



Bird[®]

DAS Product Overview



| Agenda

- Product Summary
 - Head End components
 - Fiber Interfaces
 - Remotes
 - Repeaters
- Competitive Advantages
- Quoting Information
- Application Examples



| Modularity, Flexibility and Simplicity

Scalable and supports all Commercial and Public Safety Spectrum

- Frequency Agnostic: 88MHz – 2600MHz, both public safety and commercial
- Protocol Agnostic: GSM, CDMA, UMTS, LTE, MIMO, TDD, TETRA, P25, Paging
- IP66, NEBS compliant, and NEMA 4 rated chassis

Unified and Flexible Product Platform

- Multiple Power Levels: 2W, 20W, mixed power levels
- Medium power, indoor deployments multi/single carrier adaptive
- Higher power, outdoor deployments multi/single carrier adaptive

Compact, Lightweight, Energy Efficient

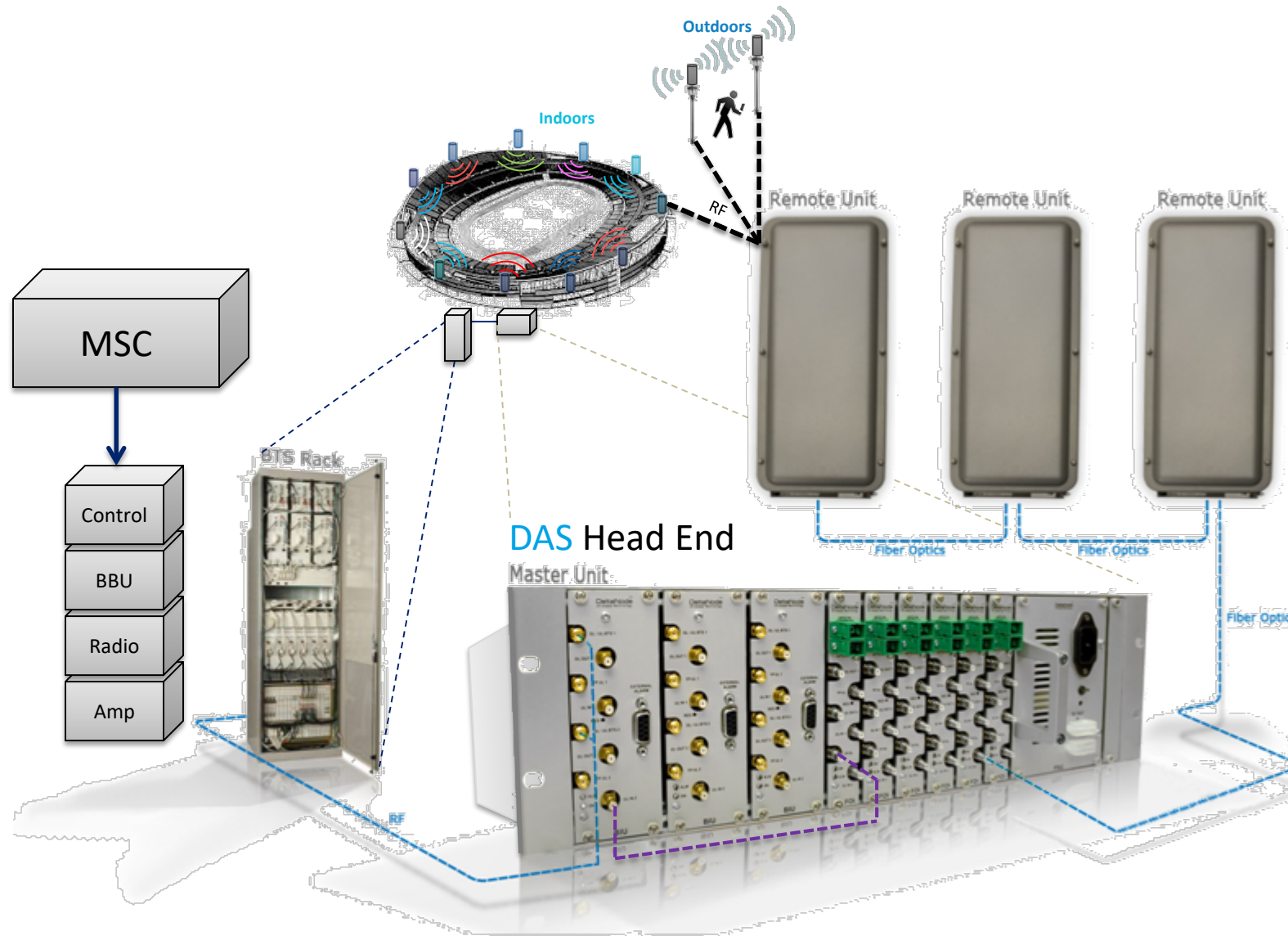
- Save headend rack space: assignable card slots, efficient use of Master Units

Ease of Maintenance

- Web GUI, SNMP, and automated database control via BGW server
- Easy setup and easy commissioning



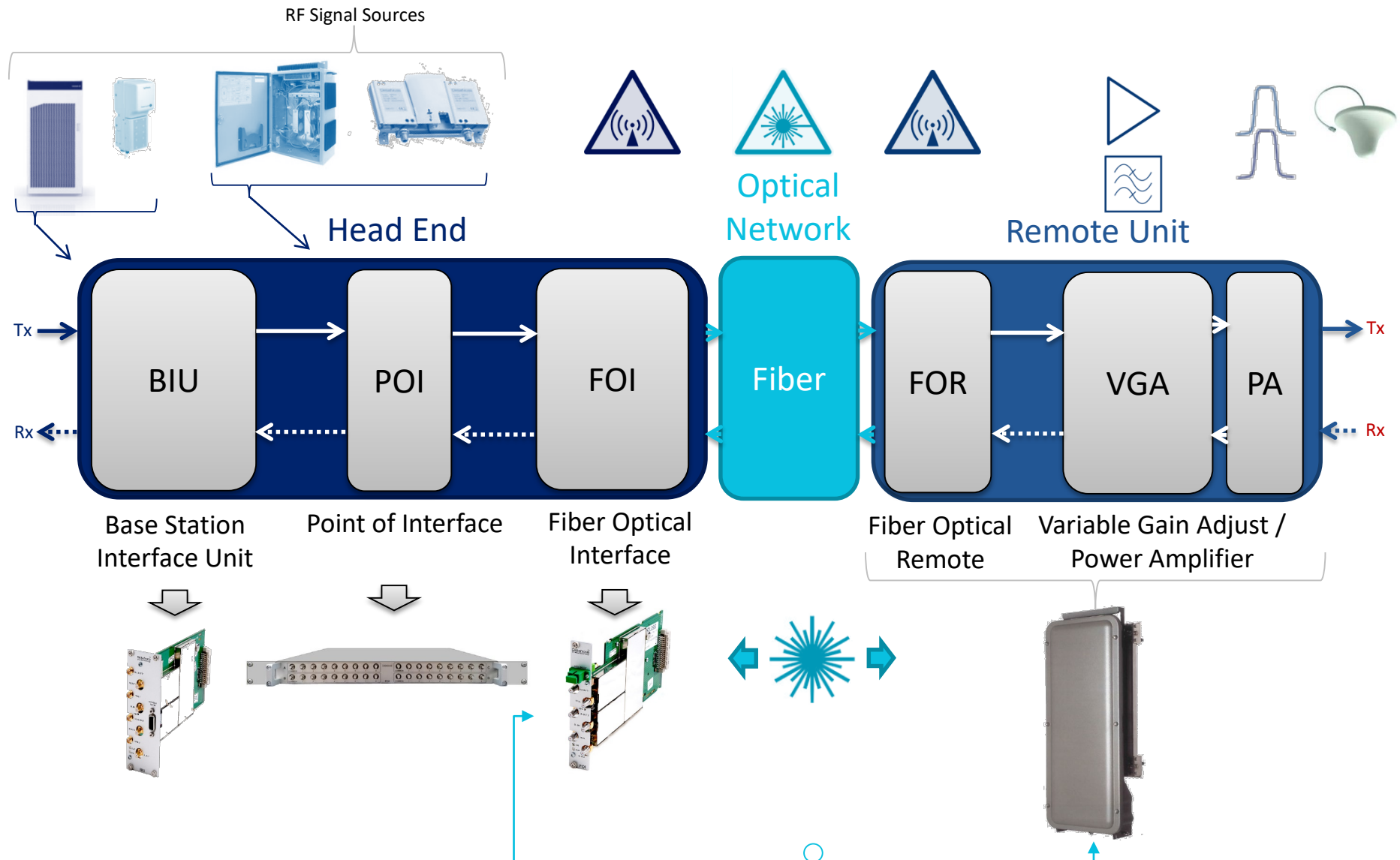
DAS Overview



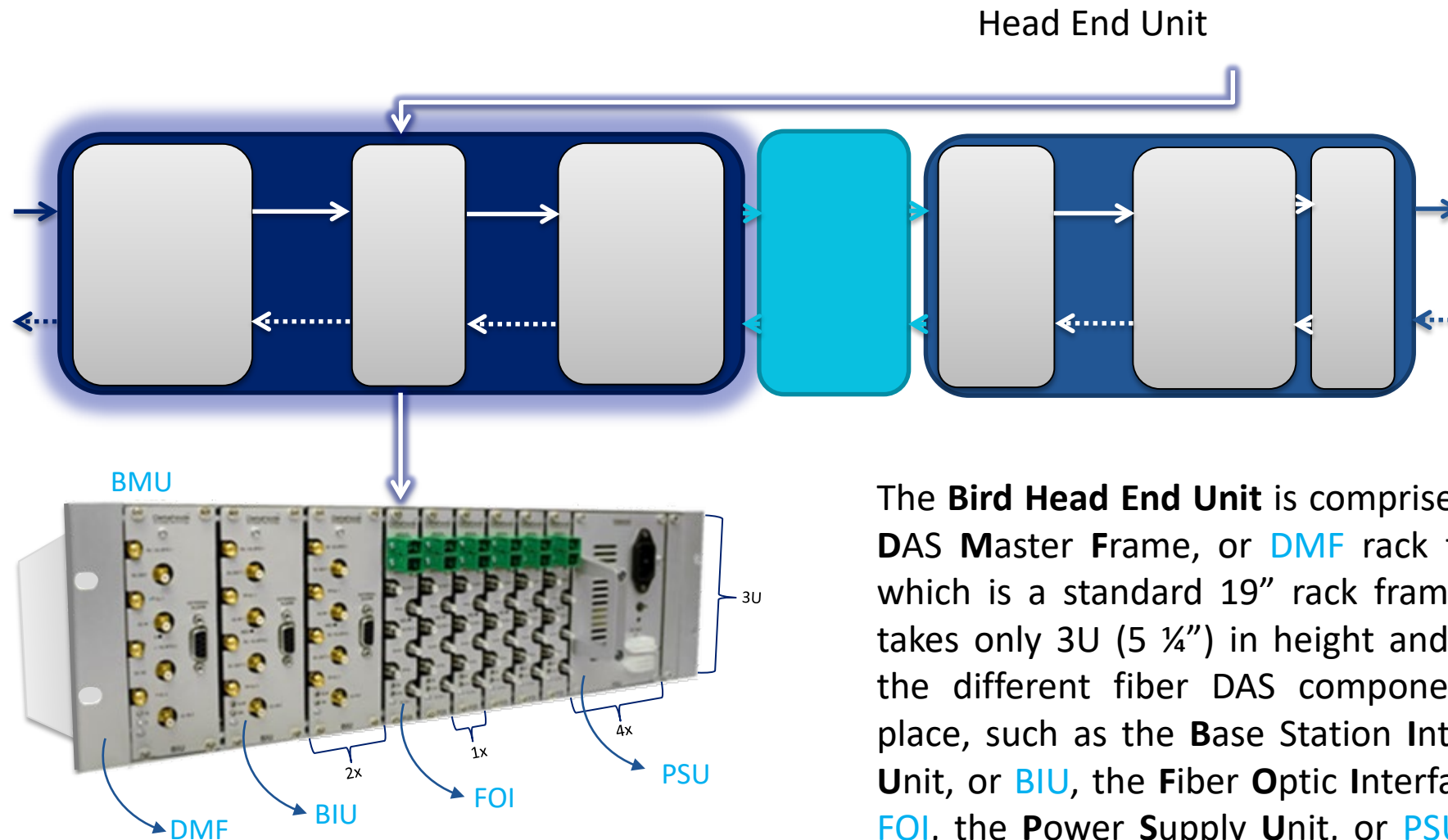
Distributed
Antenna
Systems



System Overview



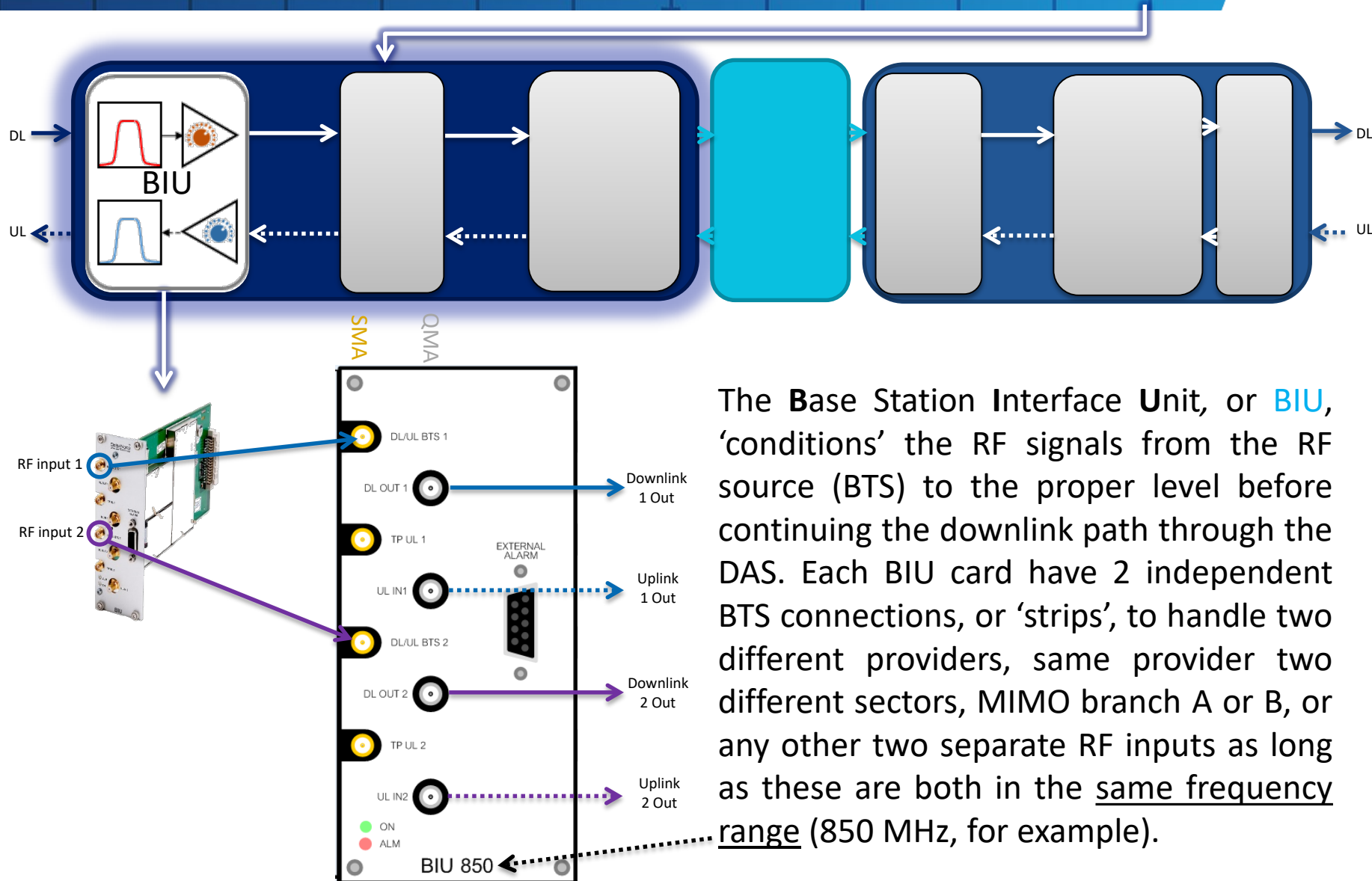
Head End Components



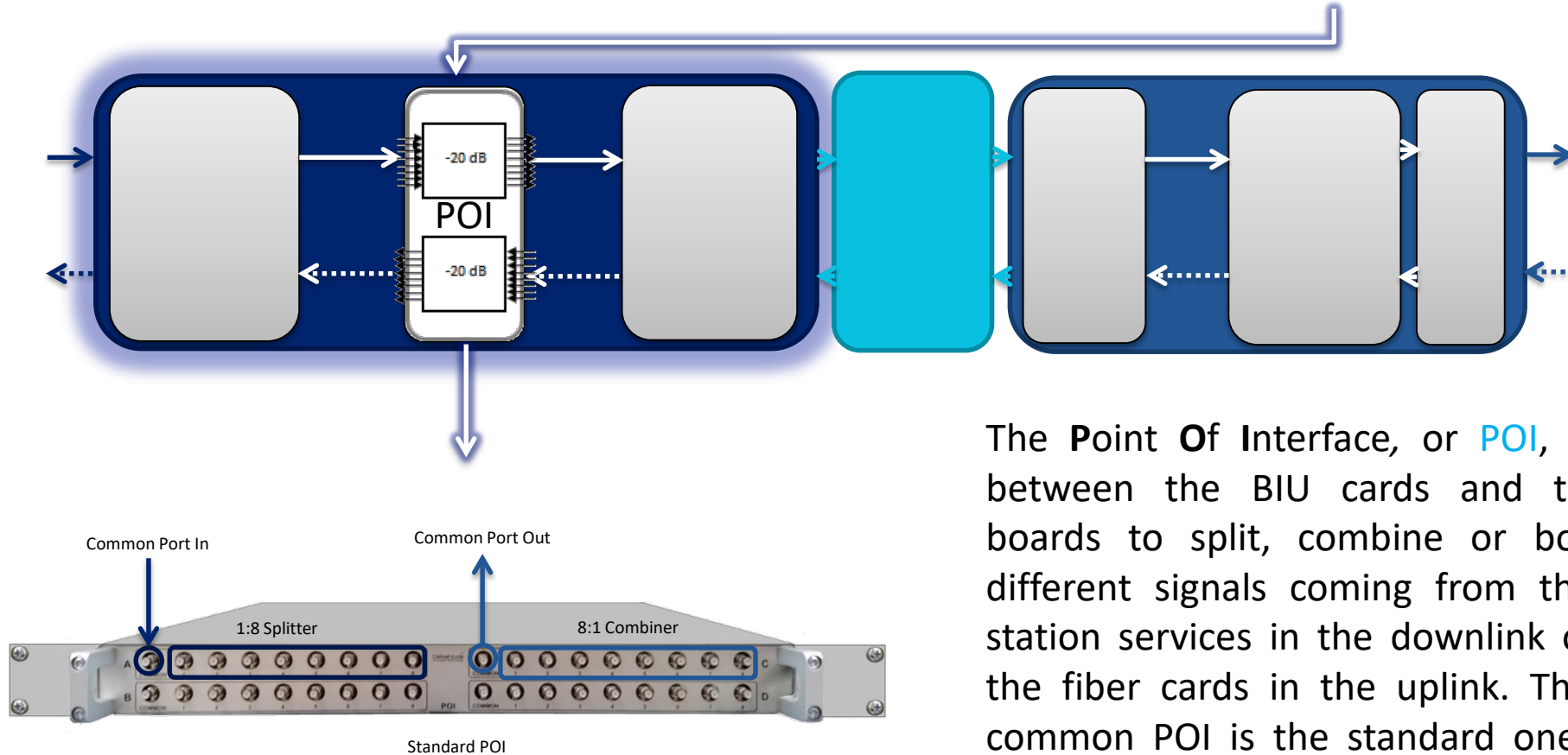
The **Bird Head End Unit** is comprised of a **DAS Master Frame**, or **DMF** rack frame, which is a standard 19" rack frame that takes only 3U (5 ¼") in height and holds the different fiber DAS components in place, such as the **Base Station Interface Unit**, or **BIU**, the **Fiber Optic Interface**, or **FOI**, the **Power Supply Unit**, or **PSU**, and others.



BIU – Base Station Interface Unit



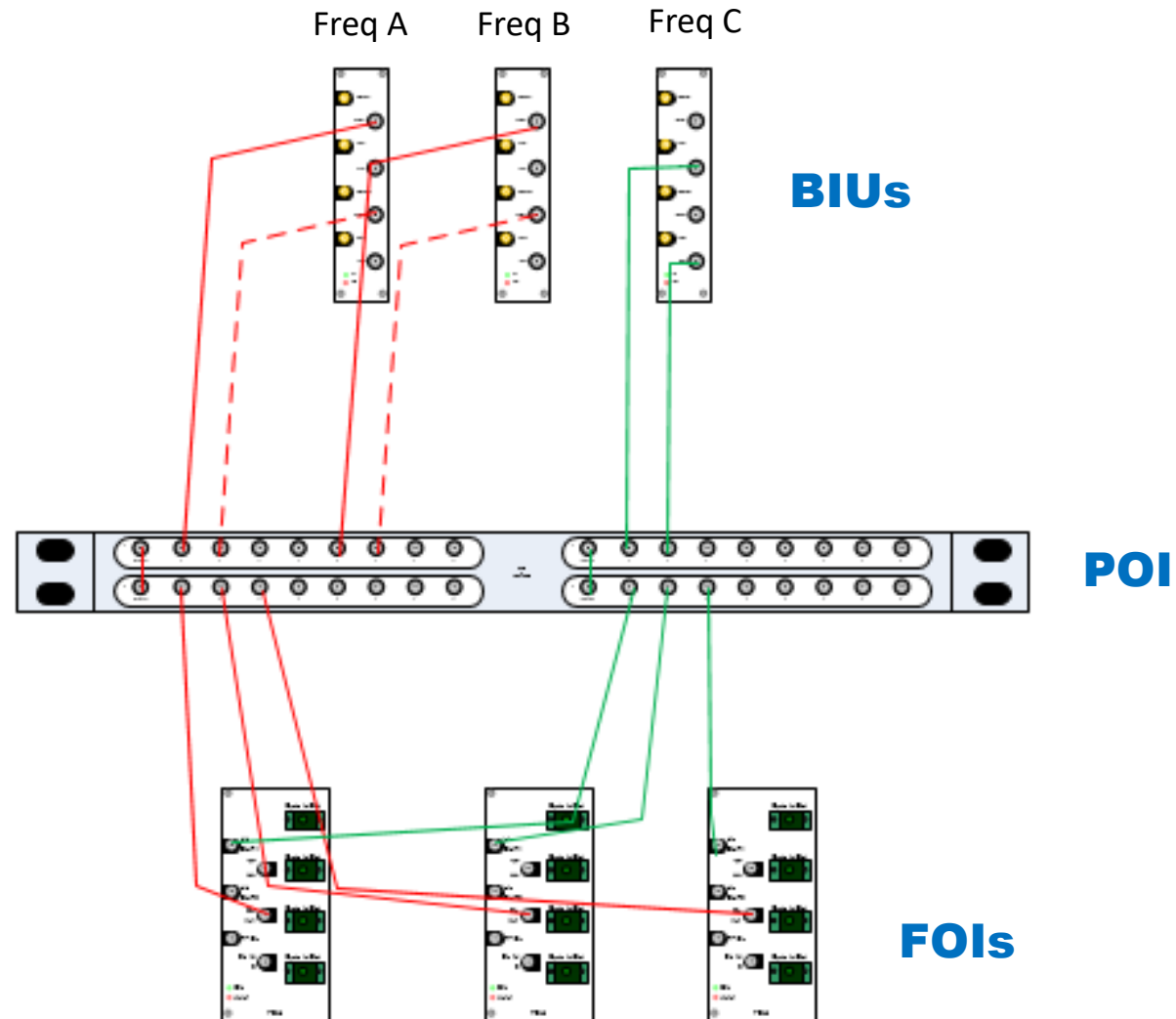
POI – Point of Interface



The **Point Of Interface**, or **POI**, is used between the BIU cards and the FOI boards to split, combine or both the different signals coming from the base station services in the downlink or from the fiber cards in the uplink. The most common POI is the standard one which consists of 4 1:8 splitters (or 8:1 combiners, depending on link).



POI Connections Example



POI - Specials

For complex systems we also have POI units with 2:2 and 4:4 hybrids as well as 1:2, 1:3 and 1:4 splitters. These are usually custom built, made to order, rack mounted (see below) or regular standalones (shown right).



2:2 hybrid coupler



1:2 splitter



1:2 (2x) & 2:2 (2x)



1:2 (4x)



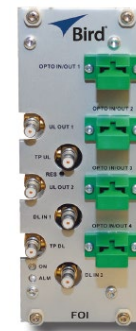
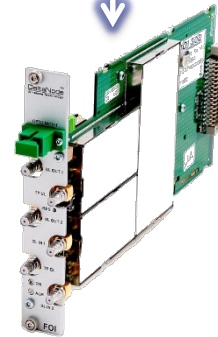
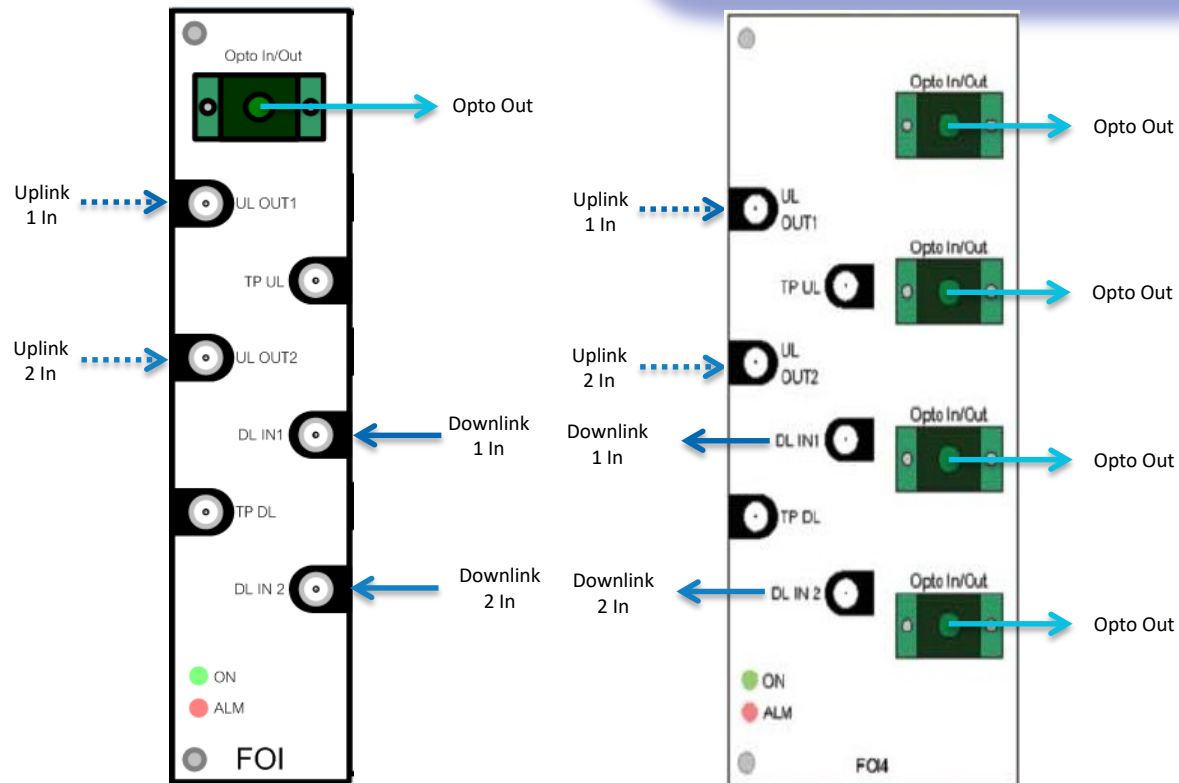
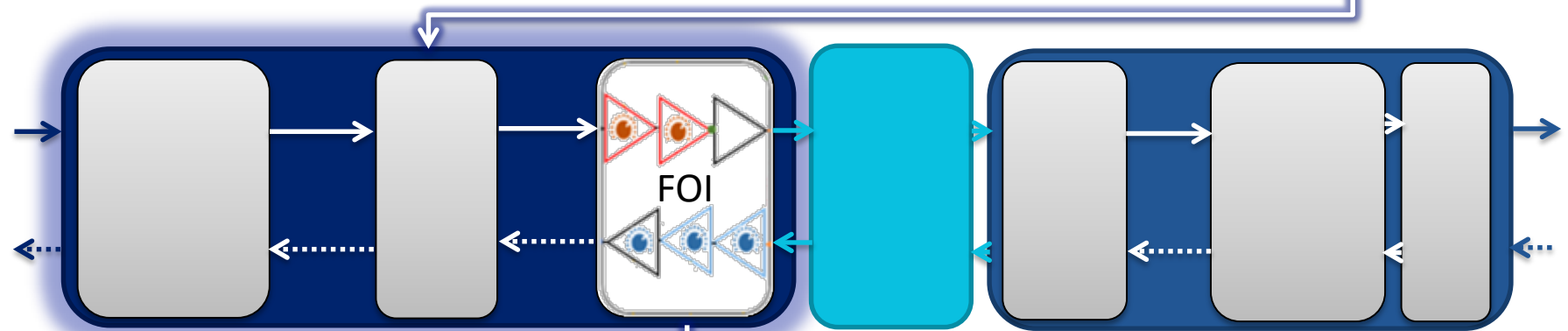
1:3 (2x)



2:2 hybrid (2x)



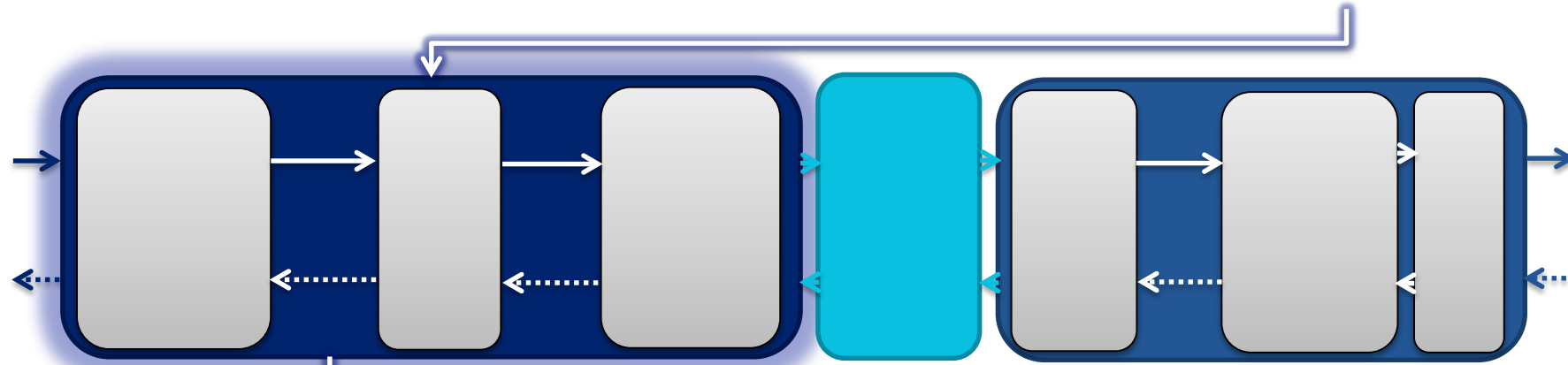
FOI - Fiber Optic Interface



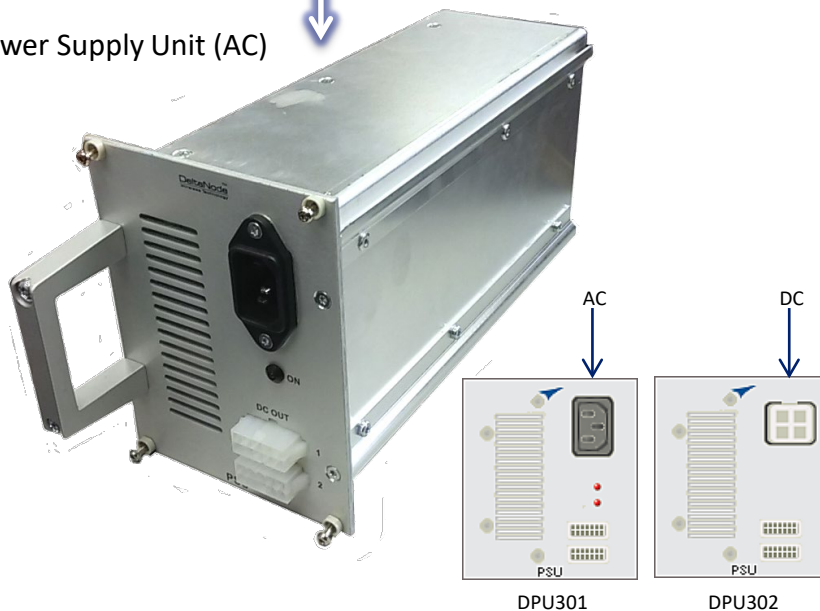
The **Fiber Optical Interface**, or **FOI**, takes analog RF downlink signals and converts them into optical laser light that can be transmitted over long distances via fiber and to the remote unit. In the uplink, the FOI detects modulated laser light and produces RF signals. The standard version has a built in **WDM** (**wavelength division multiplexing**) which allows for standard uplink wavelength (1310 nm) and downlink wavelength (1550 nm) to run on the same fiber.



PSU – Power Supply Unit



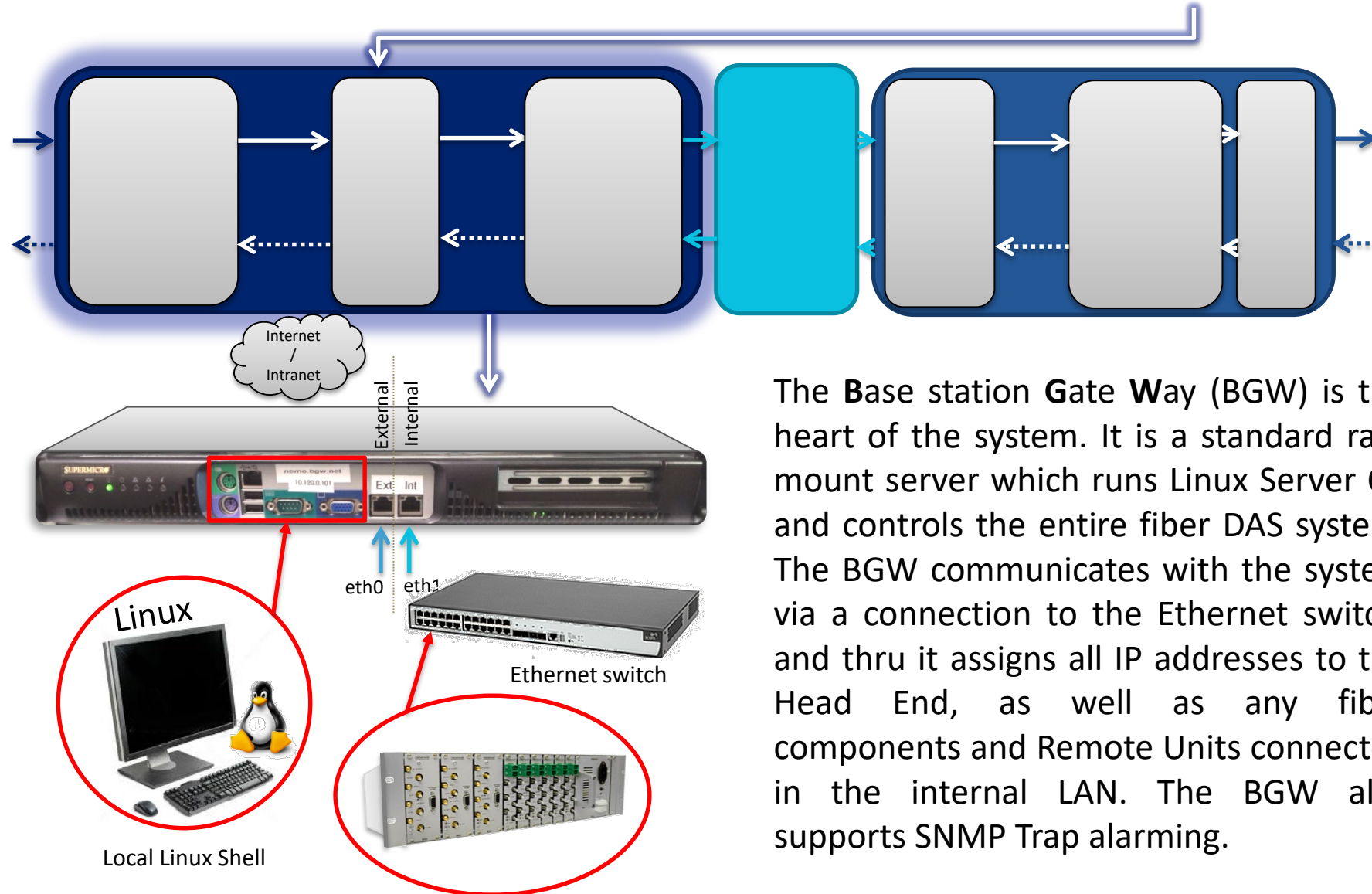
Power Supply Unit (AC)



The **Power Supply Unit**, or **PSU**, is used to supply power to the DMF rack. There are two standard PSU units: the AC version and the DC version. The AC version has an input voltage spec of 86-264 v AC with 50 or 60 Hz and has a standard IEC connector. The DC version has an input voltage spec of -72 to -36 v DC and has a special DC connector different from the AC version that can't be confused. Two PSU units can supply power to the same DMF frame for redundancy.



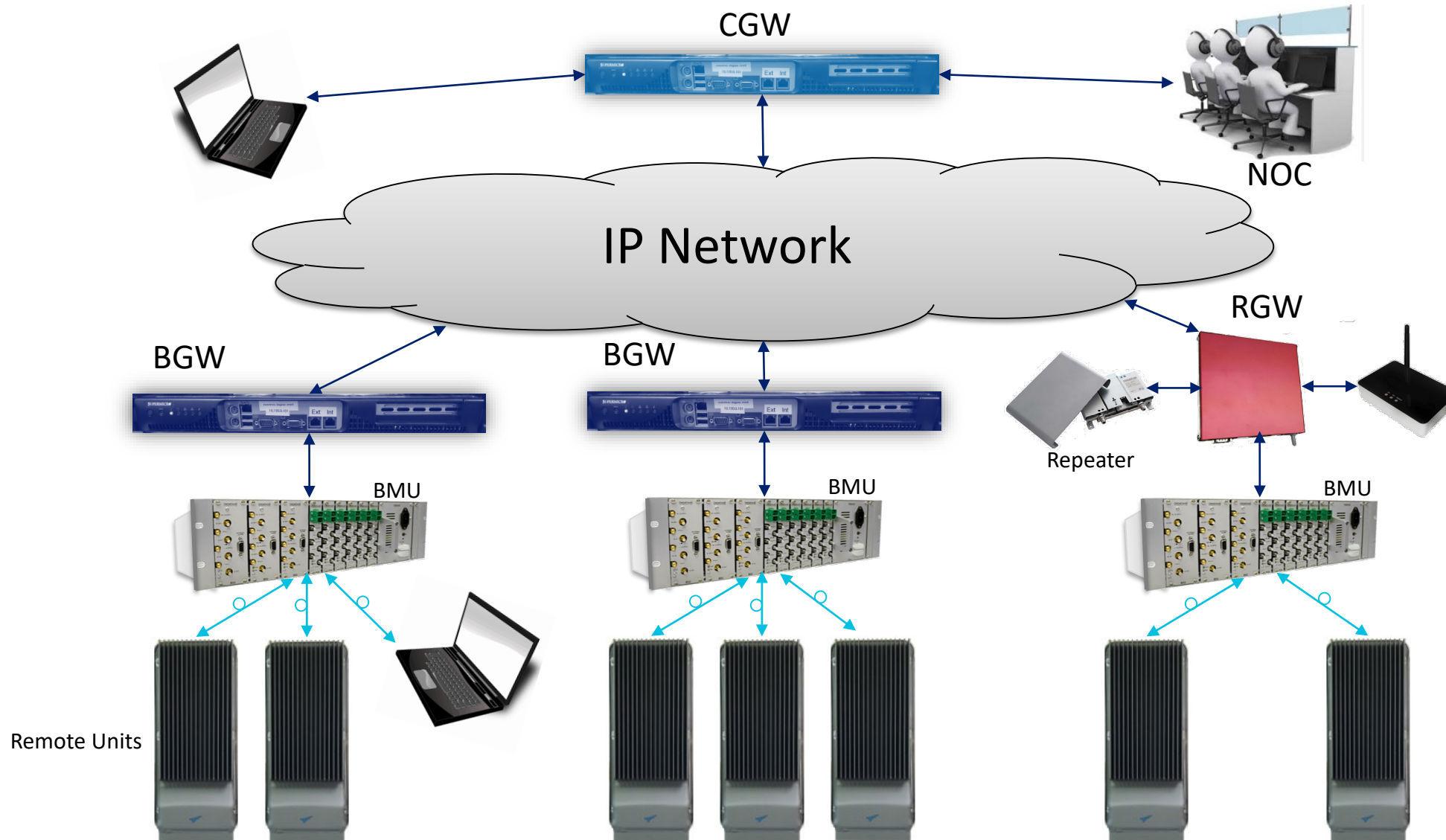
BGW – Base Station Gateway



The **Base station Gate Way** (BGW) is the heart of the system. It is a standard rack mount server which runs Linux Server OS and controls the entire fiber DAS system. The BGW communicates with the system via a connection to the Ethernet switch, and thru it assigns all IP addresses to the Head End, as well as any fiber components and Remote Units connected in the internal LAN. The BGW also supports SNMP Trap alarming.



Monitoring and Control



DAS GUI



BGW-Angola
EST -0500



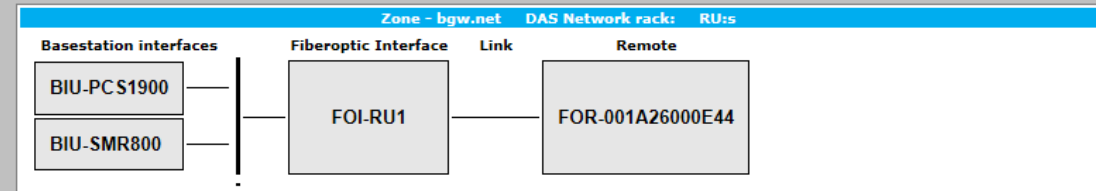
Welcome to BGW-Angola GateWay

Table of New alarms

ACK.	SEQ	HOST	A LEVEL.	Date Time (EST)	AID	Cls	Inst	Anum	MESSAGE
✓	592	biu-pcs1900	Ceased	2015-11-20 15:58:52	3146026	biu	1	42	BIU[1] Low BTS signal -55.8 dBm
✓	591	biu-pcs1900	Critical	2015-11-20 15:46:52	3146026	biu	1	42	BIU[1] Low BTS signal -16.5 dBm
✓	590	foi-ru1	Ceased	2015-11-20 10:07:56	2097464	foi	1	56	FOI[1] Received optical signal 4085 uW
✓	589	foi-ru1	Critical	2015-11-20 09:58:55	2097464	foi	1	56	FOI[1] Received optical signal 0 uW
✓	588	bgw-angola	Ceased	2015-11-20 09:51:38	65537	rgw	0	1	BGW Started. 0
✓	587	for-001a26000e44	Ceased	2015-11-20 09:34:24	65552	rgw	0	16	Node not lost any more FOR-001A26000E44.BGW.NET
✓	586	foi-ru1	Ceased	2015-11-20 09:26:50	2097464	foi	1	56	FOI[1] Received optical signal 4107 uW
✓	585	foi-ru1	Critical	2015-11-20 08:27:49	2097464	foi	1	56	FOI[1] Received optical signal 0 uW
✓	584	bgw-angola	Ceased	2015-11-20 08:23:03	65537	rgw	0	1	BGW Started. 0
✓	583	foi-ru1	Critical	2015-11-16 14:21:41	2097464	foi	1	56	FOI[1] Received optical signal 0 uW
✓	582	foi-ru1	Ceased	2015-11-16 14:16:41	2097464	foi	1	56	FOI[1] Received optical signal 2823 uW
✓	581	foi-ru1	Critical	2015-11-16 14:06:41	2097464	foi	1	56	FOI[1] Received optical signal 0 uW
✓	580	foi-ru1	Critical	2015-11-16 13:46:41	2097464	foi	1	56	FOI[1] Received optical signal 0 uW
✓	579	foi-ru1	Critical	2015-11-16 13:35:41	2097464	foi	1	56	FOI[1] Received optical signal 7 uW
✓	578	foi-ru1	Critical	2015-11-16 13:26:41	2097464	foi	1	56	FOI[1] Received optical signal 7 uW
✓	577	bgw-angola	Ceased	2015-11-16 13:22:23	65537	rgw	0	1	BGW Started. 0
✓	576	for-001a26004038	Critical	2015-11-13 16:57:06	65552	rgw	0	16	Node lost FOR-001A26004038.BGW.NET
✓	575	foi-ru1	Critical	2015-11-13 16:55:38	2097464	foi	1	56	FOI[1] Received optical signal 0 uW
✓	574	for-001a26000e44	Critical	2015-11-13 15:47:05	65552	rgw	0	16	Node lost FOR-001A26000E44.BGW.NET
✓	573	for-001a26000e44	Ceased	2015-11-11 10:41:53	65552	rgw	0	16	Node not lost any more FOR-001A26000E44.BGW.NET

Updated: Friday 2015-11-20 16:01:49

BGW-Angola
EST -0500



Updated: Friday 2015-11-20 16:04:26 (EST)

Periodic Refresh Start

Refresh

BGW-Angola
EST -0500



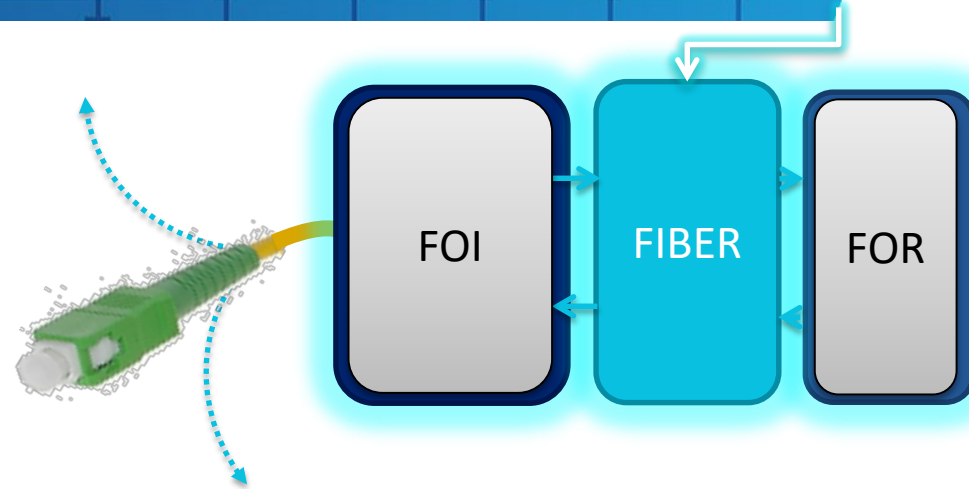
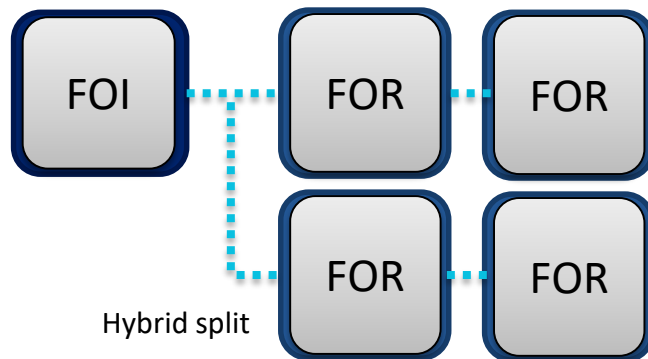
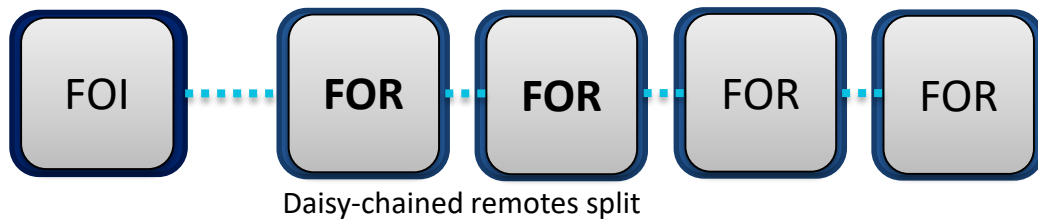
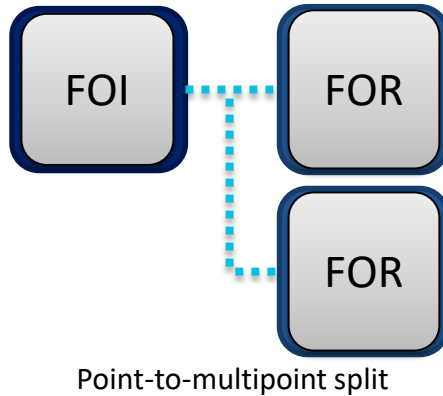
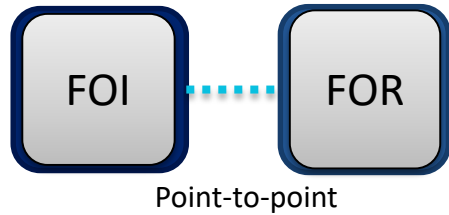
Opto Status

Variable	Value
Received optical power Uplink	0 uW
RF signal level in Downlink	-14.6 dBm
RF signal level in Uplink 1	-99.9 dBm
RF signal level in Uplink 2	-99.9 dBm
Temperature	34 degC
Att.1 Downlink 1	14.1 dB
Att.2 Downlink 1	14.1 dB
Att.1 Downlink 2	13.1 dB
Att.2 Downlink 2	13.1 dB
Att.1 Uplink common	20 dB
Att.2 Uplink common	20 dB
Att. Uplink 1	20 dB
Att. Uplink 2	10 dB
Rx opto power UL	-3276.8 dBm
Tx opto power DL	4.6 dBm

Reload



Fiber Interfaces



There are several ways to arrange fibers from the master unit to the remote units. The simplest way (*and the most common DeltaNode recommended one for link budget reasons*) is to install a single fiber to each and every remote unit, but there are several other strategies where the fiber is split to 2,3 or up to 4 remote units. The four primary fiber split fiber strategies employed by DeltaNode are:

- Point-to-point (*no split*) ●●
- Point-to-multipoint split (*multidrop*) ●●●
- Daisy-chained remotes split (*multidrop*) ●●●●●
- Hybrid split (*multidrop*) ●●●●



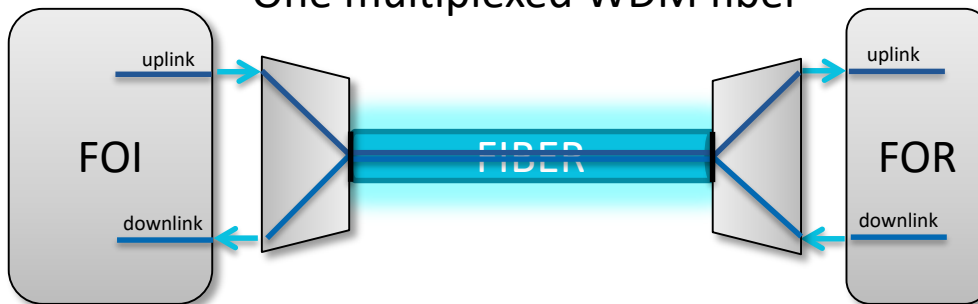
WDM and CWDM

Two independent, non WDM fibers



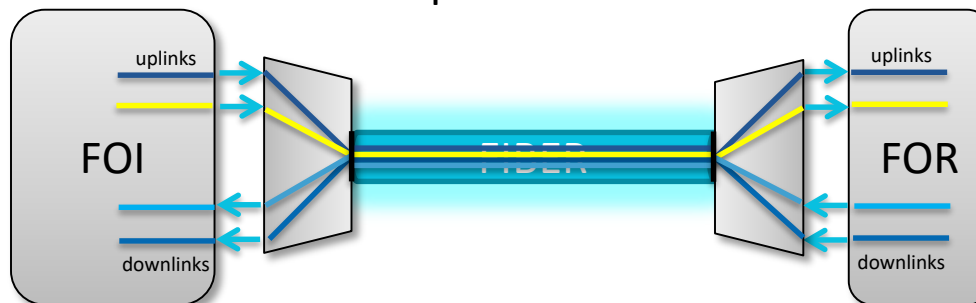
Wavelength Division Multiplexing is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (or *colors*) of laser light.

One multiplexed WDM fiber



WDM systems usually combines, or *duplexes*, just two signals (uplink and downlink) into one physical fiber.

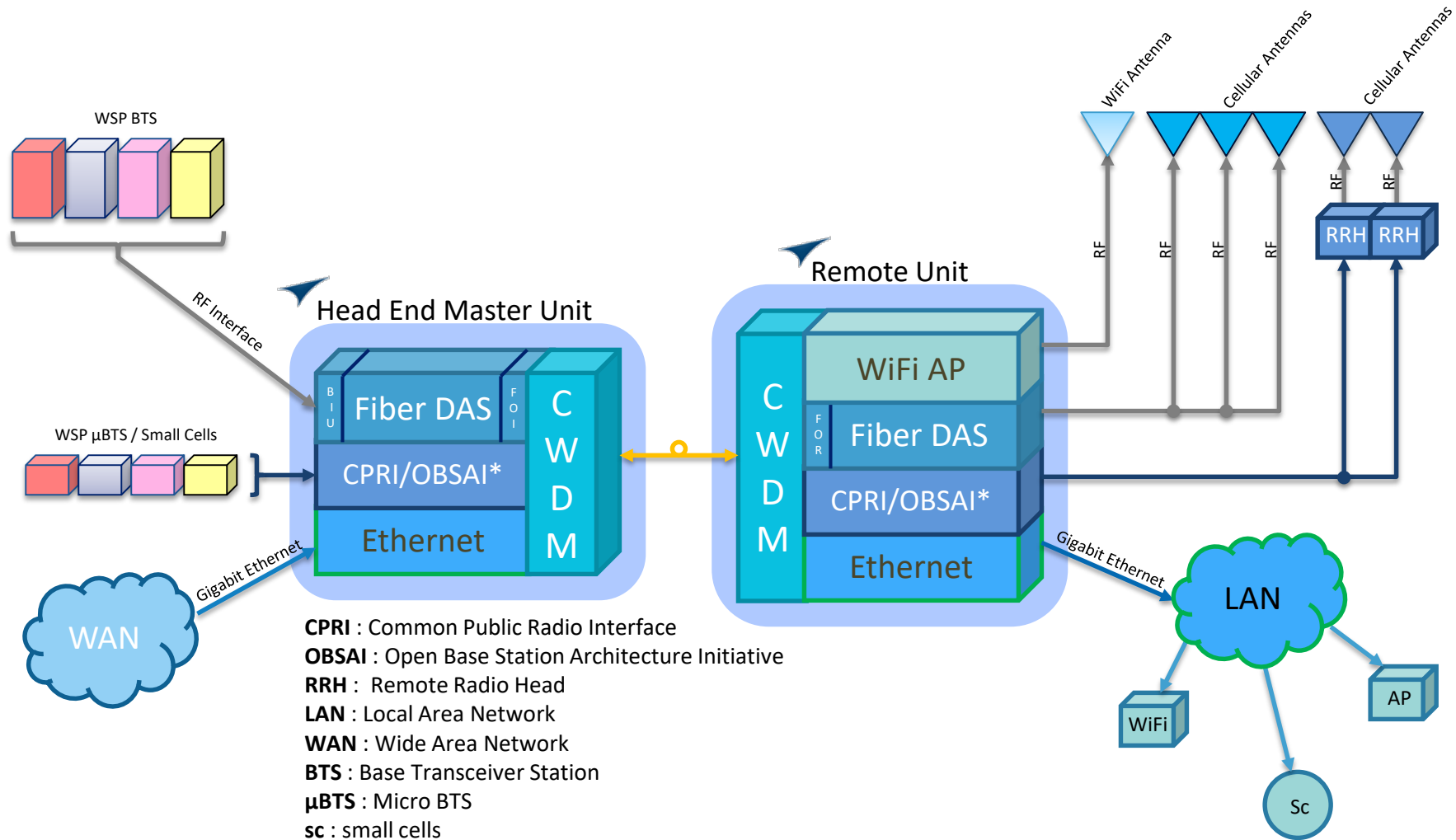
One multiplexed CWDM fiber



CWDM, or **Conventional / Coarse Wavelength Division Multiplexing**, allows for up to 8 channels* in the silica fiber C band to be multiplexed together into one physical strand.



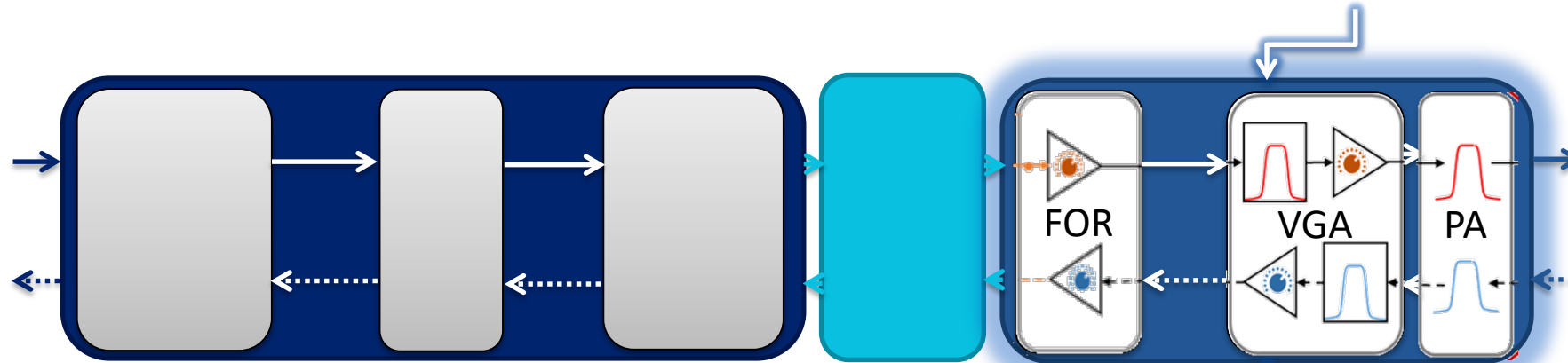
Single Net Solution



CPRI : Common Public Radio Interface
OBSAI : Open Base Station Architecture Initiative
RRH : Remote Radio Head
LAN : Local Area Network
WAN : Wide Area Network
BTS : Base Transceiver Station
μBTS : Micro BTS
sc : small cells
AP : Access Point
CWDM : Coarse Wavelength Division Multiplexing
WSP : Wireless Service Provider
**pass-through*



Remote Units



The **DAS Remote Unit** is the last piece in the DeltaNode DAS puzzle. The remote unit contains its own optical interface, known as the **Fiber Optic interface - Remote (FOR)** to convert the modulated light RF signals coming from the Head End back into radio waves to be amplified and propagated at the intended service area. It also contains a **Variable Gain Amplifier (VGA)** and **Power Amplifier (PA)**, with gain blocks to compensate for losses to/from the Head End (FOR) and optimal power output to the antenna (PA).



compact

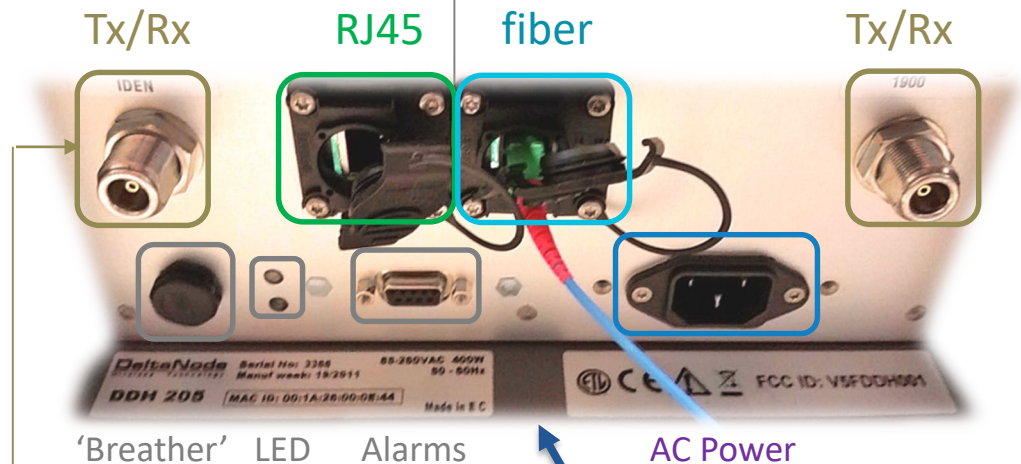
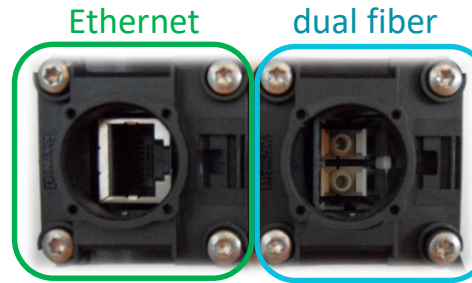


'clamshell'



Fiber Connections to Remotes

Fiber ports are SC-APC and can, either, be single fiber (WDM/CWDM) or dual uplink/downlink fibers. Ethernet port is a standard RJ 45 port.



RF ports can, either, be simplex, duplex, N, 7/16 DIN, 4.3-10 depending on configuration. External alarm is 9 pole IP67 D-sub female.

AC Power

AC mains is 3-pole C14 connector



Remote Nomenclature

DeltaNode employs a product code scheme for all Remote Units that consists of **three letters**, followed by **one number** and then various mixed indicators (characters and numbers) that represent **special options**:

The first 2 letters are for DeltaNode DAS:

DD__

The next third letter indicates the type series:

DDR for Regular **33** dBm per band

The fourth character is the number of bands:

DDR4 for 4 band remote unit

The next characters represent various options:

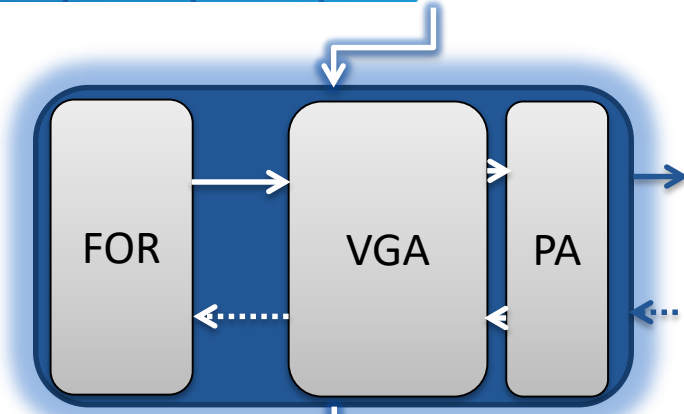
Legacy

DD series
Regular Power Remote (2W)
4 Bands
Sequential Series
DDR412

or

New

DD series
Regular Power Remote (2W)
4 Bands
700 Full Band
850 Cell Band
PCS Band
AWS Band
Duplexing
AC power
N connectors
WDM
1310nm wavelength
DDR4-GCPA1-ANW-C



Double 'clamshell'
Remote Unit



Remote Variants



DDx Compact

DDR - One or Two bands
DDH- One band

- Compact or Clamshell design
- Convection cooled
- IP65 rated
- Pole or wall mount
- External Alarm inputs/outputs
- Various Node Models
 - **DDR** Regular Power (up to 2W)
 - **DDH** High Power (up to 20W)
 - **DDX** combinations of the above



DDx Clamshell

DDR – Three or Four bands
DDH- Two bands
DDX – One to Two **DDR** band
and
- One **DDH** band



Remote Power per Band (N. Am)

Max Composite (dBm)					
BAND	3GPP BAND	UPLINK	DOWNLINK	DDR	DDH
VHF*		150-174	150-174	33	-
UHF*		450-512	450-512	33	-
LTE700 ABC	12	698-716	728-746	33	-
LTE700 UpperC	13	776-787	746-757	33	-
LTE700 Full	12/13	698-716 776-787	728-757	33	-
PS 700		793-805	763-775	33	-
800 SMR IDEN	27	806-824	851-869	33	40
850 CELLULAR	5	824-849	869-894	33	43
PCS 1900	25/2	1850-1915	1930-1995	33	43
AWS-3 2100	4, 10	1710-1780	2110-2180	33	43
LTE 2600	7	2500-2570	2620-2690	33	43



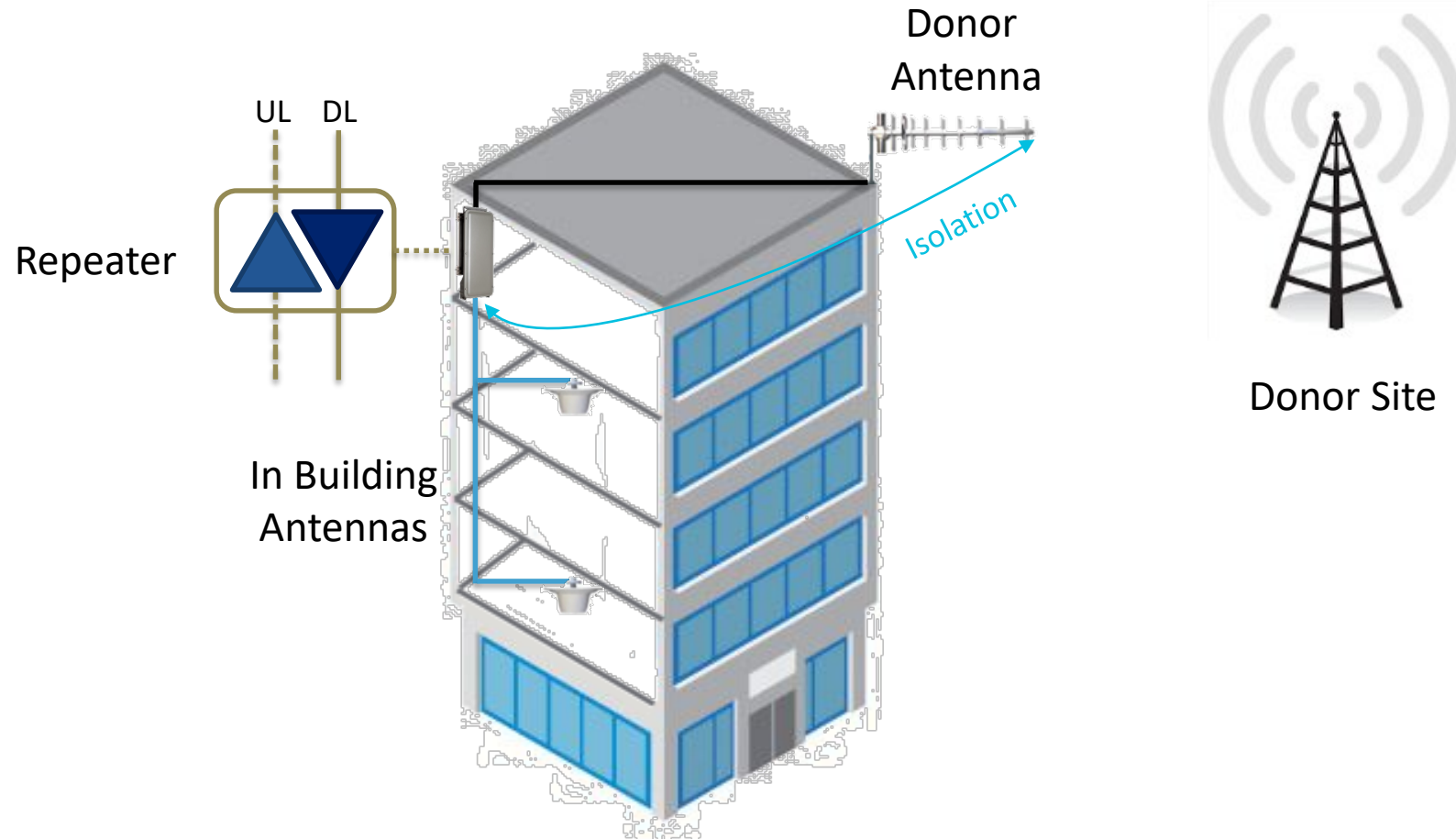
Remote Power per Band (ROW)

			Max Composite (dBm)		
BAND	3GPP BAND	UPLINK	DOWNLINK	DDR	DDH
FM		-	88-108	22	-
TETRA VHF		136-174	136-174	22	-
TETRA, Public Safety		380-385	390-395	26	33
TETRA, Commercial		410-415	420-425	26	-
TETRA, Commercial		415-420	425-430	26	-
DD800		832-862	791-821	26	40
GSM-R 900		876-880	921-925	26	40
E-GSM 900	8	880-915	925-960	26	40
GSM1800	3	1710-1785	1805-1880	28	40
UMTS 2100	1	1920-1980	2110-2170	30	43
LTE 2600	7	2500-2570*	2620-2690*	30	43



Repeater Application

Simple repeater DAS diagram

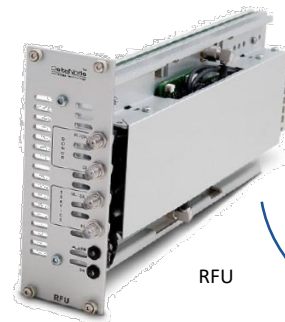
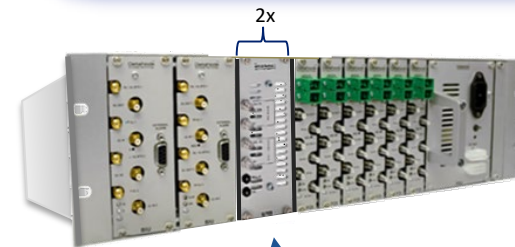
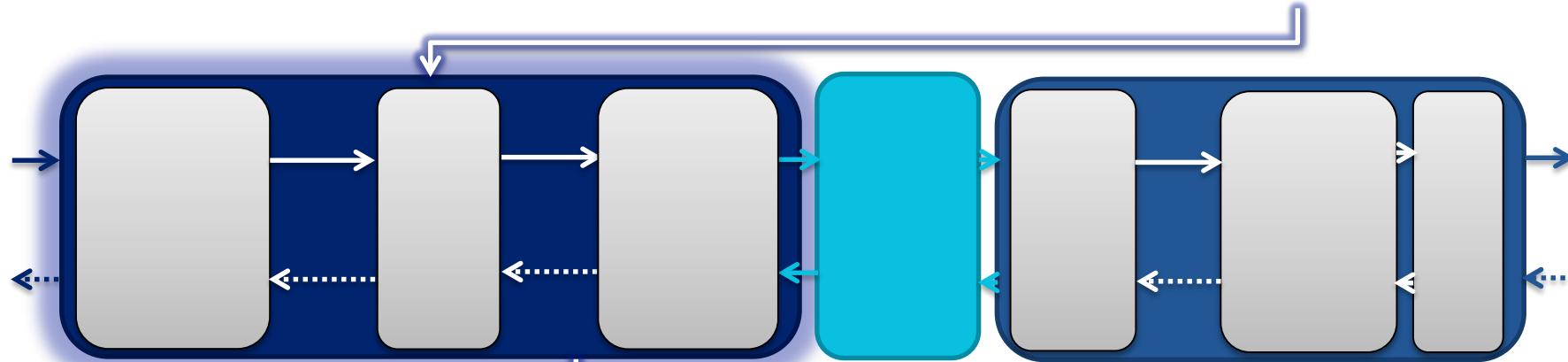


DLR600 – Low Power Repeaters

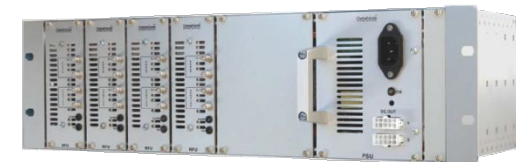
- Repeater for indoor use
- Up to 70 dB of Gain
- Variable bandwidth (up to 35 MHz)
- External power supply
- 13 (ETSI) - 16dBm (FCC) output power
- Built-in duplex filters
- No RGW



DMR400 – Repeaters



Medium Power Repeaters can be configured as a standalone independent 19" rack or as part of a DAS Head End system.



DHR800 – High Power Repeater



- Rugged chassis for use in any environment
- Variable bandwidth (up to 35 MHz)
- IP65 chassis
- DHR800 can support multiple bands
- 26 (ETSI) to 33 (FCC) dBm output power DL
- 19 (ETSI) to 25 (FCC) dBm output power UL
- Can include RGW for remote control and monitoring
- Alarm options



Repeater Bands Available

BAND	3GPP BAND	UPLINK	DOWNLINK	Compliance	Product & Max Output (dBm)									
TETRA, Public Safety	-	380-385	390-395	ETSI	DHR 801				DMR 401				DMR 801	
					20 UL	26 DL			19 UL	19 DL			19 UL	19 DL
TETRA, Commercial	-	410-415	420-425	ETSI	DHR 802				DMR 402				DMR 802	
					20 UL	26 DL			19 UL	19 DL			19 UL	19 DL
TETRA, Commercial	-	415-420	425-430	ETSI	DHR 803				DMR 403				DMR 803	
					20 UL	26 DL			19 UL	19 DL			19 UL	19 DL
CDMA450	-	458-460	468-470	ETSI	DHR 811				DMR 411				DMR 811	
					18 UL	26 DL			19 UL	19 DL			19 UL	19 DL
700 Lower ABC	12	698-716	728-746	-					DMR 405					
					-	-			25 UL	25 DL			-	-
700 Upper C	13	776-787	746-757	-					DMR 404					
					-	-			25 UL	25 DL			-	-
800 SMR IDEN	27	806-824	851-869	-	DHR 807		DLR 607		DMR 407		DMR 607		DMR 807	
					25 UL	33 DL	16 UL	16 DL	25 UL	25 DL	25 UL	25 DL	25 UL	25 DL
850 CELLULAR	5	824-849	869-894	-	DHR 808		DLR 608		DMR 408		DMR 608		DMR 808	
					25 UL	33 DL	16 UL	16 DL	25 UL	25 DL	25 UL	25 DL	25 UL	25 DL
GSM-R 900	-	876-880	921-925	ETSI	DHR 810				DMR 410		DMR 610		DMR 810	
					19 UL	26 DL			19 UL	19 DL	19 UL	19 DL	19 UL	19 DL
E-GSM 900	8	880-915	925-960	ETSI	DHR 809		DLR 609		DMR 409		DMR 609		DMR 809	
					19 UL	26 DL	13 UL	13 DL	19 UL	19 DL	19 UL	19 DL	19 UL	19 DL



Competitive Advantages



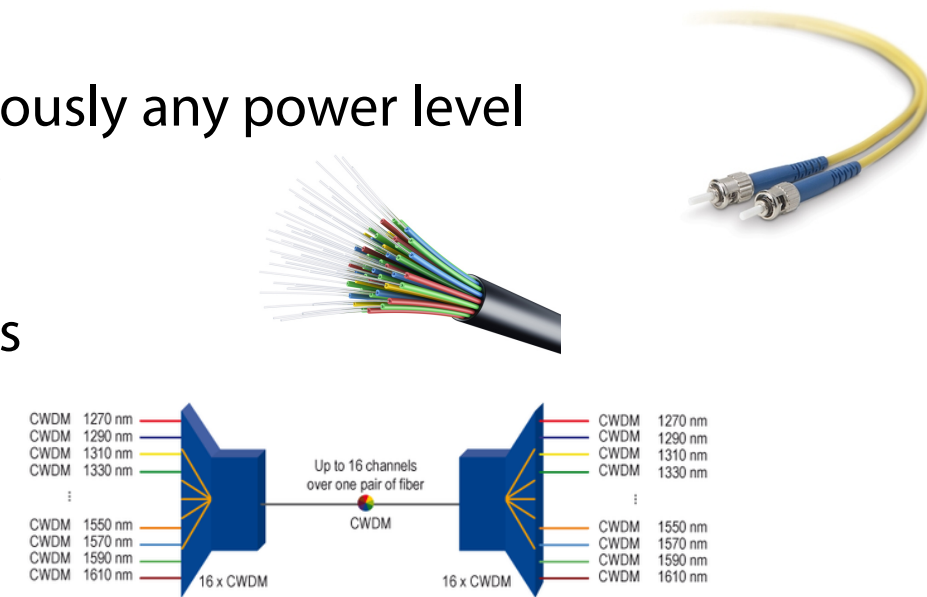
- 3dB System Noise Figure (vs > 4-6+dB competition)
- Excellent 15dBo optical link budget (vs 8dBo competition)
- Robust remote units
 - No fans
 - NEMA4 enclosures
 - Built in uplink test signal
- All web server operation
 - Single user interface monitoring of entire DAS
 - HTTP commissioning, no vendor software needed
 - IP default addresses can be changed
- All RF cable connections on front



Competitive Advantages



- Indoor and Outdoor DAS applications on same product
 - Same platform supports both applications simultaneously any power level
- Reduced fiber count (uplink and downlink on single fiber)
 - Daisy-chaining and WDM allow for single fiber usage
- Optional CWDM modularity, highly flexible, easy upgrades
 - 16 wavelengths per remote
 - Sectorization, New Protocols, New Frequencies
 - Service and Frequency Migration
- SingleNet - multiple services over same fiber
 - Open Ethernet Path for other/outside services to be launched onto the fiber (shared resource)
 - Reuse of fiber for Wi-Fi, Video, Building Control, Patient data, etc.
- **Customization!!!**



MTBF
> 100,000 hours



| Project Information needed for quoting

- Frequency Bands to be covered
 - For UHF & VHF need to know exact frequencies
- Approximate Fiber Lengths and Layout
 - Single Mode fiber only
 - SC-APC Connectors required
- Number of Remotes Needed
 - Or **DETAILED** venue information for design suggestions and RSSI/RSRP signal levels required

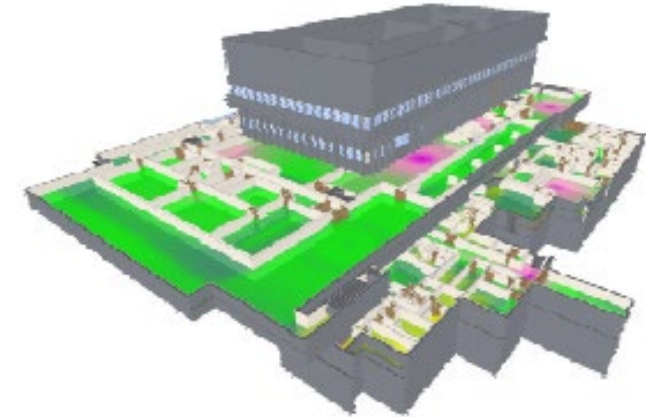
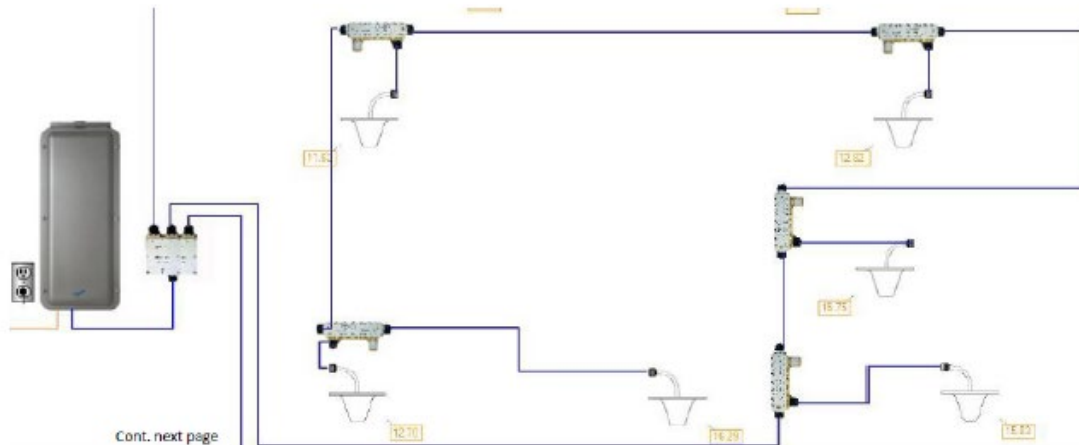
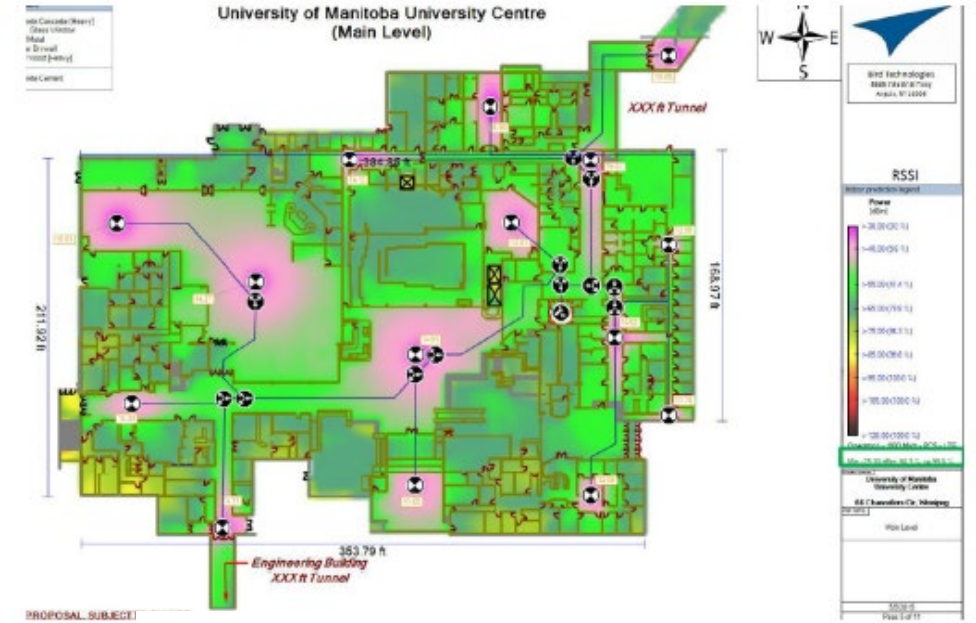
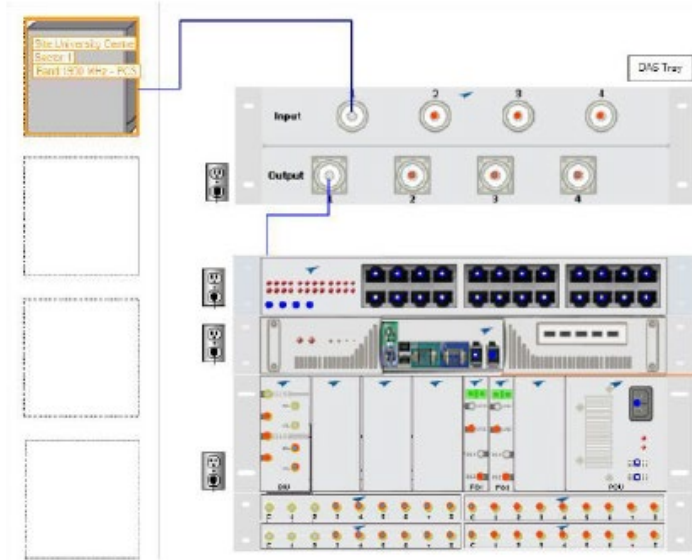


| Project Information needed for quoting (continued)

- Signal Source
 - Base Station Fed – signal level into DAS Head End?
 - Off-Air – is a repeater needed? Donor signal Level?
- RF output required out of Remote
 - Power level per band
 - Connectors
 - Duplexing/Diplexing
 - Separate port per band? Separate DL and UL ports?
- Any other special requirements – Alarming, NFPA



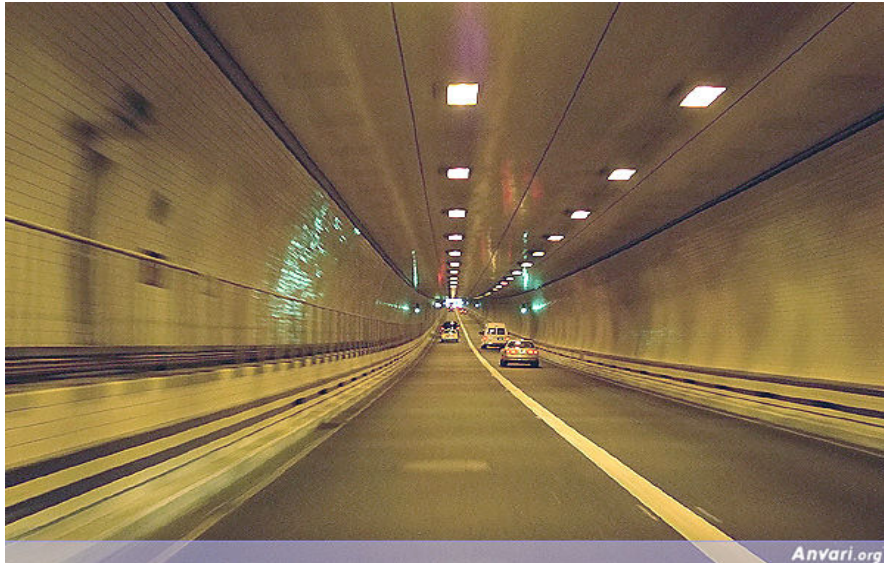
iBwave Support



Example DAS Applications



Walmart Distribution Centers



Sweden underwater tunnels



Hoover Dam



Example DAS Applications

Iceland Tunnels



Istanbul Metro



Venetian Casino



Senate Visitors Center

