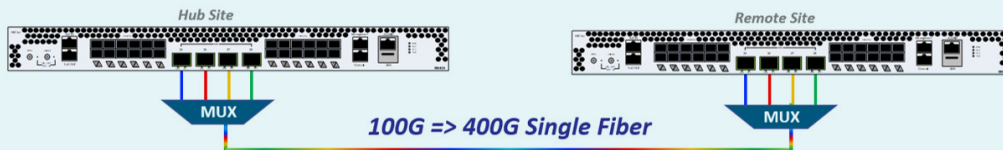


flexiHaul xWave 400G

Operational Flexibility Plus “Pay-as-You-Grow” Economics



- Minimize Space & Power
- Fiber Optimization
- In Service Capacity Additions
- Multiple Configuration Options

5G Challenges: Connecting to More Sites While Adding Large Amounts of Bandwidth

5G coverage requires a dense network of many base stations, supporting low latency and increasing traffic load. It is important for operators to optimize the cost of deploying new sites and last-mile transport capacity to new and existing sites. Operators must exploit existing fiber infrastructure to minimize the expense of capacity upgrades. The advent of fronthaul gateways using time-sensitive networking (TSN) enables the convergence of 4G/5G and Ethernet transport. High-capacity, high performance, cost effective solutions are required to conserve fiber while meeting stringent technical RAN requirements.

Proven Data Center Optical Technology Optimized for xHaul Transport

O-Band optical products have proven performance advantages and economic benefits within cloud/data center environments. Continuing to bring the latest in optical innovations to the xHaul transport domain, HFR Networks recognized that these products could also be used effectively as a 5G wireless transport solution. HFR Networks engineered the flexiHaul xWave 400G for xHaul packet/TSN transport to empower operators with valuable performance advantages, and cost control flexibility for capacity deployments and upgrades scaled over time. In today's competitive market, operators are concerned with making the most economical and efficient use of their fiber investment, in addition to gaining rapid time to market using all available assets. HFR Networks' xWave is a high performance, cost-effective alternative to laying additional fiber infrastructure, which is expensive and time consuming. It offers “pay-as-you-grow” economics with superior performance.

HFR Networks' flexiHaul xWave Compared to Fixed Solutions

Fixed 400G solutions force operators to pay for the entire cost of capacity all upfront, even though an operator may only need 100G of capacity. Paying for extra unused capacity along with all its related operational costs (i.e.: power, cooling, etc.), is wasteful and increases an operator's expenses – at a time when controlling costs is critical to achieve the highest return on investment to maintain healthy profit margins. Using a single optic also concentrates traffic which can present challenges if that optic fails. xWave offers improved resiliency by spreading traffic over a number of optics to minimize the impact of any single failure.

Fixed 400G solutions were built for moving large capacities point-to-point. For example, to distribute 100G of RAN traffic to four towers in a linear chain utilizing a fixed 400G solution, an operator would need to deploy four point-to-point links with each link utilizing 400G fixed optics. This is a total of eight 400G fixed optics and two fibers which greatly increases the cost of the deployment as well as ongoing operational costs. Furthermore, each site would electrically terminate all traffic which creates additional points of failure, latency and operational complexity. HFR Networks' flexiHaul xWave solution avoids this entirely, since it can enable 100G of dedicated traffic per tower over a single fiber with a total of only eight 100G optics. Failure points are greatly reduced since only the wavelength dedicated to each tower is terminated in that specific site, while all other wavelengths pass through via optical filters. Each tower site requires only the specific 100G necessary to terminate its own bandwidth. The flexiHaul xWave solution reduces costs while also increasing resiliency, simplifying operations, and lowering latency by the pass-through of any intermediate sites.

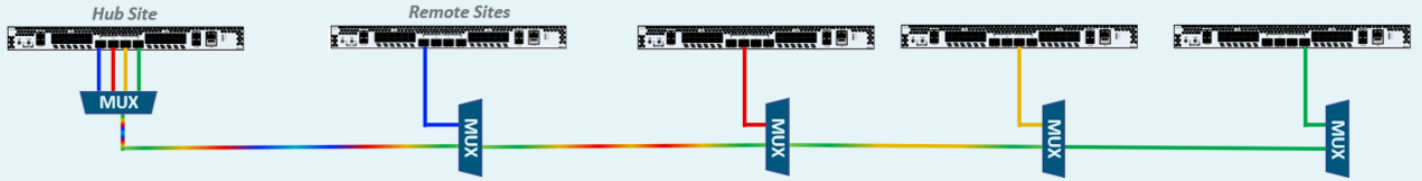
flexiHaul xWave Benefits:

- Lowest cost with highest performance - designed for xHaul applications
- Hot-pluggable QSFP28 form factor with single or dual fiber topologies supported
- Resiliency advantage as multi-port and multi-lambda.
- Compatible with existing services in the C/E/L Band
- Scales 100G up to 400G over a single fiber in “pay-as-you-grow” increments
- Point-to-point or cascading topologies supported including intermediate site bypass using Layer 0 waves.

Gain Performance Advantages and Lower the Cost of Capacity Deployments

HFR Networks' flexiHaul xWave solution addresses an operator's need for a flexible, cost-effective xHaul transport solution. The solution scales in 100G increments up to 400G - over a single fiber. This enables operators to pay ONLY for the capacity they need at the specific time in which they need it. It empowers operators with the flexibility to add the exact amount of capacity required if/when the need arises. When considering an operator's entire population of base stations, HFR Networks' flexiHaul xWave solution will save upfront CAPEX and significant ongoing operational costs associated with the deployment and operation of unneeded capacity that may go unused for years.

Multiple Remote Sites Over a Single Fiber



Parameter	Symbol	Min	Type	Max	Unit
Link Distance	D			20	km
Modulation Format			PAM4		
Transmitter Optical					
Wavelength	W7	1295.16	1295.56	1295.96	nm
	W6	1297.40	1297.80	1298.20	nm
	W5	1299.65	1300.05	1300.45	nm
	W4	1301.91	1302.31	1302.71	nm
	W3	1304.18	1304.58	1304.98	nm
	W2	1306.45	1306.85	1307.25	nm
	W1	1308.74	1309.14	1309.54	nm
	W0	1311.03	1311.43	1311.83	nm
Side-Mode Suppression Ratio	SMSR	30			dB
Average Launch Power	PAVG	0		3.4	dBm
Outer Optical Modulation Amplitude (OMA _{outer})	POMA				
TDECQ < 1.4dB		3.0		6.4	dBm
TDECQ > 1.4dB		1.6+TDECQ			
Transmitter and Dispersion Penalty	TDECQ			3.4	dB
TECQ	TECQ				
TDECQ-TECQ (Max)				2.5	dB
Extinction Ratio			5.0		dB
Optical Return Loss Tolerance				15.6	dB
Receiver Optical					
Average Receiver Power		-15.7		-3	dBm
Receiver Power (OMA _{outer})				-2.6	dBm
Receiver Reflectance				-26	dB
Receiver Sensitivity (OMA _{outer})				Max (-14.0, SECQ-15.4)	dBm

Features:

- 100G Multi-wavelength WDM
- Hot-pluggable QSFP28 Form Factor
- Supports 106.25Gb/s
- Duplex LC Receptacles
- I2C Management Interface
- RoHS-6 Compliant
- Integrated nWDM 8 Wavelength Mux

