USING WAVELENGTHS OUTSIDE THE TELECOM SPECTRUM

What applications can the unused wavelengths outside of the Telecom spectrum be used for?

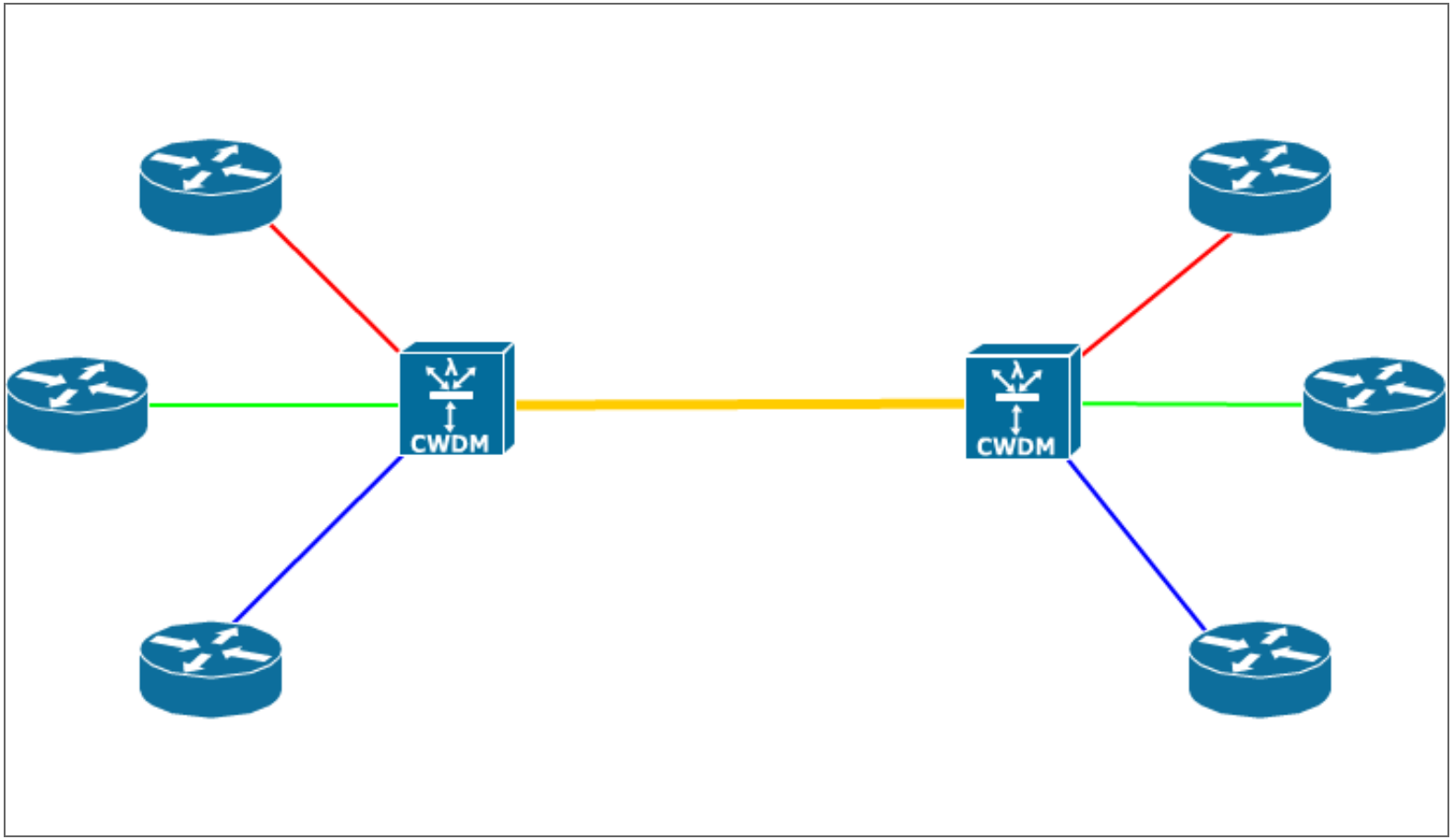
Remy de Boer

Stefan Plug

CONTENTS

THE PROJECT

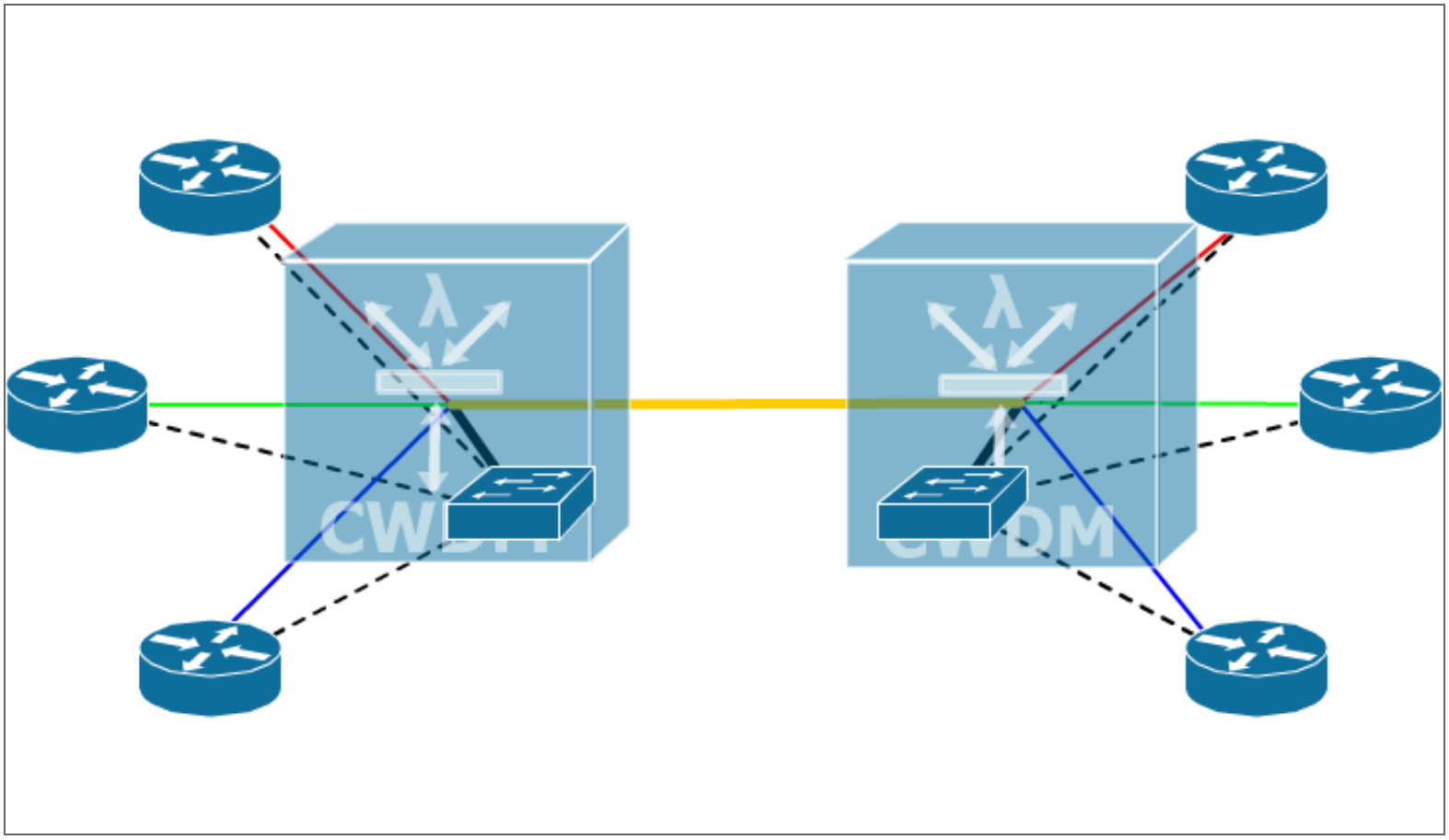
- CWDM
- passive device
- from 1270nm to 1610nm
- 20nm wide channels



Basic CWDM setup

THE PROJECT (2)

- BeetleFiberOptics
- Low-cost
- Use of extra wavelength



CWDM setup with extra out-of-band wavelength

THE ADDITIONAL WAVELENGTH

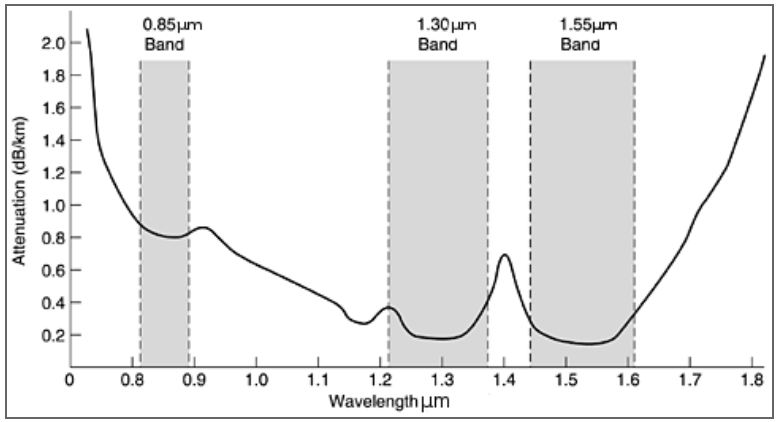
Band	Descriptor	Range [nm]
O-band	Original	1260-1360
E-band	Extended	1360-1460
S-band	Short wavelength	1460-1530
C-band	Conventional	1530-1565
L-band	Long wavelength	1565-1625
U-band	Ultra-long wavelength	1625-1675

> *“ The U-band has been defined exclusively for possible maintenance purposes. ”*

Ref: ITU-T manual 2009 P. 134

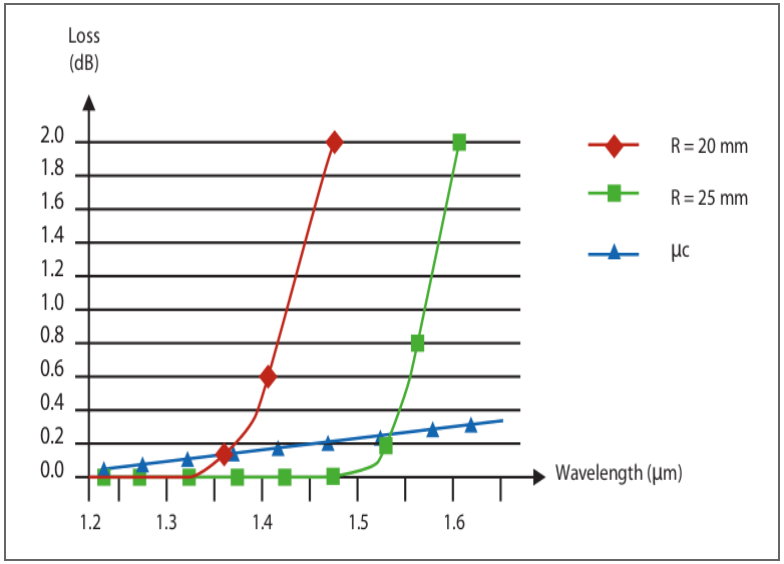
THE U-BAND

(1625 TO 1675)



Attennuation per λ per km

Ref: Computer networks, fourth edition. 2002



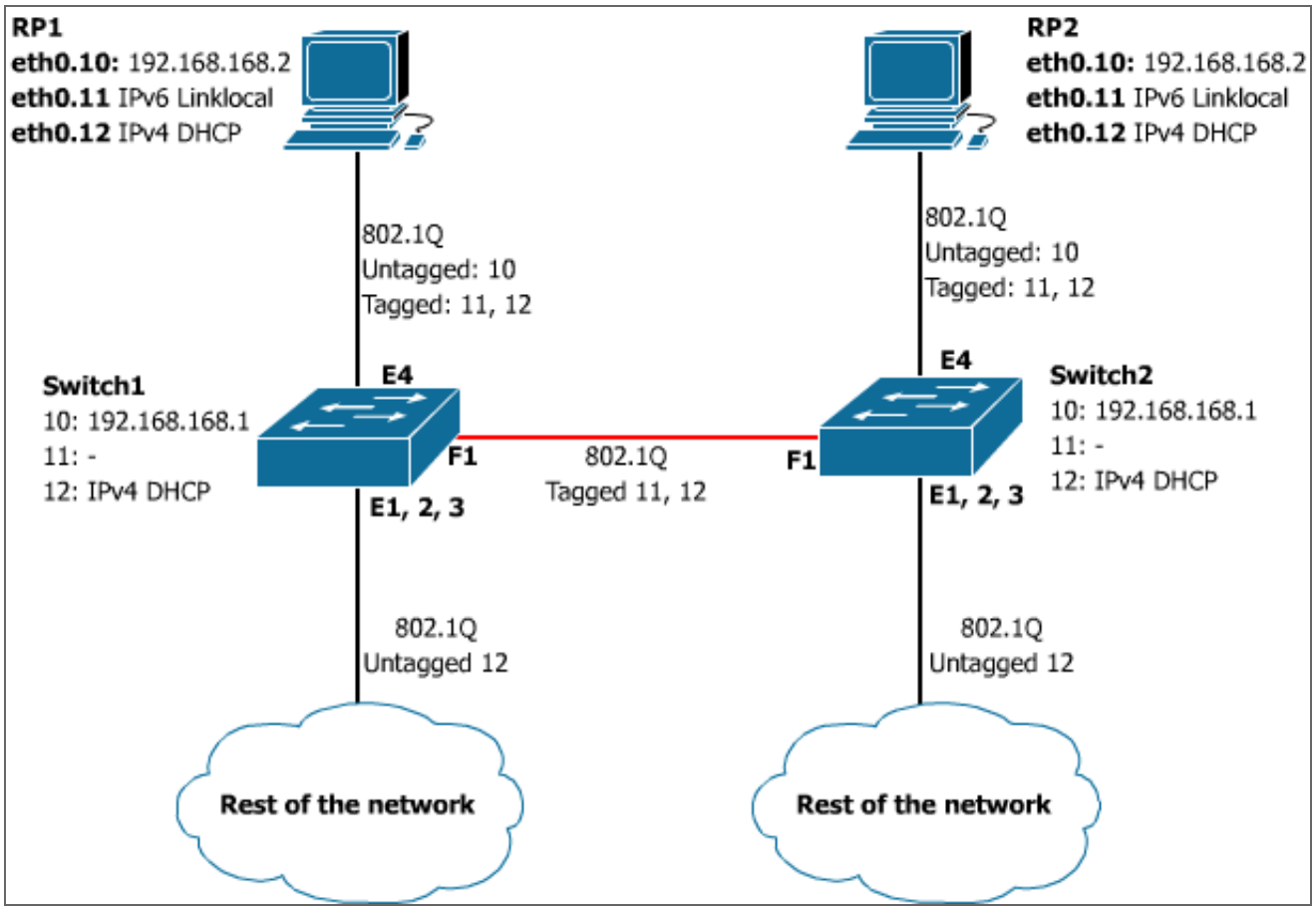
Attenuation per λ with bends

Ref: Reference Guide to Fiber Optic Testing, Second Edition, Volume 1. 2011.2

1625nm seems the logical choice

PROOF OF CONCEPT

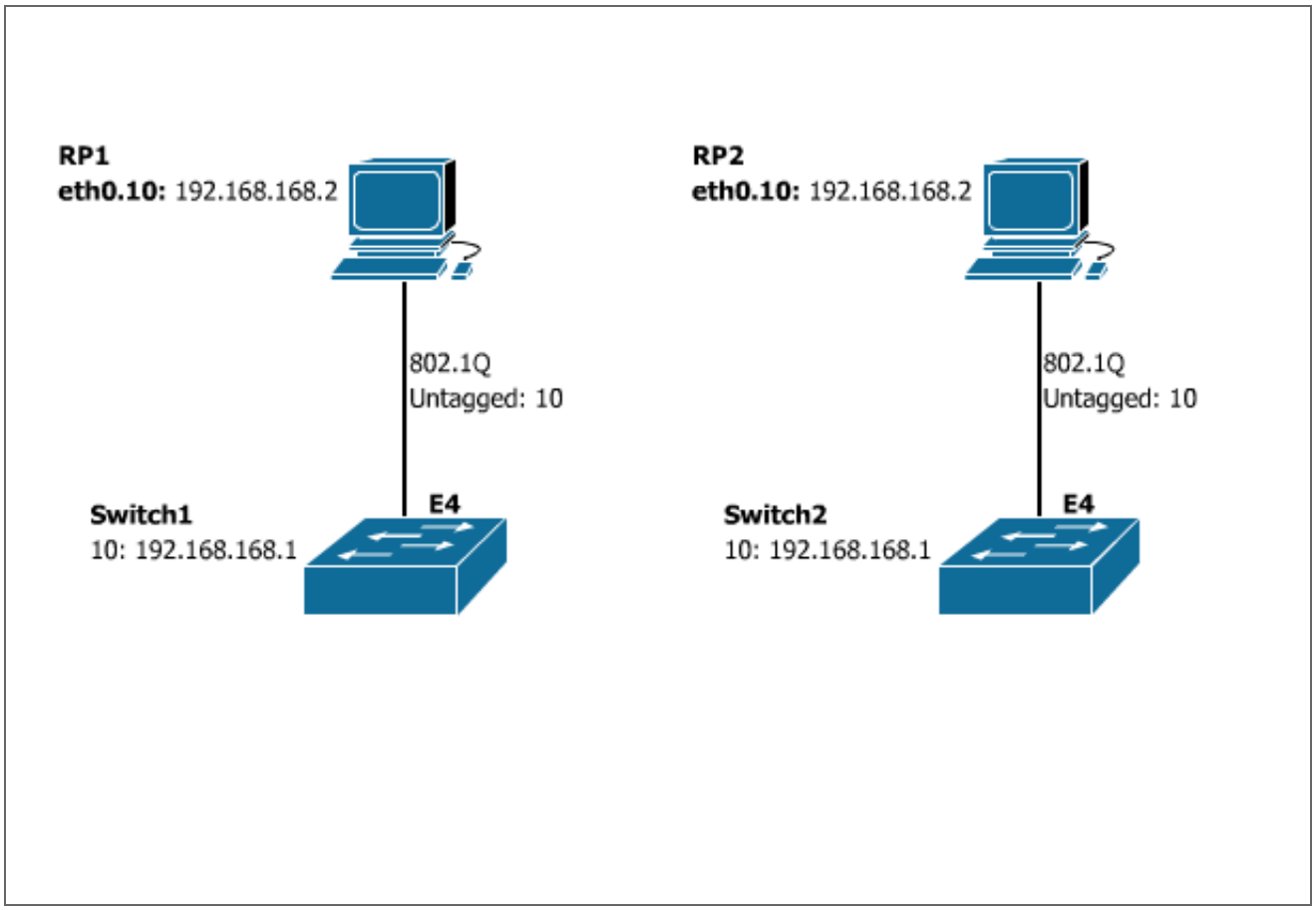
- Inteno XG6746
- Raspberry Pi
- 1625nm optics



Full network

"plug and play"

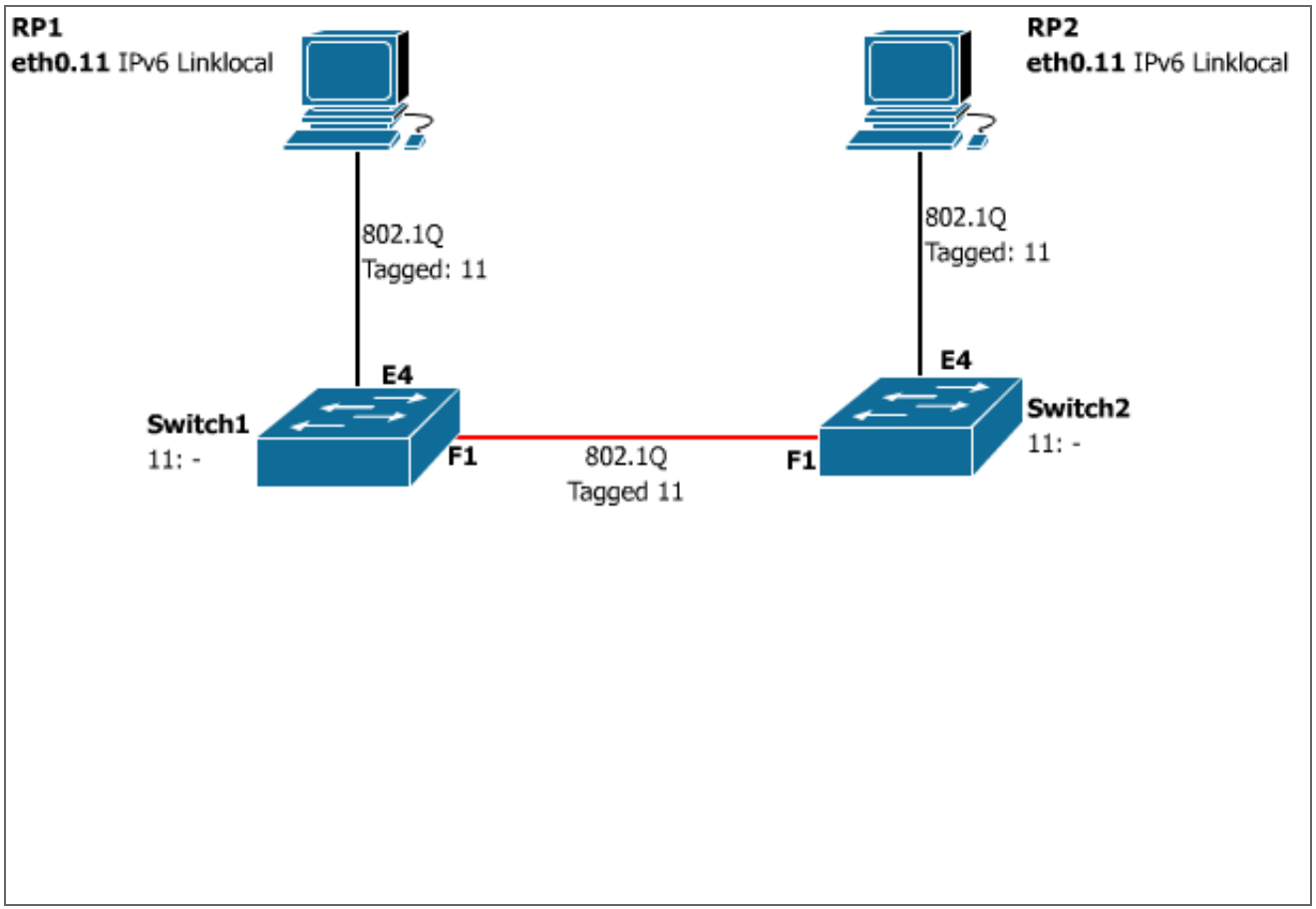
VLAN 10



VLAN 10

- RP-Switch units
- IPv4 default addressess
- RP# SNMP polls only its own switch

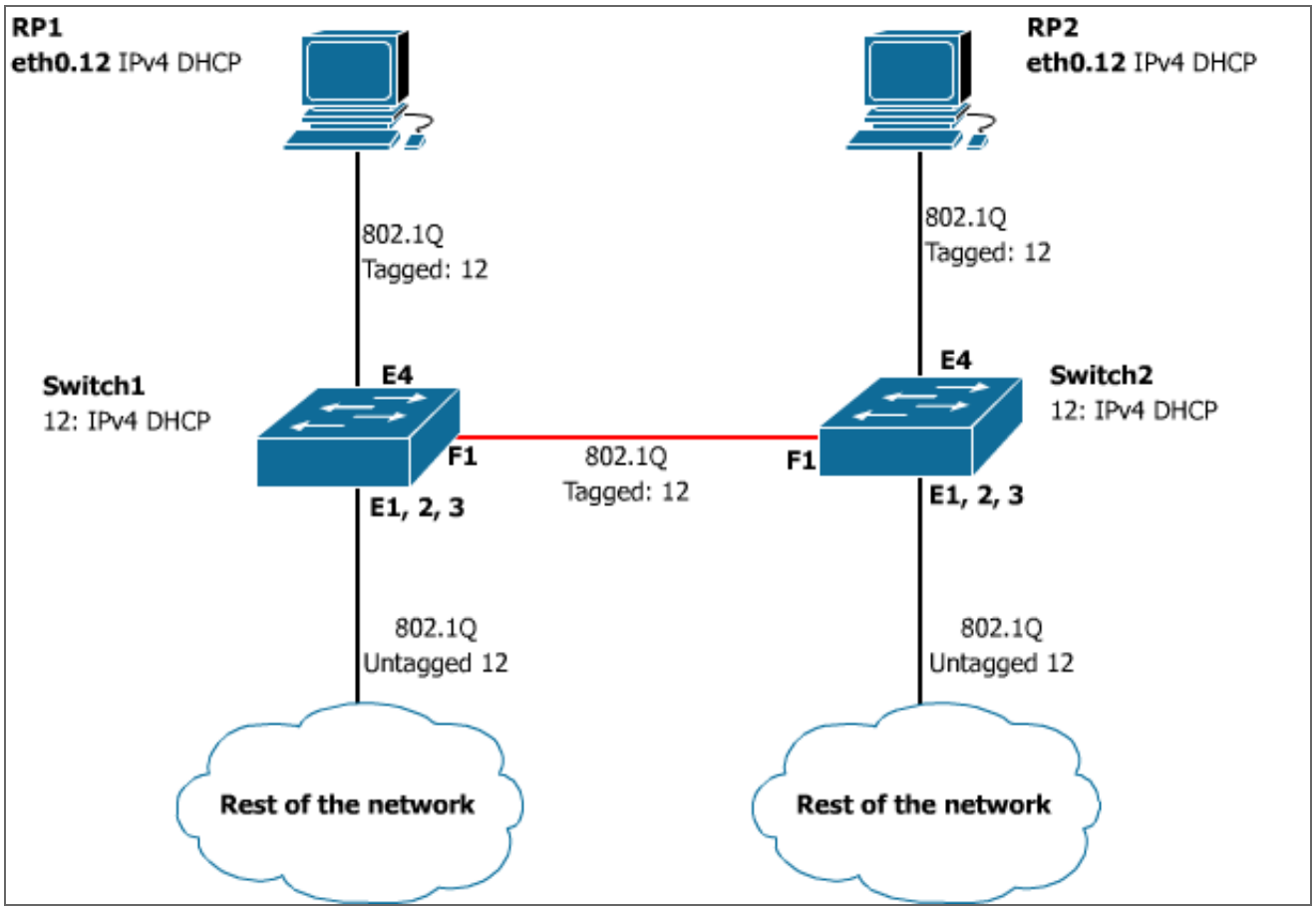
VLAN 11



VLAN 11

- RP-groups
- IPv6 Link-Local addresses
- Automatic neighbor discovery script

VLAN 12



VLAN 12

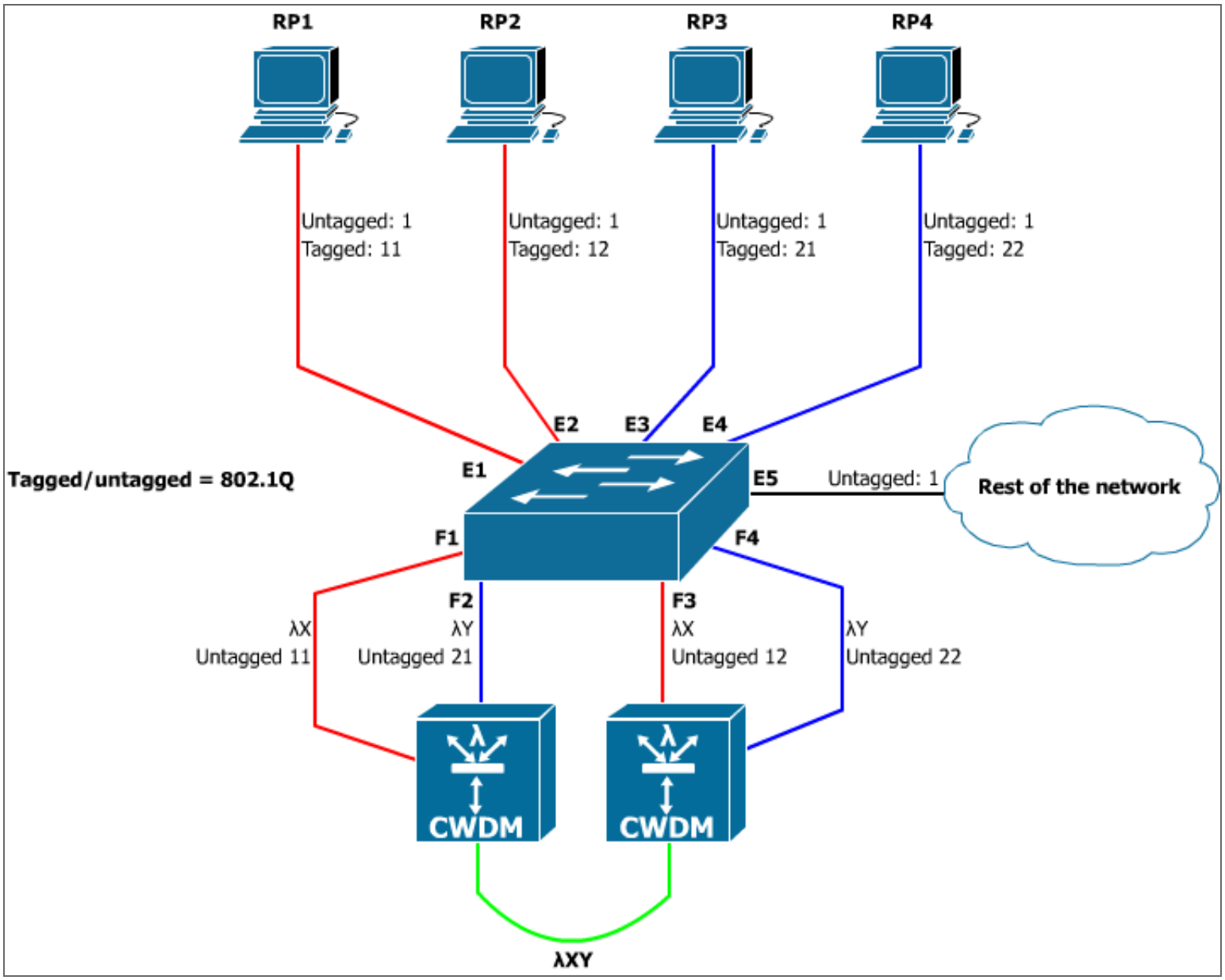
Out-of-band management

PROOF OF CONCEPT: ISSUES

- Inteno's closed-source
- Wrong DDM values

Switch	Tx	Rx	OPM measured Rx
Sw1	-4.61 dBm	-0.44 dBm	-9.8 dBm
Sw2	-4.86 dBm	-0.83 dBm	-12.4 dBm

PROOF OF CONCEPT: SECOND SET-UP



Attenuation network

- Zyxel properly reads DDM values
- $Att_{F1-F3} = Tx_{F1} - Rx_{F3}$
- Doesn't support 100mbit SPF

TESTS

- Attenuation
- Stability

ATTENUATION TEST

OTDR base test, 1550nm, 25 Km, 7.009 dB

Wavelength	1M	25KM
1550nm	-0.05 dB	8.3625 dB
1610nm	0.0875 dB	7.975 dB
1625nm	2.275 dB	14.325 dB

Wavelength	1M	25KM
1550nm	0.4425 dB	9.2325 dB
1610nm	0.62375 dB	9.2825 dB
1625nm	2.25125 dB	14.95625 dB

STABILITY TEST

10-mbit, 15 hours

Total of 62.9GB transferred

45918348 packets

RP1: iperf -suV

RP2: iperf -c fe80::ba27:eb27:ebff:fe58:69e2%eth0.11 -V -b 10000000 -t 54000

CONCLUSION

Altough 1625nm is more sensitive to:

- distance
- bending
- temerature changes

Still stable over long distances

FIN

https://github.com/remydb/rp1