-performance IP routing in Cisco Catalyst 9200 Series switches, based on:

- IP unicast routing protocols (including static, Routing Information Protocol Version 1 [RIPv1], RIPv2, RIPng, and Open Shortest Path First [OSPF], Routed Access) are supported for small network routing applications with the Network Essentials stack. Equal-cost routing facilitates Layer 3 load balancing and redundancy across the stack.
- Advanced IP unicast routing protocols (including Full [OSPF], Enhanced Interior Gateway Routing Protocol [EIGRP], and Intermediate System-to-Intermediate System Version 4 [IS-ISv4]) are supported for load balancing and for constructing scalable LANs. Ipv6 routing (using OSPFv3 and EIGRPv6) is supported in hardware for maximum performance.
- Protocol-Independent Multicast (PIM) for IP multicast routing is supported, including PIM sparse mode (PIM SM), and Source-Specific Multicast (SSM).
- Ipv6 addressing is supported on interfaces with appropriate show commands for monitoring and troubleshooting.

Licensing

Packaging: Network and Cisco DNA licensing

The Cisco Catalyst 9000 family of switches introduces a new and simplified licensing package in the form of base and add-on licenses.

- **The perpetual licensing** package includes the Network Essentials and Network Advantage licensing options that are tied to the hardware. Between them, the base licensing packages cover switching fundamentals, management automation, troubleshooting, and advanced switching features. These Network licenses are perpetual.
- **The subscription licensing** package includes the Cisco DNA Essentials and Cisco DNA Advantage options. In addition to on-box capabilities, the features available with this package provide Cisco innovations on the switch, as well as on Cisco DNA Center. The Cisco DNA subscription licenses are mandatory at the time of configuration. With Cisco DNA software licenses, customers receive embedded SWSS – which covers 24x7x365 Cisco Technical Assistance Center (TAC) support, software release updates, advanced support analytics, and designated service management. This is valid only for the Cisco DNA software subscription stacks (Cisco DNA Essentials, Advantage, and Premier).

Note: For full hardware support, including the perpetual network stack customers will require Smart Net Total Care for 24x7x365 Cisco Technical Assistance Center (TAC) support, proactive security and product alerts, and product lifecycle management. An additional option for hardware support is Solution Support for your multivendor Cisco solution environment

License consumption is easily determined by the package itself. While perpetual licenses are always permanent and without an expiration date, subscription licenses have to be purchased for a 3-, 5-, or 7-year term (and hence are also known as term-based licenses). Table 12 shows the combinations of perpetual and subscription licenses that must be purchased.

Supported licensing combinations

Table 9. Licensing combinations

	Cisco DNA Premier	Cisco DNA Advantage	Cisco DNA Essentials
Network Essentials	No	No	Yes
Network Advantage	Yes	Yes	No*

* At the time of license renewal, the Cisco DNA Essentials license can be purchased to be used with Network Advantage.

Cisco DNA Premier subscription

Cisco DNA Premier subscriptions offer a flexible way to buy software for the access, WAN, and data center domains. At each stage in the product lifecycle, Cisco DNA Premier subscriptions help make buying, managing, and upgrading your network and infrastructure software easier. Cisco DNA Premier subscriptions provide:

- Flexible licensing models to smoothly distribute customers' software spending over time
- Investment protection for software purchases through software services-enabled license portability
- Lower cost of entry with the new Cisco DNA Premier Subscription for Switching model

For ordering information for Cisco DNA Premier Software for Cisco Catalyst 9200 Series switches, go to: https://www.cisco.com/c/en/us/products/collateral/software/one-subscription-switching/nb-06-dna-sw-sub-access-sw-ctp-en.html.

Cisco Catalyst 9200 Series switches run on Cisco IOS XE Release 16.9.2 or later. This software release includes all the features listed earlier in the Platform Software Benefits section.

Managing licenses with Smart Accounts: Creating Smart Accounts by using the Cisco Smart Software Manager (Cisco SSM) enables you to order devices and licensing packages and also manage your software licenses from a centralized website. You can set up Cisco SSM to receive daily email alerts and to be notified of expiring add-on licenses that you want to renew.

You must order an add-on license in order to purchase a switch. When the license term expires, you can either renew the add-on license to continue using it or deactivate the add-on license and then reload the switch to continue operating with the base license capabilities.

Both the base and add-on licenses are also available for a 90-day evaluation period. An evaluation license is activated temporarily, without purchase. An expired evaluation license cannot be reactivated after reload.

Note: It is not required to deploy Cisco DNA Center, just to use one of the above packages.

Tables 10 shows the features included in the Network Essentials and Advantage packages.

Table 11 shows the features included in the Cisco DNA Essentials and Advantage packages.

Network licensing

Table 10. Network essentials and advantage package features

Features on Cisco Catalyst uplink switches	Network Essentials	Network Advantage
Switch fundamentals Layer 2, Routed Access (RIP, EIGRP Stub, OSPF -- 1000 routes), PBR, PIM Stub Multicast (1000 routes), PVLAN, VRRP, PBR, CDP, QoS, FHS, 802.1X, MACsec-128, CoPP, SXP, IP SLA Responder,SSO	✓	✓
Advanced switch capabilities and scale EIGRP, HSRP, IS-IS, BSR, MSDP, IP SLA, OSPF	✗	✓
Network segmentation VRF, VXLAN, LISP, SGT	✗	✓

Features on Cisco Catalyst uplink switches	Network Essentials	Network Advantage
Automation NETCONF, RESTCONF, YANG, PnP Agent, PnP	✓	✓
Telemetry and visibility Model-driven telemetry, sampled NetFlow, SPAN, RSPAN	✓	✓
Security MACsec-128	✓	✓

Cisco DNA licensing

Table 11. Cisco DNA Essentials, Advantage, and Premier Package Features

Features	Cisco DNA Essentials	Cisco DNA Advantage	Cisco DNA Premier
Switch features			
Advanced telemetry and visibility Full Flexible NetFlow, EEM	✓	✓	✓
Optimized telemetry and visibility AVC (NBAR2)	✗	✓	✓
Cisco DNA Center features			
Day-0 network bring-up automation Cisco Network Plug-and-Play application, network settings, device credentials, LAN automation, host onboarding	✓	✓	✓
Element management Discovery, inventory, topology, software image, licensing, and configuration management	✓	✓	✓
Element management Patch management	✗	✓	✓
Basic Assurance Health dashboards – Network, Client, Application; switch and wired client health monitoring	✓	✓	✓
SD-Access Policy-based automation and assurance for wired and wireless	✗	✓	✓
Network assurance and analytics Global insights, trends, compliance, custom reports; switch 360, wired client 360; fabric and non-fabric insights; app health, app 360, app performance (loss, latency, jitter)	✗	✓	✓
Other Software included (can be purchased separately)			
ISE Base	✗	✗	✓
ISE Plus	✗	✗	✓

Features	Cisco DNA Essentials	Cisco DNA Advantage	Cisco DNA Premier
StealthWatch	✗	✗	✓

Product sustainability

Refer to the CSR/Social Responsibility section for more information on Cisco's environmental sustainability policies and initiatives.

Sustainability Topic		Reference
General	Information on product-material-content laws and regulations	Materials
	Information on electronic waste laws and regulations, including our products, batteries and packaging	WEEE Compliance
	Sustainability Inquiries	Contact: csr_inquiries@cisco.com
	Safety and compliance	Table 17. Safety and compliance information
	Information on product takeback and resuse program	Cisco Takeback and Reuse Program
Power	IEEE 802.3at PoE+	Intelligent PoE+ Section
	PoE+ power availability	Table 3. PoE+ Power with Primary and secondary power supplies
	Fan	Fan Section
	Power connectors	Table 13. Connectors
	Power supply specifications	Table 15. Power supply specifications
	Power consumption (ATIS)	Table 16. Power consumption of Standalone Catalyst 9200 Series switches
Material	Product packaging weight and materials	Contact: environment@cisco.com
	Chassis Dimension, weight, MTBF	Table 12. Model Dimensions, Weight, and Mean time between failure metrics
	Elimination of wet paint on plastic bezel	2019 Cisco Corporate Social Responsibility Report, Pg. 19 Stepping up our work on circularity

Specifications

Dimensions, Eight, Acoustic, Mean time between failures

Table 12 shows the dimensions, weights, acoustic, and mean time between failures of all models of Cisco Catalyst 9200 Series switches.

Table 12. Model Dimensions, Weight, and Mean time between failures metrics

Platform Physical Specifications				
	Chassis Dimensions		Chassis + FEP + Fan Dimensions (HxWxD)	
Model	Inches	Centimeters	Inches	Centimeters
C9200-24T	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-24P	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-24PB	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-24PXG	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-48T	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-48P	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-48PL	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-48PB	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200-48PXG	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200L-24T-4G	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-24P-4G	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-48T-4G	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-48P-4G	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-48PL-4G	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-24T-4X	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-24P-4X	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-48T-4X	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-48P-4X	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-48PL-4X	1.73 x 17.5 x 11.3	4.4 x 44.5 x 28.8	1.73 x 17.5 x 12.9	4.4 x 44.5 x 32.9
C9200L-24PXG-4X	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1

Platform Physical Specifications				
	Chassis Dimensions		Chassis + FEP + Fan Dimensions (HxWxD)	
Model	Inches	Centimeters	Inches	Centimeters
C9200L-24PXG-2Y	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200L-48PXG-4X	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1
C9200L-48PXG-2Y	1.73 x 17.5 x 13.8	4.4 x 44.5 x 35.0	1.73 x 17.5 x 15.4	4.4 x 44.5 x 39.1

Model	Pounds	Kilograms
C9200-24T	11.02	5.0
C9200-24P	12.12	5.5
C9200-24PB	12.12	5.0
C9200-24PXG	11.33	5.1
C9200-48T	11.02	5.0
C9200-48P	12.12	5.5
C9200-48PL	12.12	5.5
C9200-48PB	12.12	5.5
C9200-48PXG	11.98	5.45
C9200L-24T-4G	9.59	4.35
C9200L-24P-4G	10.38	4.71
C9200L-48T-4G	9.97	4.53
C9200L-48P-4G	10.58	4.80
C9200L-48PL-4G	10.58	4.80
C9200L-24T-4X	9.59	4.35
C9200L-24P-4X	10.38	4.71
C9200L-48T-4X	9.97	4.53
C9200L-48P-4X	10.58	4.80
C9200L-48PL-4X	10.58	4.80
C9200L-24PXG-4X	12	5.44

Model	Pounds	Kilograms
C9200L-24PXG-2Y	12	5.44
C9200L-48PXG-4X	12.6	5.71
C9200L-48PXG-2Y	12.6	5.71

Mean time between failures (hours)	
C9200-24T	587,800
C9200-24P	422,310
C9200-24PB	434,220
C9200-24PXG	353,960
C9200-48T	571,440
C9200-48P	375,570
C9200-48PL	375,570
C9200-48PB	384,980
C9200-48PXG	320,440
C9200L-24T-4G	531,030
C9200L-24P-4G	392,210
C9200L-48T-4G	508,700
C9200L-48P-4G	347,760
C9200L-48PL-4G	347,760
C9200L-24T-4X	525,990
C9200L-24P-4X	390,310
C9200L-48T-4X	503,400
C9200L-48P-4X	346,270
C9200L-48PL-4X	346,270
C9200L-24PXG-4X	379,410
C9200L-24PXG-2Y	374,730
C9200L-48PXG-4X	337,360

Mean time between failures (hours)	
C9200L-48PXG-2Y	337,260
PWR-C5-125WAC	3,332,120
PWR-C5-600WAC	1,600,060
PWR-C5-1KWAC	1,600,060
PWR-C6-125WAC	3,332,120
PWR-C6-600WAC	1,600,060
PWR-C6-1KWAC	1,600,060

Environmental ranges	
Acoustic noise Measured per ISO 7779 and declared per ISO 9296 Bystander positions operating to an ambient temperature of 25° C	With AC power supply (with 24 PoE+ ports loaded): • LpA: 42dB typical, 45 dB max • LwA: 5.3B typical, 5.6B max Typical: Noise emission for a typical configuration Maximum: Statistical maximum to account for variation in production

Connectors

Table 13 shows the supported connectors for Cisco Catalyst 9200 Series switches.

Table 13. Connectors

Connectors and cabling	• 1000BASE-T ports: RJ-45 connectors, 4-pair Cat 5E UTP cabling • 1000BASE-T SFP-based ports: RJ-45 connectors, 4-pair Cat 5E UTP cabling • 100BASE-FX, 1000BASE-SX, -LX/LH, -ZX, -BX10, dense wavelength-division multiplexing (DWDM) and Coarse Wavelength-Division Multiplexing (CWDM) SFP transceivers: LC fiber connectors (single-mode or multimode fiber) • 10GBASE-SR, LR, LRM (only C9200), ER, ZR, DWDM SFP+ transceivers: LC fiber connectors (single-mode or multimode fiber) • SFP+ connector • Cisco StackWise-160/80 stacking ports: copper-based Cisco StackWise cabling • Ethernet management port: RJ-45 connectors, 4-pair Cat 5 UTP cabling • Management console port: RJ-45-to-DB9 cable for PC connections, USB-C adaptor, USB adaptor
Power connectors	• Internal power supply connector: The internal power supply is an auto-ranging unit. It supports input voltages between 100 and 240 VAC. Use the supplied AC power cord to connect the AC power connector to an AC power outlet.

For the latest Cisco transceiver module compatibility information, refer to https://www.cisco.com/c/en/us/td/docs/interfaces_modules/transceiver_modules/compatibility/matrix/TMG_CM_Tool_User_Manual.html.

Management and standards support

Table 14 shows management and standards support for Cisco Catalyst 9200 Series switches.

Table 14. Management and standards support*

Description	Specification	
Management	BRIDGE-MIB	CISCO-NHRP-EXT-MIB
	CISCO-BRIDGE-EXT-MIB	CISCO-NTP-MIB
	CISCO-BULK-FILE-MIB	CISCO-PAGP-MIB
	CISCO-CABLE-DIAG-MIB	CISCO-PORT-SECURITY-MIB
	CISCO-CALLHOME-MIB	CISCO-PORT-STORM-CONTROL-MIB
	CISCO-CEF-MIB	CISCO-POWER-ETHERNET-EXT-MIB
	CISCO-CIRCUIT-INTERFACE-MIB	CISCO-PRIVATE-VLAN-MIB
	CISCO-CONFIG-COPY-MIB	CISCO-PROCESS-MIB
	CISCO-CONFIG-MAN-MIB	CISCO-PRODUCTS-MIB
	CISCO-DEVICE-LOCATION-MIB	CISCO-RF-MIB
	CISCO-DHCP-SNOOPING-MIB	CISCO-RTP-METRICS-MIB
	CISCO-EIGRP-MIB	CISCO-RTTMON-ICMP-MIB
	CISCO-EMBEDDED-EVENT-MGR-MIB	CISCO-STACKWISE-MIB
	CISCO-ENTITY-FRU-CONTROL-MIB	CISCO-STP-EXTENSIONS-MIB
	CISCO-ENTITY-SENSOR-MIB	CISCO-SYSLOG-MIB
	CISCO-ENTITY-VENDORTYPE-OID-MIB	CISCO-TCP-MIB
	CISCO-ERR-DISABLE-MIB	CISCO-UDLDP-MIB
	CISCO-FLASH-MIB	CISCO-VLAN-IFTABLE-RELATIONSHIP-MIB
	CISCO-FLOW-MONITOR-MIB	ENTITY-MIB
	CISCO-FTP-CLIENT-MIB	HC-ALARM-MIB
	CISCO-HSRP-EXT-MIB	HC-RMON-MIB
	CISCO-HSRP-MIB	IEEE8023-LAG-MIB
	CISCO-IETF-BFD-MIB	IF-MIB
	CISCO-IETF-PPVPN-MPLS-VPN-MIB	IP-FORWARD-MIB
	CISCO-IETF-PW-MPLS-MIB	IP-MIB
	CISCO-IF-EXTENSION-MIB	LLDP-EXT-MED-MIB
	CISCO-IGMP-FILTER-MIB	LLDP-MIB
	CISCO-IMAGE-LICENSE-MGMT-MIB	MAU-MIB
	CISCO-IMAGE-MIB	MPLS-L3VPN-STD-MIB
	CISCO-IP-CBR-METRICS-MIB	MPLS-LSR-STD-MIB
	CISCO-IP-STAT-MIB	MPLS-VPN-MIB
	CISCO-IP-TAP-MIB	OLD-CISCO-CHASSIS-MIB
	CISCO-IP-URPF-MIB	OLD-CISCO-CPU-MIB
	CISCO-IPSEC-FLOW-MONITOR-MIB	

Description	Specification	
	CISCO-IPSEC-MIB CISCO-IPSEC-PROVISIONING-MIB CISCO-IPSLA-AUTOMEASURE-MIB CISCO-IPSLA-ECHO-MIB CISCO-IPSLA-JITTER-MIB CISCO-L2-CONTROL-MIB CISCO-L2L3-INTERFACE-CONFIG-MIB CISCO-LAG-MIB CISCO-LICENSE-MGMT-MIB CISCO-LOCAL-AUTH-USER-MIB CISCO-MAC-NOTIFICATION-MIB CISCO-MDI-METRICS-MIB CISCO-MEDIA-METRICS-MIB CISCO-MEMORY-POOL-MIB CISCO-MPLS-LSR-EXT-STD-MIB CISCO-NBAR-PROTOCOL-DISCOVERY-MIB	OLD-CISCO-INTERFACES-MIB OLD-CISCO-IP-MIB OLD-CISCO-MEMORY-MIB OLD-CISCO-SYS-MIB OLD-CISCO-TCP-MIB OLD-CISCO-TS-MIB POWER-ETHERNET-MIB RFC1213-MIB RMON-MIB RMON2-MIB SMON-MIB SNMPv2-MIB SONET-MIB TCP-MIB UDP-MIB
Standards	EEE 802.1s IEEE 802.1w IEEE 802.1x IEEE 802.1x-Rev IEEE 802.3ad IEEE 802.3af IEEE 802.3at IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports IEEE 802.1D Spanning Tree Protocol IEEE 802.1p CoS prioritization IEEE 802.1Q VLAN IEEE 802.3 10BASE-T specification IEEE 802.3u 100BASE-TX specification IEEE 802.3ab 1000BASE-T specification IEEE 802.3z 1000BASE-X specification IEEE 802.1AE - 128-bit AES MACsec inter network device encryption with MACsec Key Agreement (MKA) IEEE 802.3bz (for mGig PKG SKU's only) IEEE 802.3an (10GBase-T) (for mGig PKG SKU's only)	RMON I and II standards SNMPv1, v2c, and v3

Power supply specifications

Table 15 lists the power specifications for Cisco Catalyst 9200 Series switches based on the kind of power supply used.

Table 15. Power supply specifications

Description	Specification					
	PWR-C5-125WAC	PWR-C6-125WAC	PWR-C5-600WAC	PWR-C6-600WAC	PWR-C5-1KWAC	PWR-C6-1KWAC
Power supply rated maximum	125W	125W	600W	600W	1000W	1000W
Total output BTU (note: 1000 BTU/hr = 293W)	426.5 BTU/hr, 125W	426.5 BTU/hr, 125W	2047.3 BTU/hr, 600W	2047.3 BTU/hr, 600W	3412 BTU/hr, 1000W	3412 BTU/hr, 1000W
Input-voltage range and frequency	100 to 240 VAC, 50 to 60 Hz	100 to 240 VAC, 50 to 60 Hz	100 to 240 VAC, 50 to 60 Hz	100 to 240 VAC, 50 to 60 Hz	100 to 240 VAC, 50 to 60 Hz	100 to 240 VAC, 50 to 60 Hz
Input current	1.6-0.7A	1.6-0.7A	7-2.8A	7-2.8A	12-6A	12-6A
Output ratings	12V at 10.5A	12V at 10.5A	54V at 11.1A	54V at 11.1A	54V at 16.5A	54V at 16.5A
Output holdup time	20 ms minimum at 100 VAC	20 ms minimum at 100 VAC	20 ms minimum at 100 VAC	20 ms minimum at 100 VAC	20 ms minimum at 100 VAC	20 ms minimum at 100 VAC
Power-supply input receptacles	IEC 320-C14 (IEC60320-C14)	IEC 320-C14 (IEC60320-C14)	IEC 320-C16 (IEC60320-C16)	IEC 320-C16 (IEC60320-C16)	IEC 320-C16 (IEC60320-C16)	IEC 320-C16 (IEC60320-C16)
Power cord rating	10A	10A	15A	15A	15A	15A
Physical specifications	(H x W x D): 1.58” x 4.0” x 7.6” Weight: 1.5 lb (0.68 kg)	(H x W x D): 1.58” x 4.0” x 7.6” Weight: 1.5 lb (0.68 kg)	(H x W x D): 1.58” x 4.0” x 7.6” Weight: 1.7 lb (0.77 kg)	(H x W x D): 1.58” x 4.0” x 7.6” Weight: 1.7 lb (0.77 kg)	(H x W x D): 1.58” x 4.0” x 7.6” Weight: 2 lb (0.9 kg)	(H x W x D): 1.58” x 4.0” x 7.6” Weight: 2 lb (0.9 kg)
Supported Product Family	C9200, C9200L	C9200	C9200, C9200L	C9200	C9200, C9200L	C9200

Description	Specification
Operating temperature	Normal operating temperature* and altitudes: • -5° C to +45° C, up to 5000 feet (1500m) • -5° C to +40° C, up to 10,000 feet (3000m) * Minimum ambient temperature for cold start is 32° F (0° C) Short-term* exceptional conditions: • -5° C to +50° C, up to 5000 feet (1500m) • -5° C to +45° C, up to 10,000 feet (3000m) • -5° C to +45° C, at sea level with single fan failure * Not more than following in one-year period: 96 consecutive hours, or 360 hours total, or 15 occurrences
Storage temperature	-40° to 158° F (-40° to 70° C)
Relative humidity operating and nonoperating noncondensing	5% to 90% noncondensing
Altitude	10,000 ft. (3000 meters), up to 45° C
EMI and EMC compliance	FCC Part 15 (CFR 47) Class A ICES-003 Class A EN 55032 Class A CISPR 32 Class A AS/NZS 3548 Class A BSMI Class A VCCI Class A CISPR 35 EN 55024, EN300 386*, EN 61000-3-2, EN 61000-3-3 EN 61000-6-1
Safety compliance	UL 60950-1, CAN/CSA-C22.2 No. 60950-1, EN 60950-1, IEC 60950-1, CCC, CE Marking
LED indicators	“AC OK”: Input power to the power supply is OK “PS OK”: Output power from the power supply is OK

* Use shielded cables for locations other than telecom centers

Power consumption of Standalone 9200 Series switches

Table 16 shows the power consumption of standalone Cisco Catalyst 9200 Series switches based on Alliance for Telecommunications Industry Solutions (ATIS) testing using Internet Mix (IMIX) distribution stream traffic, with input voltage of 115VAC at 60 Hz and no PoE loading. The values given are the maximum possible power consumption numbers under the respective test scenarios.

Table 16. Power consumption of Standalone Catalyst 9200 Series switches

				Measured P(W)														
				Half port traffic					Full port traffic					Weighted average Pw	No link	PoE test (no traffic)			
SKU	FEP	Uplink	Input	0.01% / EEE	10%	30%	50%	100%	0.01% / EEE	10%	30%	50%	100%			25%	50%	90%	100%
C9200-24T	125W (C5/C6)	C9200-NM-4X1G	115VAC	33.09	36.08	36.15	36.20	36.34	35.51	41.78	41.89	42.00	42.27	41.20	30.65				
			230VAC	33.15	35.95	36.00	36.06	36.19	35.36	41.50	41.62	41.74	42.01	40.94	30.53				
C9200-24T	125W	C9200-NM–4X10G	115VAC	33.62	36.99	37.29	37.58	38.26	35.41	42.00	42.55	43.11	44.49	41.588	32.20				
			230VAC	33.70	36.85	37.13	37.41	38.10	35.40	41.75	42.30	42.85	44.22	41.364	31.90				
C9200-24P	600W (C5/C6)	C9200-NM-4X1G	115VAC	43.57	47.37	47.42	47.47	47.68	46.82	53.79	53.91	54.02	54.30	53.14	40.75	150.71	251.67	416.85	457.98
			230VAC	43.38	46.92	46.95	47.03	47.18	46.35	53.23	53.34	53.45	53.76	52.59	40.43	148.14	247.03	406.62	446.27
C9200-24P	600W (C5/C6)	C9200-NM-4X10G	115VAC	44.62	48.49	48.79	49.11	49.88	47.02	54.18	54.77	55.34	56.77	53.72	42.55	144.60	245.42	410.22	451.45
			230VAC	44.32	48.06	48.37	48.66	49.40	46.41	53.38	53.99	54.51	55.96	52.94	42.26	142.29	241.14	400.76	440.37
C9200-24PXG	600W (C6)	C9200-NM-4X10G	115VAC	84.30	90.90	91.00	92.30	94.20	95.00	110.60	111.60	112.60	115.20	109.5	72.8	296.8	506.3	858.3	941.5
			230VAC	84.10	90.50	91.10	91.60	92.90	94.30	108.80	109.90	111.00	113.60	107.83	72.24	287.8	492.4	826.7	909.1
C9200-24PXG	600W (C6)	C9200-NM-2X25G	115VAC	83.41	87.59	88.56	89.19	90.85	93.96	101.38	103.32	104.89	107.22	101.22	72.52	187.94	290.47	452.61	494.88
			230VAC	81.90	86.97	87.68	88.38	90.03	92.21	99.79	101.14	102.45	105.65	99.62	71.74	185.45	283.86	441.83	480.86
C9200-24PXG	600W (C6)	C9200-NM-2X40G	115VAC	82.34	86.78	87.91	88.90	91.64	92.97	100.93	103.00	104.89	108.81	100.92	71.72	188.86	289.2	448.52	496.28
			230VAC	80.05	84.53	85.64	86.69	89.29	90.26	99.20	101.41	103.56	108.70	99.26	71.72	185.29	282.86	441.33	480.95

				Measured P(W)															
				Half port traffic					Full port traffic					Weighted average Pw	No link	PoE test (no traffic)			
C9200-48T	125W (C5/C6)	C9200-NM-4X1G	115VAC	36.57	45.09	45.45	45.63	45.70	36.98	53.95	55.36	53.91	55.87	52.445	36.98				
			230VAC	36.99	45.58	45.65	45.71	45.86	36.48	54.51	54.64	54.7	55.04	52.76	36.48				
C9200-48T	125W (C5/C6)	C9200-NM-4X10G	115VAC	38.84	47.07	48.67	48.71	50.41	39.20	56.33	58.36	58.75	61.80	55.164	38.38				
			230VAC	39.1	47.11	47.91	48.37	49.65	39.46	56.32	57.25	58.19	60.72	55.074	38.67				
C9200-48P	1000W (C5/C6)	C9200-NM-4X1G	115VAC	56.07	60.25	60.31	60.36	60.55	56.45	69.33	69.46	69.56	69.87	68.10	50.42	262.61	467.50	812.39	899.99
			230VAC	55.66	59.98	60.05	60.05	60.27	56.09	69.07	69.20	69.30	69.58	67.83	50.04	258.08	457.61	785.35	867.75
C9200-48P	1000W (C5/C6)	C9200-NM-4X10G	115VAC	54.27	61.71	62.20	62.68	63.88	56.114	70.93	70.95	71.92	74.39	69.79	52.26	262.38	467.41	812.23	899.40
			230VAC	53.89	61.09	61.60	62.07	63.24	55.79	69.52	70.47	71.43	73.89	68.58	51.34	257.97	457.30	785.03	867.35
C9200-48PL	600W (C6)	C9200-NM-4X1G	115VAC	43.57	47.37	47.42	47.47	47.68	46.82	53.79	53.91	54.02	54.30	53.14	40.75	150.71	251.67	416.85	457.98
			230VAC	43.38	46.92	46.95	47.03	47.18	46.35	53.23	53.34	53.45	53.76	52.59	40.43	148.14	247.03	406.62	446.27
C9200-48PL	600W (C6)	C9200-NM-4X10G	115VAC	44.62	48.49	48.79	49.11	49.88	47.02	54.18	54.77	55.34	56.77	53.72	42.55	144.60	245.42	410.22	451.45
			230VAC	44.32	48.06	48.37	48.66	49.40	46.41	53.38	53.99	54.51	55.96	52.94	42.26	142.29	241.14	400.76	440.37
C9200-48PXG	1000W (C6)	C9200-NM-4X10G	115VAC	84.26	90.86	91.02	92.26	94.18	95.01	110.55	111.62	112.62	115.2	109.46	72.3	296.81	506.33	858.27	941.49
			230VAC	84.14	90.52	91.05	91.57	92.85	94.25	108.84	109.94	111	113.6	107.86	73.2	287.79	492.42	826.74	909.07
C9200-48PXG	1000W (C6)	C9200-NM-2X25G	115VAC	87.84	95.23	95.98	96.69	98.34	99.25	113.66	115.37	116.7	120.91	112.94	77.57	300.71	513.82	872.63	957.36
			230VAC	87.12	94.14	94.79	95.42	96.99	97.59	111.99	113.52	114.86	117.82	111.13	76.53	290.61	492.91	826.5	910.08
C9200-48PXG	1000W (C6)	C9200-NM-2X40G	115VAC	88.01	94.35	95.5	96.48	99.36	98.72	113.2	115.13	117.08	121.84	112.61	76.84	296.86	503.87	861.87	957.4
			230VAC	87.02	93.09	94.15	95.16	97.79	97.28	111.43	113.57	115.66	120.67	110.94	75.84	291.54	491.67	824.85	909.78

				Measured P(W)															
				Half port traffic					Full port traffic					Weighted average Pw	No link	PoE test (no traffic)			
C9200L-24T-4G	125W (C5)	Fixed	115VAC	30.03	32.15	32.17	32.2	32.33	32.03	35.90	35.98	36.06	36.23	35.546	27.39				
			230VAC	29.81	32.26	32.23	32.22	32.35	31.86	35.86	35.94	36.03	36.28	35.502	27.50				
C9200L-24P-4G	600W (C5)	Fixed	115VAC	39.28	43.98	44.04	44.08	44.22	38.95	48.47	48.6	48.74	49.00	47.571	39.59	153.06	256.56	423.44	466.34
			230VAC	38.88	43.6	43.66	43.69	43.83	38.57	48.09	48.22	48.35	48.62	47.191	39.20	150.51	252.10	413.89	455.15
C9200L-24T-4X	125W (C5)	Fixed	115VAC	30.99	31.98	32.21	32.43	33.04	33.29	36.62	37.02	37.47	38.6	36.485	27.82				
			230VAC	30.98	32.02	32.24	32.46	33.02	33.24	36.59	36.96	37.41	38.52	36.448	27.90				
C9200L-24P-4X	600W (C5)	Fixed	115VAC	42.83	44.15	44.62	44.72	45.39	45.45	51.08	51.52	52.2	53.49	50.758	40.17	144.82	241.99	401.32	445.35
			230VAC	42.36	44.19	44.47	44.61	45.28	44.6	49.33	49.91	50.36	51.51	49.075	39.48	142.32	237.52	392.77	434.06
C9200L-48T-4G	125W (C5)	Fixed	115VAC	33.85	40.11	40.20	40.24	40.34	32.74	46.65	46.88	46.96	47.33	45.327	33.85				
			230VAC	33.62	40.5	40.57	40.63	40.74	33.06	46.8	46.91	47.05	47.49	45.495	34.16				
C9200L-48P-4G	1000W (C5)	Fixed	115VAC	45.07	52.15	52.22	52.28	52.44	44.6	58.59	58.7	58.81	59.1	57.242	45.82	270.96	484.59	842.07	933.03
			230VAC	44.55	51.5	51.55	51.6	51.77	44.08	57.82	57.91	58.04	58.29	56.493	45.17	266.35	474.24	814.85	899.58
C9200L-48PL-4G	600W (C5)	Fixed	115VAC	39.28	43.98	44.04	44.08	44.22	38.95	48.47	48.6	48.74	49.00	47.571	39.59	153.06	256.56	423.44	466.34
			230VAC	38.88	43.6	43.66	43.69	43.83	38.57	48.09	48.22	48.35	48.62	47.191	39.20	150.51	252.10	413.89	455.15
C9200L-48T-4X	125W (C5)	Fixed	115VAC	35.52	42.36	42.9	43.35	43.69	35.06	49.27	50.24	51.19	53.60	48.282	36.08				
			230VAC	35.84	42.60	43.09	43.58	44.81	35.27	49.41	50.36	51.33	53.67	48.422	36.38				
C9200L-48P-4X	1000W (C5)	Fixed	115VAC	53.12	56.89	57.34	57.80	57.81	55.22	63.92	64.86	65.84	68.36	63.494	50.31	262.59	463.36	789.46	872.6
			230VAC	52.63	56.37	56.82	57.3	58.47	54.71	63.41	64.32	65.27	67.64	62.963	50.02	258.64	453.81	766.04	843.89
C9200L-48PL-4X	600W (C5)	Fixed	115VAC	42.83	44.15	44.62	44.72	45.39	45.45	51.08	51.52	52.2	53.49	50.758	40.17	144.82	241.99	401.32	445.35
			230VAC	42.36	44.19	44.47	44.61	45.28	44.6	49.33	49.91	50.36	51.51	49.075	39.48	142.32	237.52	392.77	434.06
C9200L-48PXG-4X	1000W (C5)	Fixed	115VAC	82.60	87.80	88.28	88.76	89.95	92.56	103.53	104.55	105.57	108.19	102.90	72.14	291.62	496.85	842.43	930.11
			230VAC	81.77	86.62	87.11	87.60	88.82	91.87	102.05	103.02	103.98	106.40	101.47	72.50	286.71	486.25	814.71	898.24
C9200L-24PXG-4X	600W (C5)	Fixed	115VAC	70.94	73.88	74.37	74.84	76.02	77.37	84.12	85.06	86.00	88.32	83.86	64.54	173.05	271.04	431.68	472.39
			230VAC	70.10	73.04	73.62	74.07	75.15	76.74	82.96	83.86	84.78	87.09	82.75	64.04	170.02	265.51	**420.96**	**459.88**

				Measured P(W)														
				Half port traffic					Full port traffic					Weighted average Pw	No link	PoE test (no traffic)		
C9200L-48PXG-2Y	1000W (C5)	Fixed	115VAC	81.81	85.14	85.81	86.49	88.08	89.40	96.32	97.51	98.71	101.76	96.17	71.45	294.56	500.25	**846.33**	934.08
			230VAC	79.59	82.94	83.64	84.28	85.81	88.20	95.17	96.36	97.52	100.40	95.00	70.28	283.88	483.54	812.20	894.11
C9200L-24PXG-2Y	600W (C5)	Fixed	115VAC	70.54	73.04	73.78	74.46	76.10	76.25	83.50	84.78	86.09	89.26	83.35	65.58	178.82	280.13	446.82	489.62
			230VAC	68.89	72.02	72.66	73.35	74.93	75.32	82.00	83.34	84.64	87.87	81.92	65.01	175.55	274.59	434.38	475.39

Safety and compliance

Table 17 lists the safety and compliance information for Cisco Catalyst 9200 Series switches.

Table 17. Safety and compliance information

Description	Specification
Safety certifications	• IEC 60950-1 • UL 60950-1 • CAN/CSA C22.2 No. 60950-1 • EN 60950-1 • AS/NZS 60950.1 • Class I Equipment
Electromagnetic emissions certifications	• 47 CFR Part 15 • CISPR 22 Class A • CISPR 32 Class A • CNS 13438 • EN 300 386* • EN 55022 Class A • EN 55032 Class A • EN61000-3-2 • EN61000-3-3 • ICES-003 Class A • KN 32 • TCVN 7189 Class A • V-3 Class A • CISPR 24 • EN 300 386* • EN 55024 • KN 35 • TCVN 7317
Environmental	Reduction of Hazardous Substances (ROHS) 5

* Use shielded cables for locations other than telecom centers

Warranty

Cisco enhanced limited lifetime hardware warranty

Cisco Catalyst 9200 Series switches come with a Cisco Enhanced Limited Lifetime Warranty (E-LLW) that includes Next-Business-Day (NBD) delivery of replacement hardware where available and 90 days of 8x5 Cisco Technical Assistance Center (TAC) support.

Your formal warranty statement, including the warranty applicable to Cisco software, appears in the information packet that accompanies your Cisco product. We encourage you to review the warranty statement shipped with your specific product carefully before use.

Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

For further information about warranty terms, visit https://www.cisco.com/go/warranty. Table 18 provides information about the E-LLW.

Table 18. E-LLW details

	Cisco E-LLW
Devices covered	Applies to Cisco Catalyst 9200 Series switches.
Warranty duration	As long as the original customer owns the product.
End-of-life policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to 5 years from the announcement of discontinuance.
Hardware replacement	Cisco or its service center will use commercially reasonable efforts to ship a replacement for NBD delivery, where available. Otherwise, a replacement will be shipped within 10 working days after receipt of the Return Materials Authorization (RMA) request. Actual delivery times might vary depending on customer location.
Effective date	Hardware warranty commences from the date of shipment to customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco).
TAC support	Cisco will provide during business hours, 8 hours per day, 5 days per week, basic configuration, diagnosis, and troubleshooting of device-level problems for up to a 90-day period from the date of shipment of the originally purchased Cisco Catalyst 9200 Series product. This support does not include solution or network-level support beyond the specific device under consideration.
Cisco.com access	Warranty allows guest access only to Cisco.com.

Cisco services for next-generation Cisco Catalyst switches

Achieve infrastructure excellence faster and with less risk. Cisco Catalyst 9000 Switch Services provide expert guidance to help you successfully deploy, manage and support the Cisco Catalyst 9000 switches. With unmatched networking expertise, best practices and innovative tools, we can help you reduce overall upgrade, refresh, and migration costs as you introduce new hardware, software and protocols into the network. Offering a comprehensive lifecycle of services – from implementation, optimization, technical and managed services – Cisco experts help you minimize disruption and achieve operational excellence to extract maximum value from your Cisco DNA ready infrastructure.

Learn more about Cisco Services for Enterprise Networks

Software Policy for Cisco Catalyst 9200 Series switches

Software Policy for Network Stack Components

Customers with the Network Essentials Stack and Network Advantage Stack software feature sets are provided with maintenance updates and bug fixes designed to maintain compliance of the software. This includes compliance with published specifications, release notes, and industry standards as long as the original end user continues to own or use the product or up to one year from the end-of-sale date for the product, whichever occurs earlier.

Cisco Embedded Support for Cisco DNA Term Components

Cisco Embedded Support delivers the right support for Cisco software products and suites. It will keep your business applications performing as expected and protect your investment. Cisco Embedded Support for the Cisco DNA Essentials and Cisco DNA Advantage term components is included. Cisco Embedded Support provides access to TAC support, major software updates, maintenance and minor software releases, and the Cisco Embedded Support site, for increased productivity with anytime access.

Ordering

Ordering information

Table 19 lists ordering information for Cisco Catalyst 9200 Series switches. To place an order, visit the Cisco Ordering home page at https://www.cisco.com/en/US/ordering/or13/or8/order_customer_help_how_to_order_listing.html.

Table 19. Ordering information

Switches	
Product number	**Product description**
C9200-24T-A	Catalyst 9200 24-port Data Switch, Network Advantage
C9200-24T-E	Catalyst 9200 24-port Data Switch, Network Essentials
C9200-24P-A	Catalyst 9200 24-port PoE+ Switch, Network Advantage
C9200-24P-E	Catalyst 9200 24-port PoE+ Switch. Network Essentials
C9200-24PB-A	Catalyst 9200 24-port PoE+, enhanced VRF, Network Advantage
C9200-24PXG-E	Catalyst 9200 24-port 8xmGig, 16x1G, PoE+, Network Essentials
C9200-24PXG-A	Catalyst 9200 24-port 8xmGig, 16x1G, PoE+, Network Advantage
C9200-48T-A	Catalyst 9200 48-port Data Switch, Network Advantage
C9200-48T-E	Catalyst 9200 48-port Data Switch, Network Essentials
C9200-48P-A	Catalyst 9200 48-port PoE+ Switch, Network Advantage
C9200-48P-E	Catalyst 9200 48-port PoE+ Switch, Network Essentials
C9200-48PL-A	Catalyst 9200 48-Port partial PoE+ Switch, Network Advantage

Switches	
C9200-48PL-E	Catalyst 9200 48-Port partial PoE+ Switch, Network Essentials
C9200-48PB-A	Catalyst 9200 48-port PoE+, enhanced VRF, Network Advantage
C9200-48PXG-E	Catalyst 9200 48-port 8xmGig, 40x1G, PoE+, Network Essentials
C9200-48PXG-A	Catalyst 9200 48-port 8xmGig, 40x1G, PoE+, Network Advantage
C9200L-24T-4G-A	Catalyst 9200L 24-port Data 4x1G uplink Switch, Network Advantage
C9200L-24T-4G-E	Catalyst 9200L 24-port Data 4x1G uplink Switch, Network Essentials
C9200L-24P-4G-A	Catalyst 9200L 24-port PoE+ 4x1G uplink Switch, Network Advantage
C9200L-24P-4G-E	Catalyst 9200L 24-port PoE+ 4x1G uplink Switch, Network Essentials
C9200L-48T-4G-A	Catalyst 9200L 48-port Data 4x1G uplink Switch, Network Advantage
C9200L-48T-4G-E	Catalyst 9200L 48-port Data 4x1G uplink Switch, Network Essentials
C9200L-48P-4G-A	Catalyst 9200L48-port PoE+ 4x1G uplink Switch, Network Advantage
C9200L-48P-4G-E	Catalyst 9200L48-port PoE+ 4x1G uplink Switch, Network Essentials
C9200L-48PL-4G-A	Catalyst 9200L48-port partial PoE+ 4x1G uplink Switch, Network Advantage
C9200L-48PL-4G-E	Catalyst 9200L48-port partial PoE+ 4x1G uplink Switch, Network Essentials
C9200L-24T-4X-A	Catalyst 9200L 24-port Data 4x10G uplink Switch, Network Advantage
C9200L-24T-4X-E	Catalyst 9200L 24-port Data 4x10G uplink Switch, Network Essentials
C9200L-24P-4X-A	Catalyst 9200L 24-port PoE+ 4x10G uplink Switch, Network Advantage
C9200L-24P-4X-E	Catalyst 9200L 24-port PoE+ 4x10G uplink Switch, Network Essentials
C9200L-48T-4X-A	Catalyst 9200L 48-port Data 4x10G uplink Switch, Network Advantage
C9200L-48T-4X-E	Catalyst 9200L 48-port Data 4x10G uplink Switch, Network Essentials
C9200L-48P-4X-A	Catalyst 9200L 48-port PoE+ 4x10G uplink Switch, Network Advantage
C9200L-48P-4X-E	Catalyst 9200L 48-port PoE+ 4x10G uplink Switch, Network Essentials
C9200L-48PL-4X-A	Catalyst 9200L 48-port partial PoE+ 4x10G uplink Switch, Network Advantage
C9200L-48PL-4X-E	Catalyst 9200L 48-port partial PoE+ 4x10G uplink Switch, Network Essentials
C9200L-24PXG-4X-E	Catalyst 9200L 24-port 8xmGig, 16x1G, 4x10G, PoE+, Network Essentials
C9200L-24PXG-4X-A	Catalyst 9200L 24-port 8xmGig, 16x1G, 4x10G, PoE+, Network Advantage
C9200L-48PXG-4X-E	Catalyst 9200L 48-port 12xmGig, 36x1G, 4x10G PoE+, Network Essentials

Switches	
C9200L-48PXG-4X-A	Catalyst 9200L 48-port 12xmGig, 36x1G, 4x10G PoE+, Network Advantage
C9200L-24PXG-2Y-E	Catalyst 9200L 24-port 8xmGig, 16x1G, 2x25G, PoE+, Network Essentials
C9200L-24PXG-2Y-A	Catalyst 9200L 24-port 8xmGig, 16x1G, 2x25G, PoE+, Network Advantage
C9200L-48PXG-2Y-E	Catalyst 9200L 48-port 8xmGig, 40x1G, 2x25G PoE+, Network Essentials
C9200L-48PXG-2Y-A	Catalyst 9200L 48-port 8xmGig, 40x1G, 2x25G PoE+, Network Advantage
Network modules	
Product number	**Product description**
C9200-NM-2Y (=)	Catalyst 9200 2 x 25 GE Network Module, spare
C9200-NM-2Q (=)	Catalyst 9200 2 x 40GE Network Module, spare
C9200-NM-4G (=)	Catalyst 9200 4 x 1GE Network Module, spare
C9200-NM-4X (=)	Catalyst 9200 4 x 10GE Network Module, spare
C9200-NM-BLANK	Catalyst 9200 BLANK Network Module
StackWise-80 and StackWise-160 Kit and cables	
Product number	**Product description**
C9200-STACK-KIT=	C9200 Stack Kit Spare
C9200L-STACK-KIT=	C9200L Stack Kit Spare
STACK-T4-50CM	50CM Type 3 Stacking Cable
STACK-T4-50CM=	50CM Type 3 Stacking Cable, spare
STACK-T4-1M	1M Type 3 Stacking Cable
STACK-T4-1M=	1M Type 3 Stacking Cable, spare
STACK-T4-3M	3M Type 3 Stacking Cable
STACK-T4-3M=	3M Type 3 Stacking Cable, spare
Software licenses	
Product number	**Product description**
C9200-DNA-P-24	C9200 Cisco DNA Premier Term, 24-Port: Includes Term Licenses for Cisco DNA Advantage, 25 ISE Base and 25 ISE Plus Endpoints, 25 Stealthwatch Flows (including Virtual Flow Collector and Management Console). Requires separate purchase of ISE appliance/ISE VM and Cisco DNA Center appliance
C9200-DNA-P-24-3Y	C9200 Cisco DNA Premier, 24-port, 3Y Term - Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH

Switches	
C9200-DNA-P-24-5Y	C9200 Cisco DNA Premier, 24-port, 5Y Term - Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200-DNA-P-24-7Y	C9200 Cisco DNA Premier, 24-port, 7Y Term - Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200-DNA-P-48	C9200 Cisco DNA Premier Term, 48-Port: Includes Term Licenses for Cisco DNA Advantage, 25 ISE Base and 25 ISE Plus Endpoints, 25 Stealthwatch Flows (including Virtual Flow Collector and Management Console). Requires separate purchase of ISE appliance/ISE VM and Cisco DNA Center appliance
C9200-DNA-P-48 -3Y	C9200 Cisco DNA Premier, 48-port, 3Y Term - Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200-DNA-P-48 -5Y	C9200 Cisco DNA Premier, 48-port, 5Y Term - Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200-DNA-P-48 -7Y	C9200 Cisco DNA Premier, 48-port, 7Y Term - Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200-DNA-E-24	C9200 Cisco DNA Essentials Term 24-port
C9200-DNA-E-24-3Y	C9200 Cisco DNA Essentials, 24-port, 3 Year Term license
C9200-DNA-E-24-5Y	C9200 Cisco DNA Essentials, 24-port, 5 Year Term license
C9200-DNA-E-24-7Y	C9200 Cisco DNA Essentials, 24-port, 7 Year Term license
C9200-DNA-E-48	C9200 Cisco DNA Essentials Term 48-port
C9200-DNA-E-48-3Y	C9200 Cisco DNA Essentials, 48-port, 3 Year Term license
C9200-DNA-E-48-5Y	C9200 Cisco DNA Essentials, 48-port, 5 Year Term license
C9200-DNA-E-48-7Y	C9200 Cisco DNA Essentials, 48-port, 7 Year Term license
C9200-DNA-A-24	C9200 Cisco DNA Advantage Term 24-port
C9200-DNA-A-24-3Y	C9200 Cisco DNA Advantage, 24-port, 3 Year Term license
C9200-DNA-A-24-5Y	C9200 Cisco DNA Advantage, 24-port, 5 Year Term license
C9200-DNA-A-24-7Y	C9200 Cisco DNA Advantage, 24-port, 7 Year Term license
C9200-DNA-A-48	C9200 Cisco DNA Advantage Term 48-port
C9200-DNA-A-48-3Y	C9200 Cisco DNA Advantage, 48-port, 3 Year Term license
C9200-DNA-A-48-5Y	C9200 Cisco DNA Advantage, 48-port, 5 Year Term license
C9200-DNA-A-48-7Y	C9200 Cisco DNA Advantage, 48-port, 7 Year Term license
C9200L-DNA-P-24	C9200L Cisco DNA Premier Term, 24-Port: Includes Term Licenses for Cisco DNA Advantage, 25 ISE Base and 25 ISE Plus Endpoints, 25 Stealthwatch Flows (including Virtual Flow Collector and Management Console). Requires separate purchase of ISE appliance/ISE VM and Cisco DNA Center appliance

Switches	
C9200L-DNA-P-24-3Y	C9200L Cisco DNA Premier, 24-port, 3Y Term – Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200L-DNA-P-24-5Y	C9200L Cisco DNA Premier, 24-port, 5Y Term – Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200L-DNA-P-24-7Y	C9200L Cisco DNA Premier, 24-port, 7Y Term – Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200L-DNA-P-48	C9200L Cisco DNA Premier Term, 48-Port: Includes Term Licenses for Cisco DNA Advantage, 25 ISE Base and 25 ISE Plus Endpoints, 25 Stealthwatch Flows (including Virtual Flow Collector and Management Console). Requires separate purchase of ISE appliance/ISE VM and Cisco DNA Center appliance
C9200L-DNA-P-48-3Y	C9200L Cisco DNA Premier, 48-port, 3Y Term – Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200L-DNA-P-48 -5Y	C9200L Cisco DNA Premier, 48-port, 5Y Term – Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200L-DNA-P-48 -7Y	C9200L Cisco DNA Premier, 48-port, 7Y Term – Cisco DNA, 25 ISE PLS and ISE BASE, 25 SWATCH
C9200L-DNA-E-24	C9200L Cisco DNA Essentials Term 24-port
C9200L-DNA-E-24-3Y	C9200L Cisco DNA Essentials, 24-port, 3 Year Term license
C9200L-DNA-E-24-5Y	C9200L Cisco DNA Essentials, 24-port, 5 Year Term license
C9200L-DNA-E-24-7Y	C9200L Cisco DNA Essentials, 24-port, 7 Year Term license
C9200L-DNA-E-48	C9200L Cisco DNA Essentials Term 48-port
C9200L-DNA-E-48-3Y	C9200L Cisco DNA Essentials, 48-port, 3 Year Term license
C9200L-DNA-E-48-5Y	C9200L Cisco DNA Essentials, 48-port, 5 Year Term license
C9200L-DNA-E-48-7Y	C9200L Cisco DNA Essentials, 48-port, 7 Year Term license
C9200L-DNA-A-24	C9200L Cisco DNA Advantage Term 24-port
C9200L-DNA-A-24-3Y	C9200L Cisco DNA Advantage, 24-port, 3 Year Term license
C9200L-DNA-A-24-5Y	C9200L Cisco DNA Advantage, 24-port, 5 Year Term license
C9200L-DNA-A-24-7Y	C9200L Cisco DNA Advantage, 24-port, 7 Year Term license
C9200L-DNA-A-48	C9200L Cisco DNA Advantage Term 48-port
C9200L-DNA-A-48-3Y	C9200L Cisco DNA Advantage, 48-port, 3 Year Term license
C9200L-DNA-A-48-5Y	C9200L Cisco DNA Advantage, 48-port, 5 Year Term license
C9200L-DNA-A-48-7Y	C9200L Cisco DNA Advantage, 48-port, 7 Year Term license
C9200-LIC=	Electronic Cisco DNA Upgrade License for C9200 switches. Note: when upgrading from Cisco

Switches	
	DNA Essentials to Cisco DNA Advantage, Network Essentials is upgraded to Network Advantage
C9200-24-E-A	C9200 24-port NW and DNA Essentials to NW and DNA Advantage Upgrade
C9200-24-E-A-3	24-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 3Y
C9200-24-E-A-5	24-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 5Y
C9200-24-E-A-7	24-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 7Y
C9200-48-E-A	C9200 48-port NW and DNA Essentials to NW and DNA Advantage Upgrade
C9200-48-E-A-3	48-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 3Y
C9200-48-E-A-5	48-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 5Y
C9200-48-E-A-7	48-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 7Y
C9200L-LIC=	Electronic Cisco DNA Upgrade License for C9200L switches. Note: when upgrading from Cisco DNA Essentials to Cisco DNA Advantage, Network Essentials is upgraded to Network Advantage
C9200L-24-E-A	C9200L 24-port NW and DNA Essentials to NW and DNA Advantage Upgrade
C9200L-24-E-A-3	24-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 3Y
C9200L-24-E-A-5	24-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 5Y
C9200L-24-E-A-7	24-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 7Y
C9200L-48-E-A	C9200L 48-port NW and DNA Essentials to NW and DNA Advantage Upgrade
C9200L-48-E-A-3	48-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 3Y
C9200L-48-E-A-5	48-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 5Y
C9200L-48-E-A-7	48-port NW and Cisco DNA Ess to NW and DNA Adv Upgrade License 7Y
Power supplies	
Product Number	**Product Description**
PWR-C5-125WAC (=)	125W AC Config 5 Power Supply
PWR-C5-125WAC/2	125W AC Config 5 Power Supply - Secondary Power Supply
PWR-C5-600WAC (=)	600W AC Config 5 Power Supply
PWR-C5-600WAC/2	600W AC Config 5 Power Supply - Secondary Power Supply
PWR-C5-1KWAC (=)	1KW AC Config 5 Power Supply
PWR-C5-1KWAC/2	1KW AC Config 5 Power Supply - Secondary Power Supply

Switches	
PWR-C6-125WAC (=)	125W AC Config 6 Power Supply
PWR-C6-125WAC/2	125W AC Config 6 Power Supply - Secondary Power Supply
PWR-C6-600WAC (=)	600W AC Config 6 Power Supply
PWR-C6-600WAC/2	600W AC Config 6 Power Supply - Secondary Power Supply
PWR-C6-1KWAC (=)	1KW AC Config 6 Power Supply
PWR-C6-1KWAC/2	1KW AC Config 6 Power Supply - Secondary Power Supply
PWR-C5-BLANK=	Blank Module
Spare power cords	
CAB-TA-NA=	AC power cord for Cisco Catalyst (North America)
CAB-TA-AP=	AC power cord for Cisco Catalyst (Australia)
CAB-TA-AR=	AC power cord for Cisco Catalyst (Argentina)
CAB-TA-SW=	AC power cord for Cisco Catalyst (Switzerland)
CAB-TA-UK=	AC power cord for Cisco Catalyst (United Kingdom)
Power supplies	
Spare power cords	
CAB-TA-JP=	AC power cord for Cisco Catalyst (Japan)
CAB-TA-250V-JP=	Japan 250VAC power cord for Cisco Catalyst (Japan)
CAB-TA-125V-JP=	Japan 125V AC Type A Power Cable (Japan – 48 port only)
CAB-TA-EU=	AC power cord for Cisco Catalyst (Europe)
CAB-TA-IT=	AC power cord for Cisco Catalyst (Italy)
CAB-TA-IN=	AC power cord for Cisco Catalyst (India)
CAB-TA-CN=	AC power cord for Cisco Catalyst (China)
CAB-TA-DN=	AC power cord for Cisco Catalyst (Denmark)
CAB-TA-IS=	AC power cord for Cisco Catalyst (Israel)
CAB-ACBZ-12A=	AC power cord for Cisco Catalyst (Brazil), 12A/125V BR-3-20 plug up to 12A
CAB-ACBZ-10A=	AC power cord for Cisco Catalyst (Brazil), 10A/250V BR-3-10 plug up to 10A
CAB-C15-CBN	Cabinet jumper power cord, 250VAC 13A, C14-C15 connectors

Switches	
Rack Mounting Brackets	
ACC-KIT-T1=	Accessory kit with 19 inch Type 1 rack mount
RACK-KIT-T1=	19, 23, 24 inch and ETSI Type 1 rack mount kit
4PT-KIT-T2=	4 Point rack mount kit New

Optics online reference

Cisco Catalyst 9200 Series switches support a wide range of optics. Because the list of supported optics is updated on a regular basis, consult the tables available here for the latest SFP+ and SFP compatibility information: https://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Cisco services

Accelerate your journey to intent-based networking

With Cisco Services, you can achieve infrastructure excellence faster with less risk. Our services for Cisco Catalyst 9200 Series switches provide expert guidance to help you successfully plan, deploy, manage, and support your new switches. With unmatched networking expertise, best practices, and innovative tools, Cisco Services can help you reduce overall upgrade, refresh, and migration costs as you introduce new hardware, software, and protocols into the network. With a comprehensive lifecycle of services, Cisco experts will help you minimize disruption and improve operational efficiency to extract maximum value from your Cisco DNA ready infrastructure. Learn more.

CSR/Social Responsibility

Information about Cisco's environmental, social and governance (ESG) policies and intiatives can be found in Cisco's Corporate Social Responsibility (CSR) Report.

Cisco Capital

Flexible payment solutions to help you achieve your objectives

Cisco Capital makes it easier to get the right technology to achieve your objectives, enable business transformation and help you stay competitive. We can help you reduce the total cost of ownership, conserve capital, and accelerate growth. In more than 100 countries, our flexible payment solutions can help you acquire hardware, software, services and complementary third-party equipment in easy, predictable payments. Learn more.

Document history

New or revised topic	Described In	Date
Added New C9200/L partial PoE Information	Table 1, 3, 7, 8, 12,14, 16, 19	September 22, 2020
Added correct images for module uplinks	Network Modules	February 21, 2020
Added New C9200 mGig and C9200 32 VN information	Table 1, 3, 7, 8, 12, 19	January 28, 2020
Added New C9200 Network Modules	Table 2, 19	January 28, 2020
Added New Power Supply information PWR-C6-600WAC	Table 3, 15, 16, 19	October 09, 2019
Forwarding rate with Stacking	Table 8	October 09, 2019
Cloud Security Information	General Information	October 09, 2019
Adding C9200L mGig SKUs	Table 1, 3, 8, 12, 16	May 14, 2019
Revisions of Weight, addition of LIC upgrade and other minor edits	Software licenses table and weights table	April 01, 2019
Revised Table of Contents Headings	Specifications (was "Dimensions, eight, acoustic, mean time between failures"), added Document History	January 03, 2019

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Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **https://www.cisco.com/go/offices**.

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Appendix 4

SIERRA WIRELESS®

TECHNICAL SPECIFICATIONS

AirLink® RV55

Performance Series Routers

	North America	EMEA	North America	Global	Global
	LTE		LTE-A Pro		LTE-M/ NB-IoT
LTE CATEGORY	Cat 4 (WP7610|WP7607)		Cat 12 (EM7511|EM7565)		Cat M1/NB1 (WP7702)
Peak D/L	Up to 150 Mbps		Up to 600 Mbps		Cat-M1: 300kbps Cat-NB1: 27kbps
Peak U/L	Up to 50 Mbps		Up to 150 Mbps		Cat-M1: 375kbps Cat-NB1: 65kbps
4G LTE Frequency Bands	1900(B2), AWS(B4), 850(B5), 700(B12), 700(B13), 700(B17), 1700(B66)	2100(B1), 1800(B3), 2600(B7), 900(B8), 800(B20), 700(B28)	2100(B1), 1900(B2),1800(B3), AWS(B4), 850(B5), 2600(B7), 900(B8), 1800(B9), 700(B12), 700(B13), 700(B14), 850(B18), 850(B19), 800(B20), 850(B26), 700(B29), 2300(B30), 1500(B32), TDD B41, TDD B42, TDD B43, TDD B46, CBRS B48,1700(B66)	2100(B1), 1900(B2), 1800(B3), AWS(B4), 850(B5), 2600(B7), 900(B8), 1800(B9), 700(B12), 700(B13), 850(B18), 850(B19), 800(B20), 850(B26), 700(B28), 700(B29), 2300(B30), 1500(B32), TDD B41, TDD B42, TDD B43, TDD B46, CBRS B48, 1700(B66)	2100(B1), 1900(B2), 1800(B3), AWS(B4), 850(B5), 900(B8), 700(B12), 700(B13), 700(B17), 850 (B18), 850(B19), 800(B20), 850(B26), 700(B28)
3G HSPA/HSPA+ Frequency Bands*	1900(B2), AWS(B4), 850(B5)	2100(B1), 900(B8)	2100(B1), 1900(B2), AWS(B4), 850(B5), 800(B6), 900(B8), 1700(B9), 850(B19)	2100(B1), 1900(B2), AWS(B4), 850(B5), 800(B6), 900(B8), 1700(B9), 850(B19)	
2G EDGE/GSM/GPRS Frequency Bands		900, 1800			850, 900, 1800, 1900
APPROVALS Regulatory	FCC, IC, PTCRB	GCF, CE	FCC, IC, PTCRB	FCC, IC, PTCRB, GCF, CE, RCM, IFT, Anatel	FCC, IC, PTCRB, GCF, CE, RCM
Carrier	Verizon, AT&T, T-Mobile		Verizon, AT&T/FirstNet, US Cellular, T-Mobile, Telus	Verizon, AT&T, Telstra(Planned)	Verizon(Cat-M), AT&T(Cat-M)
PART NUMBER Regulatory	1104335	1104337	1104303, 1104302 (Wi-Fi) 1104302 (Wi-Fi)	1104332, 1104331 (Wi-Fi) 1104331 (Wi-Fi)	1104333

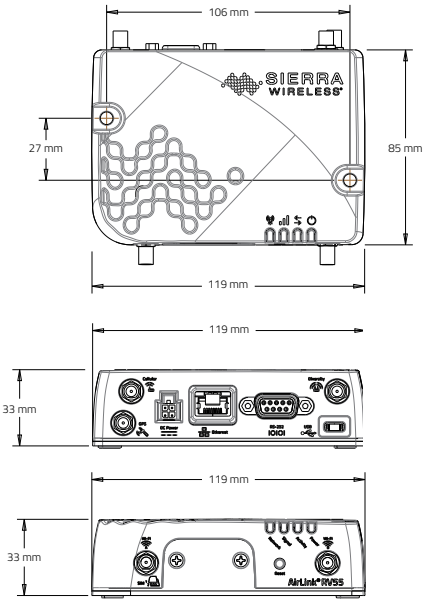
For carrier-specific band support please refer to the hardware user guide.

	Specification
HOST INTERFACES	10/100/1000 Ethernet (RJ45)
	RS-232 serial port (DB-9)
	USB 2.0 Micro-B Connector
	3 SMA antenna (cellular, diversity, GNSS)
	2 RP-SMA antenna (1x1 Wi-Fi, Optional)
	LTE-M/NB-IoT: 1 SMA (cellular) only, no GNSS or Wi-Fi
	Active GPS antenna support
WI-FI (Optional)	Dual Band 2.4/5GHz Wi-Fi
	Dual Radio, 802.11 b/g/n/ac (Wave2 Client Mode)
	Support for 10 clients, WPA2 Enterprise per radio
	Output power 16dBm
	Configurable as Dual Band Access Point (AP) or AP+Client Mode
	Single SSID Support per radio
	Captive Portal

	Specification
SATELLITE NAVIGATION (GNSS)	LTE-A Pro Variant: 30 Channel GPS and GLONASS Receiver (Tracking Sensitivity: -160dBm)
	LTE Variant: 48 Channel Dedicated GNSS Receiver (Tracking Sensitivity: -162 dBm)
	Accuracy: <2 m (50%), <5 m (90%), <0.2 m/s
	Acquisition Time: 1s Hot Start
	Reports: NMEA 0183 V3.0, TAIP, RAP, XORA
	Multiple Redundant Servers
	Reliable Store and Forward
SECURITY	Remote Authentication (LDAP, RADIUS, TACACS+, DMZ)
	Inbound and Outbound Port filtering
	Inbound and Outbound Trusted IP
	MAC Address Filtering
	PCI compatible
	Secure Firmware Update

TECHNICAL SPECIFICATIONS

	Specification	
INPUT/OUTPUT	Configurable I/O pin on power connector • Digital Input ON Voltage: 2.7 to 36 VDC • Configurable Pull-up for dry contact input • Digital Open Collector Output > sinking 500 mA • Analog Input: 0.5-36 VDC	
LAN (ETHERNET/USB)	DHCP Server	Host Interface Watchdog
	IP Passthrough	PPPoE
	VLAN	
SERIAL	TCP/UDP PAD Mode	
	Modbus (ASCII, RTU, Variable)	
	PPP	
	DNP3 Interoperability	
	Dual Serial option (with an accessory)	
NETWORK AND ROUTING	Network Address Translation (NAT)	Reliable Static Route
	Port Forwarding	Dynamic DNS
	Policy Routing	Verizon PNTM
	NEMO/DMNR	IPV6 Gateway
	VRRP	
VPN**	IPsec, GRE, and OpenVPN Client	
	Up to 5 concurrent tunnels	
	Split Tunnel	
	Dead Peer Detection (DPD)	
	FIPS 140-2 compatible	
APPLICATION FRAMEWORK	ALEOS Application Framework (AAF)	
	LUA Scripting Language	
POWER	Input Voltage: 7 to 36 VDC	
	LTE Idle Power: 900mW (75 mA @ 12VDC)	
	Standby Mode Power: 53 mW (4.4 mA @ 12 VDC) triggered on low voltage, I/O or periodic timer	
	Low voltage disconnect to prevent battery drain	
	Built-in protection against voltage transients including 5 VDC engine cranking and +200 VDC load dump	
	Ignition Sense with time delay shutdown	
	Configurable features and ports to optimize power consumption	
DIMENSIONS	119 mm x 33 mm x 85 mm (102 mm including wi-fi connectors)	
	4.69 in x 1.34 in x 3.35 in (3.70 in including connectors)	
	Weight: 320 g	



	Specification
NETWORK MANAGEMENT	Secure mobile network & asset management application available in the cloud or licensed platform in the enterprise data center
	Fleet wide firmware upgrade delivery
	Router configuration and template management
	Router staging over the air and local Ethernet connection
	Over-the-air software and radio module firmware updates
	Device Configuration Templates
	Configurable monitoring and alerting
	Remote provisioning and airtime activation (where applicable)
ROUTER MANAGEMENT	ALMS
	Local web user interface
	AT Command Line Interface (Telnet/SSH/Serial)
	SMS Commands
	SNMP
EVENTS ENGINE	Custom event triggers and reports
	Configurable interface, no programming
	Event Types: Digital Input, Network Parameters, Data Usage, Timer, Power, Device Temperature and Voltage
	Report Types: RAP, SMS, Email, SNMP Trap, TCP (Binary, XML, CSV)
	Event Actions: Drive Relay Output
ENVIRONMENTAL	Operating Temperature: -40°C to +70°C / -40°F to +158°F
	Operating Temperature (Wi-Fi variant): -30°C to +70°C / -22°F to +158°F
	Storage Temperature: -40°C to +85°C / -40°F to +185°F
	Humidity: 95% RH @ 60°C
	Military Spec MIL-STD-810G conformance to shock, vibration, thermal shock, and humidity
	IP64 rated ingress protection
INDUSTRY CERTIFICATIONS	Safety: IECEE Certification Bodies Scheme (CB Scheme), UL 60950***
	Vehicle Usage: E-Mark (UN ECE Regulation 10.04), Rail Usage: EN50155
	ISO7637-2, SAE J1455 (Shock & Vibration)
	Hazardous Environments: Class 1 Div 2– Ambient temperatures of -30°C to +60°C
	Environmental: RoHS, REACH, WEEE
SUPPORT AND WARRANTY	Includes 1st Year AirLink Complete: • AirLink Management Service (ALMS) • Direct 24/7 Technical Support • 3-year standard warranty; optional 2-year warranty extension
	1-day Accelerated Hardware Replacement available through participating resellers
ACCESSORIES	In the Box: DC Power Cable, and Quick Start Guide
	Other Accessories (sold separately):
	2000579 AC Adapter, 12VDC
	6000659 DIN Rail Bracket
	For Antenna options visit: sierrawireless.com/antennas

*** IPsec, GRE and OpenVPN Client are not available in the member states of the EAEU.*
**** Ambient temperatures of -30C to +60C*

Related AirLink Products

AIRLINK DEVICE MANAGEMENT SOLUTIONS

AirLink Management Service (ALMS)

- Secure, Cloud-based network and asset management
- Remotely deploy, configure, monitor and manage AirLink devices
- Carrier-grade, high availability, secure, global infrastructure

AIRLINK VPN APPLIANCE

AirLink Connection Manager

- VPN appliance built from the ground up for AirLink routers & gateways
- Simplify deployment and management of your VPN solution, extending the enterprise to the network edge for fixed and mobile endpoints
- Carrier agnostic – ACM doesn't require fixed and/or public IP
- Compatible with FIPS 140-2, and always-on VPN capability

AIRLINK ANTENNA SOLUTIONS

AirLink Antennas

- Tested and certified to provide guaranteed performance with all AirLink routers and gateways
- Accelerate deployment with always-on, end-to-end connectivity

About Sierra Wireless

Sierra Wireless (NASDAQ: SWIR) (TSX: SW) is the leading IoT solutions provider that combines devices, network and software to unlock value in the connected economy. Companies globally are adopting IoT to improve operational efficiency, create better customer experiences, improve their business models and create new revenue streams. Whether it's a solution to help a business securely connect edge devices to the cloud, or a software/API solution to help manage processes associated with billions of connected assets, or a platform to extract real-time data to make the best business decisions, Sierra Wireless will work with you to create the right industry-specific solution for your next IoT endeavor. Sierra Wireless has more than 1,300 employees globally and operates R&D centers in North America, Europe and Asia.

For more information, visit www.sierrawireless.com.

PAESSLER

Appendix 6

SYSTEM REQUIREMENTS

System Requirements for PRTG Network Monitor

PRTG NETWORK MONITOR

System Requirements for PRTG Network Monitor

Paessler AG offers licenses for PRTG Network Monitor that range from 100 sensors to an unrestricted number of sensors. The hardware required for the PRTG core server depends very much on the number of sensors you are running, as well as on a few additional key values such as the number of remote probes in use.

The summary below provides guidelines for the system requirements, as well as an indication of what we recommend and what we support. Due to technical limitations, the sensor limit is lower when you are running the core server in a virtual machine or in a cluster. For more details, please refer to Paessler's System Requirements for PRTG online, at www.paessler.com/prtg/requirements.

Recommended Setup for Most PRTG Users

There are many parameters that influence the user experience of PRTG, but for the majority of PRTG users, the following sizing recommendations for the hardware of the PRTG core server work fine.

We recommend that you run your PRTG core server installation

- directly on x64 server hardware or in a properly configured virtual environment (for more information, see section Running PRTG in virtual environments).
- on **Windows Server 2019, Windows Server 2016, or Windows Server 2012 R2**.

Note: .NET Framework 4.7.2 or later must be installed on the core server system. For new PRTG core server installations, we recommend .NET Framework 4.8.

See also System Requirements for Remote Probes in the PRTG Manual.

Sensors per PRTG core server installation	CPU cores	RAM	Disk space	Concurrently active administrator sessions	Number of remote probes	Virtualization	Cluster	Recommended license
Up to 500	4	4 GB	100 GB	< 30	< 30	✓	✓	PRTG 500
Up to 1,000	6	6 GB	500 GB	< 30	< 30	✓	✓	PRTG 100
Up to 2,500	8	8 GB	750 GB	< 20	< 30	✓	✓	PRTG 2500
Up to 5,000	8	12 GB	1,000 GB	< 20	< 60	✓	!	PRTG 5000
Up to 10,000	10-12**	16 GB	1,500 GB	< 15	< 80	✓ *	!	PRTG XL1
> 10,000	We recommend that you set up additional PRTG core server installations or contact the Paessler Presales team for more information on scaling.							PRTG Enterprise

✓ = OK ✓ = OK ! = not recommended ! = not officially supported: please contact your presales team.

* For more information, see Running PRTG in virtual environments below.

** When you use more than 10 CPU cores, you might need to apply a CPU-splitting configuration in the Windows registry

Note: Most PRTG users have 10 sensors per device on average. In most cases, a license for 1,000 sensors is therefore enough to monitor about 100 devices, for example. If you exceed any of these recommendations, please contact the Paessler Presales team.

Recommended setup for remote probes

We recommend that you run remote probes

- directly on compatible x86 hardware or in a properly configured virtual environment (for more information, see section Running PRTG in virtual environments).
- on Windows Server 2019, Windows Server 2016, Windows Server 2012 R2, or Windows 10.

Note: .NET Framework 4.7.2 or later must be installed on the probe system. For new installations, we recommend .NET Framework 4.8.

Sensors per remote probe	CPU cores	RAM	Disk space*
Up to 200	2	2 GB	40 GB
200 - 2,000	4	4 GB	40 GB
2,000 - 5,000	6	6 GB	40 GB
> 5,000	We recommend that you set up additional remote probes or contact the Paessler Presales team for more information on scaling.		

* A remote probe system does not have any special disk requirements (< 1 GB).
In general, we recommend at least 40 GB.

Running PRTG in virtual environments

PRTG is an all-in-one monitoring solution with lots of different components that all rely on the performance and the stability of the system on which the PRTG core server runs. Here, virtual environments add even more layers of complexity. This needs to be considered when you want to set up your PRTG core server installation in a way that you can achieve the same level of performance as on a physical server.

Most PRTG core server installations from 500 to 5,000 sensors do not need any specific optimization regarding your virtual infrastructure.

If you run larger installations of PRTG with more than 5,000 sensors, please follow the instructions in our Best Practice Guide: Running large installations of PRTG in a virtual environment.

If you run larger installations of PRTG with more than 5,000 sensors, please follow the instructions in our Best Practice Guide: Running large installations of PRTG in a virtual environment.

More considerations and requirements:

Minimum requirements for special use cases

If you run PRTG with a limited use case, for example, if you only use Ping sensors and SNMP v1 or v2c sensors with long scanning intervals, your installation can work fine with lower system requirements. We have seen PRTG installations that work well with the following minimum requirements.

Minimum requirements for the PRTG core server installation (only special, low-resource use cases)

Sensors per PRTG core server installation	CPU cores	RAM	Disk space	Concurrently active administrator sessions	Number of remote probes	Virtualization	Cluster	Recommended license
Up to 500	2	2 GB	60 GB	< 10	< 10	✓	✓	PRTG 500
Up to 1,000	4	4 GB	250 GB	< 10	< 10	✓	✓	PRTG 100
Up to 2,500	6	6 GB	500 GB	< 10	< 10	✓	✓	PRTG 2500
Up to 5,000	6	8 GB	750 GB	< 10	< 10	✓	!	PRTG 5000
Up to 10,000	8	12 GB	1 TB	< 10	< 10	✓ *	!	PRTG XL1
> 10,000	We recommend that you set up additional PRTG core server installations or contact the Paessler Presales team for more information on scaling.							PRTG Enterprise

✓ = OK ✓ = OK ! = not recommended ! = not officially supported: please contact your presales team.

* For more information, see Running PRTG in virtual environments below.

Minimum requirements for remote probes (only special, low-resource use cases)

Sensors per remote probe	CPU cores	RAM	Disk space*
Up to 200	1	2 GB	40 GB
200 - 2,000	2	2 GB	40 GB
2,000 - 5,000	4	2 GB	40 GB
> 5,000	We recommend that you set up additional remote probes or contact the Paessler Presales team for more information on scaling.		

* A remote probe system does not have any special disk requirements (< 1 GB).
In general, we recommend at least 40 GB.

Performance considerations

Please note the following aspects that can affect performance:

- As a **rule of thumb**, we can say that typical PRTG installations almost never run into performance issues when they stay below 5,000 sensors, below 30 remote probes, and below 30 user accounts.
- In a cluster, the **monitoring load doubles with each cluster node**. The performance is accordingly divided in half with each additional cluster node. Therefore, in a single failover cluster setup that consists of two PRTG core servers that each work as a cluster node, please divide our recommended numbers from above in half.
- When you have more than 5,000 sensors, you should set **5-minute scanning intervals or longer** instead of using 1-minute scaning intervals.
- Some **sensor types create much more load** than others. For example, Ping and SNMP sensors create much less load than complex sensors like xFlow (NetFlow, jFlow, sFlow, IPFIX) sensors, VMware sensors, Sensor Factory sensors, WMI sensors, or Syslog/Trap Receiver sensors, to name just a few examples.
- Try to use **sensors with less than 50 channels**. Note that sensors with more than 50 channels are not officially supported and can have a high impact on system performance.
- We recommend that you **stay below 30 active user accounts** for each PRTG core server. You can have more users if these do not all use the PRTG web interface at the same time (including public dashboards or 'Maps').
- Try to **keep the usage of the following features down**: many quickly refreshed dashboards (or 'Maps'), frequently generated, huge sensor reports, heavy usage of packet sniffing, Sensor Factory sensors and Toplists, frequent automatically scheduled auto-discoveries for large network segments, and constant queries of monitoring data via the application programming interface (API).
- **Load balancing** is possible using remote probes. To distribute load, you can set up multiple remote probes on different computers. For more information, see the PRTG Manual: Remote Probes and Multiple Probes and watch the video tutorial Distributed Monitoring with PRTG.

Stability considerations

Please note the following aspects that can affect the stability of PRTG:

- Remote probes require a **stable network connection** between the PRTG core server and the remote probe. Unstable connections, for example via 3G or via satellite, might work. However, there have been situations where stable monitoring was not possible.
- Our general recommendation is to **stay below 30 remote probes** on one PRTG core server. PRTG still scales well up to 60 remote probes as long as you have less than 100 sensors per probe.
- The **quality of your network** also plays an important role. When monitoring via the User Datagram Protocol (UDP), for example, a high packet loss rate can l ead to frequent timeouts. Remote probes that connect via unstable WAN connections can lead to delays as well.

Note: An internet connection is required for the license activation via HTTP or email.

Supported Windows versions for the PRTG core server and remote probes

The following Windows versions are officially supported for the PRTG core server service and the PRTG probe service. We recommend 64-bit (x64) operating systems.

- Microsoft Windows Server 2019
- Microsoft Windows Server 2016
- Microsoft Windows Server 2012 R2
- Microsoft Windows Server 2012
- Microsoft Windows 10
- Microsoft Windows 8.1
- Microsoft Windows 8
- Microsoft Windows 7*
- Microsoft Windows Server 2008 R2*

Note: Windows Servers in Core mode or Minimal Server Interface are not officially supported.

* On Windows 7 and Windows Server 2008 R2, you have to install the required .NET version manually. For more information, see the Knowledge Base: Which .NET version does PRTG require?

System requirements for user interfaces of PRTG

PRTG Web interface

The following browsers (in order of performance and reliability) are officially supported for the web browser based primary user interface of PRTG at a screen resolution of 1024x768 pixels (more is recommended):

- Google Chrome 72 or later (recommended)
- Mozilla Firefox 65 or later
- Microsoft Internet Explorer 11

Note: Other browsers and older browsers might not be able to access the PRTG web interface at all.

PRTG Desktop

PRTG Desktop runs under all supported Windows and Mac versions. For detailed system requirements, see All PRTG Desktop downloads.

PRTG apps for iOS and Android

We provide free apps for Android and iOS devices. For detailed system requirements, see PRTG app download and the corresponding app pages.

System requirements for ITOps Board

Please see ITOps Board for detailed system requirements.

Note: ITOps Board is exclusively available for Paessler PRTG Enterprise Monitor.

Requirements for monitored devices

- **Monitoring via the Simple Network Protocol (SNMP)**: The monitored devices must be equipped with SNMP v1, v2c, or v3, and an SNMP-compatible software must be installed on the device. SNMP must be enabled on the device and the machine running PRTG must be allowed to access the SNMP interface. For more information, see the PRTG Manual: Monitoring via SNMP.
- **Monitoring via Windows Management Instrumentation (WMI)**: To use WMI monitoring, you need a Windows network. Host computers and client computers with Windows operating systems as specified above are officially supported. Do not use Windows Vista or Windows Server 2008 on host computers for WMI monitoring because both have WMI performance issues. For more information, see the PRTG Manual: Monitoring via WMI.
- **Monitoring via xFlow (NetFlow, jFlow, sFlow, IPFIX)**: The device must be configured to send NetFlow (v5, v9, or IPFIX), sFlow (v5), or jFlow (v5) data packets to the probe system. For more information, see the PRTG Manual: Monitoring Bandwidth via xFlows.
- **Monitoring via packet sniffing:** Only data packets that pass the network card of the local machine can be analyzed. Switches with so-called 'monitoring ports' are necessary for network-wide monitoring in switched networks. For more information, see the PRTG Manual: Monitoring Bandwidth via Packet Sniffing.

Need further assistance? Planning an installation with thousands of sensors?

Our Presales team is happy to assist you! Please write to presales@paessler.com. If possible, describe your monitoring requirements in detail so that we can find the best person to help you. For larger installations, see Monitoring large IT infrastructures.

ABOUT PAESSLER

In 1997 Paessler revolutionized IT monitoring with the introduction of PRTG Network Monitor. Today over 300,000 IT administrators, in more than 170 countries, rely on PRTG to monitor their business-critical systems, devices and network infrastructures. PRTG monitors the entire IT infrastructure 24/7 and helps IT professionals to seamlessly solve problems before they impact users. Our mission is to empower technical teams to manage their infrastructure, ensuring maximum productivity. We build lasting partnerships and integrative, holistic solutions to achieve this. Thinking beyond IT networks, Paessler is actively developing solutions to support digital transformation strategies and the Internet of Things.

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Cisco Catalyst IOS Software Update Program for Cisco Catalyst 9200, 9300, 9400, 9500 and 9600 Series switches

Contents

Covered Products

The Cisco Catalyst IOS Software Update Program ("Program") applies to the following Cisco® Catalyst® switches:

- Cisco Catalyst 9200 Series fixed access switches
- Cisco Catalyst 9300 Series fixed access switches
- Cisco Catalyst 9400 Series modular access switches
- Cisco Catalyst 9500 Series fixed core and aggregation switches
- Cisco Catalyst 9600 Series modular core switches

Program summary

The Cisco Catalyst IOS Software Update Program (formerly the "IOS Software Update Policy") was put in place to complement the Enhanced Limited Lifetime hardware Warranty (E-LLW) offered with Catalyst 9000 switches. Each Catalyst 9000 switch is sold with both a network stack perpetual license (Network Essentials or Network Advantage) and a Cisco DNA™ Software term-based subscription license (Cisco DNA Essentials, Advantage or Premier).

The table below provides an insight into Technical Services features.

Service Features	Catalyst IOS XE Software Update Program	Enhanced Limited Lifetime Warranty	Cisco DNA Software Subscription License Support (incl with subscription)	Smart Net Total Care (optional)	Cisco Solution Support (optional)
Warranty: 90 days of Cisco TAC support; local business hours, 8x5		●			
Warranty: Hardware replacement (next business day where available)		●			
Warranty: Duration is lifespan of hardware product		●			
Global 24x7 hardware and IOS XE TAC support (Network Essentials and Advantage)				●	●
Global 24x7 Cisco DNA subscription TAC support			●		●
24-hour access to Cisco® online resources			●	●	●
Hardware replacement (2- and 4- hour, next calendar day)				●	●
Operating system updates and upgrades	●			●	●
Cisco DNA updates and upgrades			●		●
Proactive diagnostics/immediate alerts on			●	●	●

Service Features	Catalyst IOS XE Software Update Program	Enhanced Limited Lifetime Warranty	Cisco DNA Software Subscription License Support (incl with subscription)	Smart Net Total Care (optional)	Cisco Solution Support (optional)
devices through Cisco Smart Call Home					
Web-based user community for self-service support of smart capabilities			●	●	●
Primary point of contact with solution-level expertise					●
Accountability for issue resolution, no matter where it resides					●
Coordination between Cisco and Solution Support Alliance Partner product support teams					●
Multiproduct, multivendor case management from first call to resolution					●
Service response objective for severity 1 and 2 cases				60 minute response	30 min response

This Program allows customers using a valid Cisco.com ID to receive the following:

- **Free critical updates:**
  - Free critical updates are available to the original customer for up to 1 year after announced end-of-support. These critical updates maintain the compliance of the Software with published specifications, release notes and industry wide compliance.
  - Free vulnerability and security updates are available to the original customer for up to 3 years after announced end-of-sale.
  - No support contract is required to obtain these software updates.
- **Free major and minor releases:**
  - Free major and minor release updates are available to an original customer moving from one release to another within the same perpetual license level (i.e. Cisco Network Advantage or Cisco Network Essentials).
  - No support contract is required to obtain these releases.
- **Upgrades of Cisco DNA Software subscription licenses:**
  - Upgrading from Cisco DNA Essentials to Cisco DNA Advantage or Cisco DNA Premier licenses are available for an additional fee. If the customer chooses to upgrade a Cisco DNA Software subscription license, a corresponding upgrade of the Network Stack license on the applicable switch is free.

All software (including updates and upgrades) is available on the Software Download Center tool located here: https://software.cisco.com/download/navigator.html, and is subject to the terms and conditions of Cisco's End

User License Agreement and any supplemental terms, located here: https://www.cisco.com/c/en/us/about/legal/cloud-and-software/software-terms.html.

This Program is subject to change without notice.

More information about Cisco Solution Support, Cisco Smart Net Total Care®, is located here:

https://www.cisco.com/go/solutionsupport

https://www.cisco.com/go/smartnet

Definitions

"**Maintenance Release**" means an incremental Software release that provides maintenance fixes and may provide additional Software functions. Cisco designates a Maintenance Release as a change in the digits to the right of the tenths or hundredths digit of the Software version number [x.x.(x) or x.x.x.(x)].

"Major Release" means a release of Software that provides additional software functions. Cisco designates a Major Release as a change in the ones digit of the Software version number [(x).x.x].

"Minor Release" means an incremental release of Software that provides maintenance fixes and additional software functions. Cisco designates a Minor Release as a change in the tenths digit of the Software version number [x.(x).x].

"Software" means the software programs provided by Cisco, including any copies, Updates, Upgrades, modifications, enhancements, and any derivative works thereof.

"Update" means a Maintenance Release or Minor Release.

"Upgrade" means a separately licensed and priced Software release that contains an enhanced configuration or feature set.

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