



DragonWave Solution Overview



**BUILDING BETTER
BACKHAUL SOLUTIONS**

DragonWave Fast Facts

- **Headquartered in Ottawa, Canada**
 - Founded in 2000
 - Offices in US, France, Australia, Singapore, India, and UAE
 - Global support team (60% N. America, 40% EMEA)
- **Public company**
 - Traded on TSX (DWI) and NASDAQ (DRWI)
- **Financials**
 - Fiscal 2011 Revenue:
 - Revenue of \$46 million
 - Cash: \$53 million
- **Capital-efficient scalable business model with outsourced manufacturing**



DragonWave Record of Technology

- First packet microwave system
- First dual-channel microwave system
- First all-outdoor solution
- Long-standing leadership in capacity and spectral efficiency
- Only vendor in the industry to offer:
 - Multi-channel, multi-gigabit microwave systems
 - All-outdoor system with XPIC
 - Wire-speed bulk data compression technology
 - Fully integrated microcellular platform
 - Network evolution from hybrid to pure packet via simple software configuration



2048 QAM Milestone Reached

- DragonWave delivers another microwave industry-first
- First to market with 2048 QAM radios
- Highest spectral efficiency in the industry with up to 37% more capacity than existing 256 QAM systems
- Added gains from DragonWave's unique Bandwidth Accelerator



Meeting Service Provider Requirements

Next Gen Network Requirements

Flexible IP networking

- Converged services
- Lowest cost networking

Carrier Grade

- High Availability (99.999%)
- Interference free
- Environmentally hardened

Scalability

- Handle current & future needs

IP Service Enabling

- VOIP, mobility & video

Affordability

- First and lifetime cost

DragonWave's Solution

- Packet Microwave

- Fast Mesh continuous connectivity
- Operates in licensed spectrum

- High capacity and remotely scalable

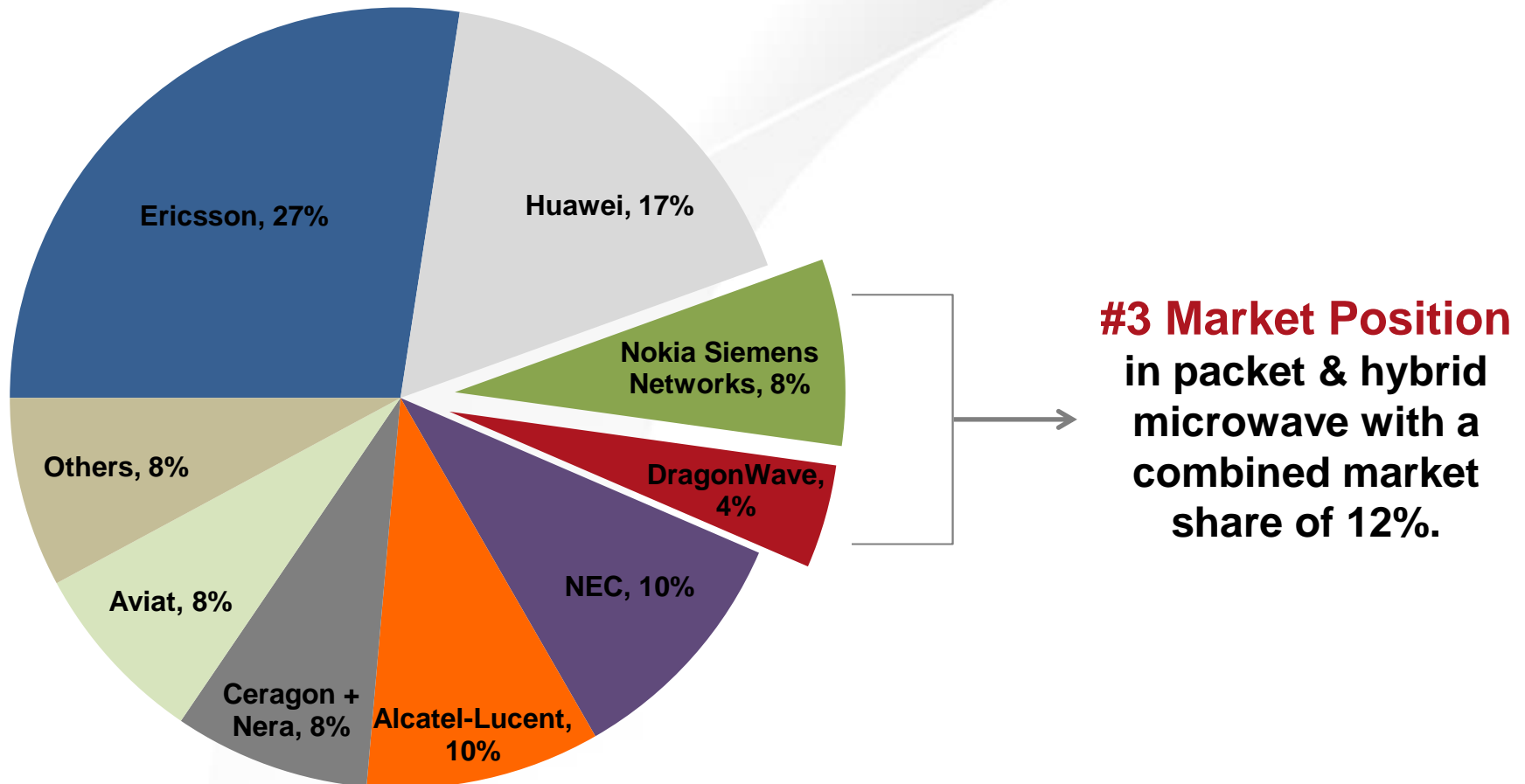
- Ultra-low delay
- Advanced queuing

- Pay as you grow
- Lowest TCO – HAAM, all outdoors, ring/mesh

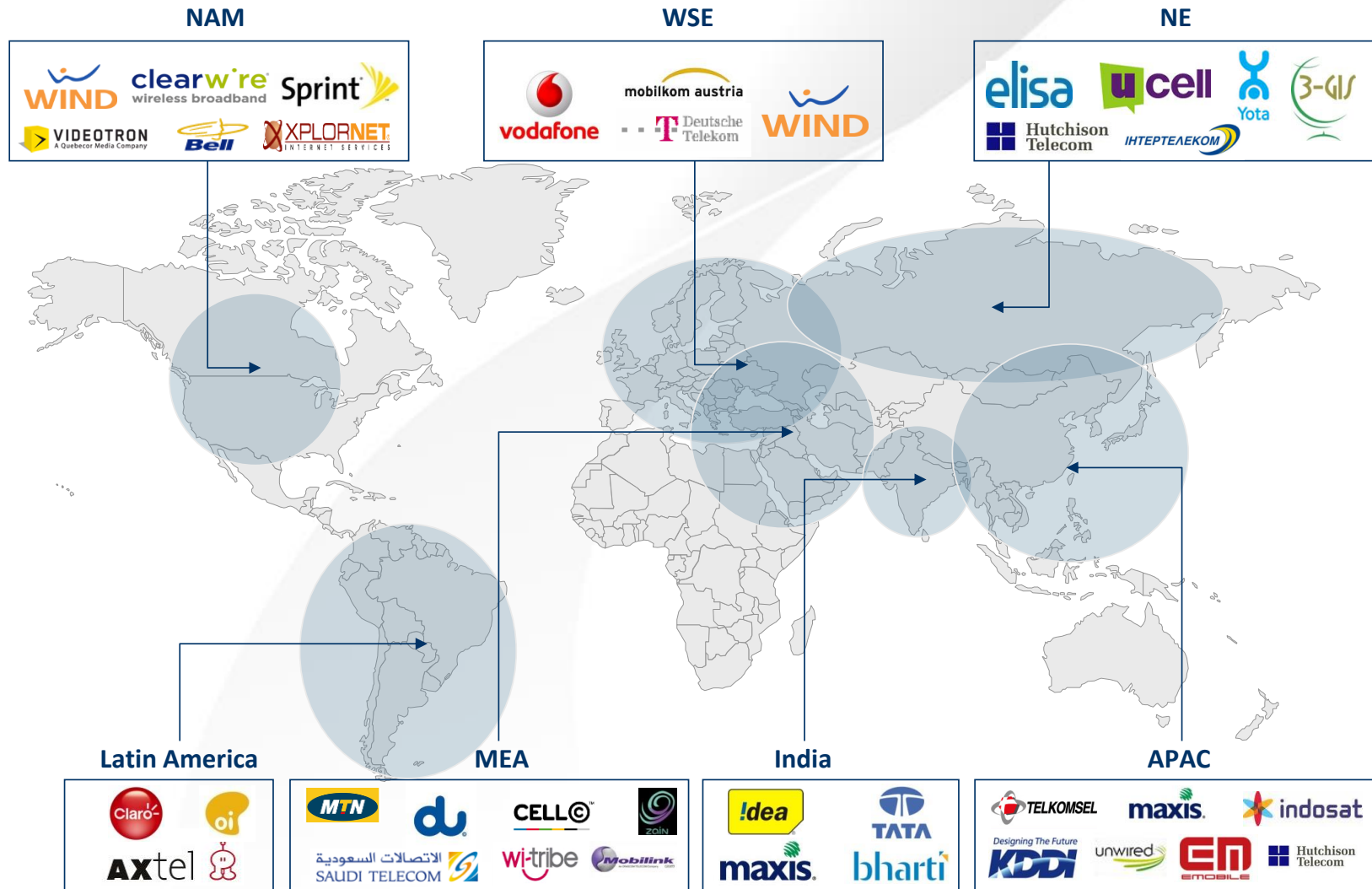
DragonWave Addresses Next Gen Network Requirements

Strong Market Share Position

2010 Market Share for Packet & Hybrid Microwave



Global Customer Base



DragonWave Products

DragonWave Product Portfolio

Horizon Packet Microwave

Horizon Compact+
6-60 GHz



Horizon Quantum
6-38 GHz



Horizon E-Series
70/80 GHz



Avenue Microcellular Solutions

Avenue Site
Integrated Microcellular Platform



Avenue Link
Microcellular Backhaul



Avenue Lite
Microcellular Backhaul



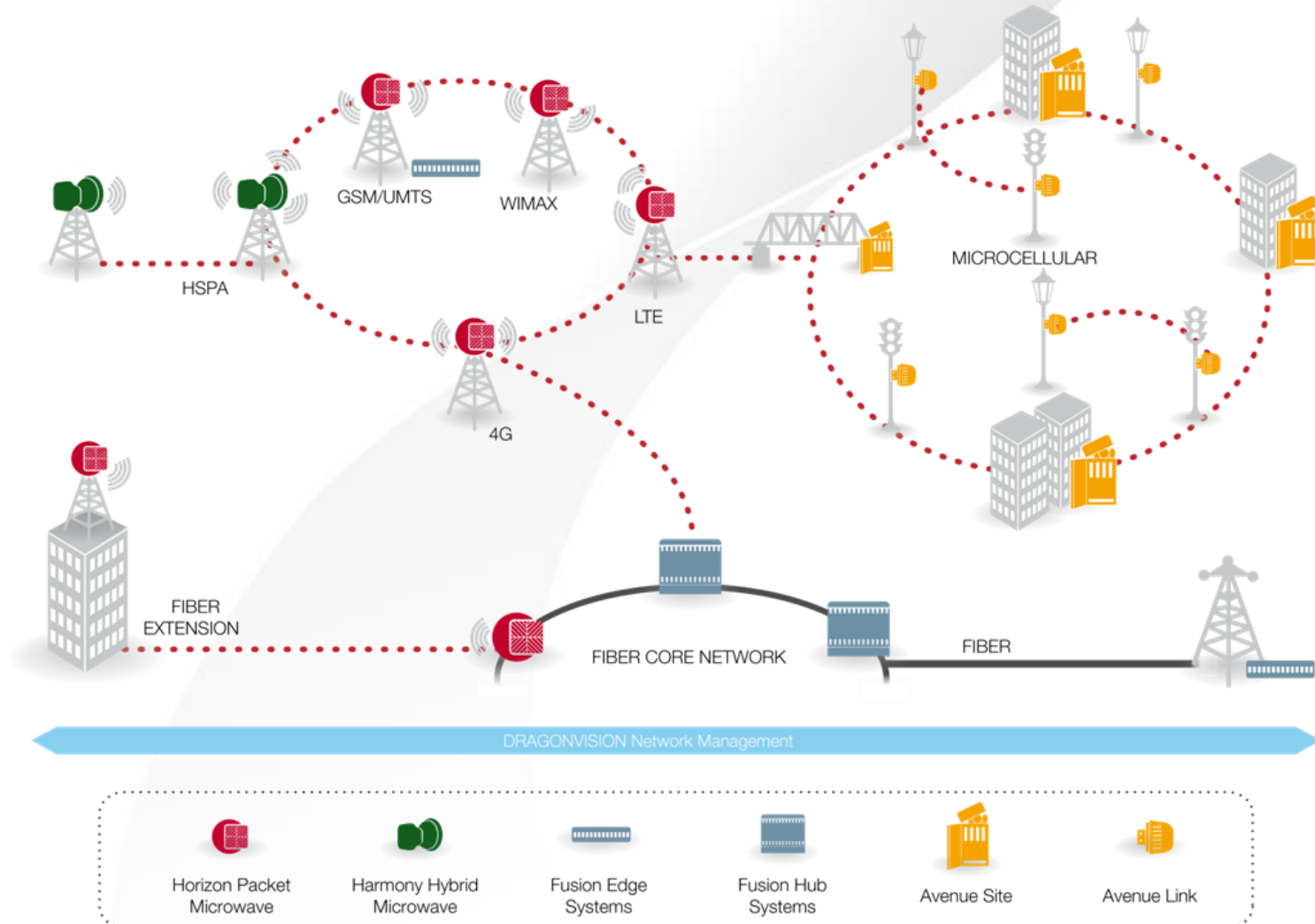
Harmony Packet/Hybrid Microwave

Harmony Radio, Hub 800 & First Mile 200
Hybrid / Full-packet / Dual Traffic



DragonVision Network Management

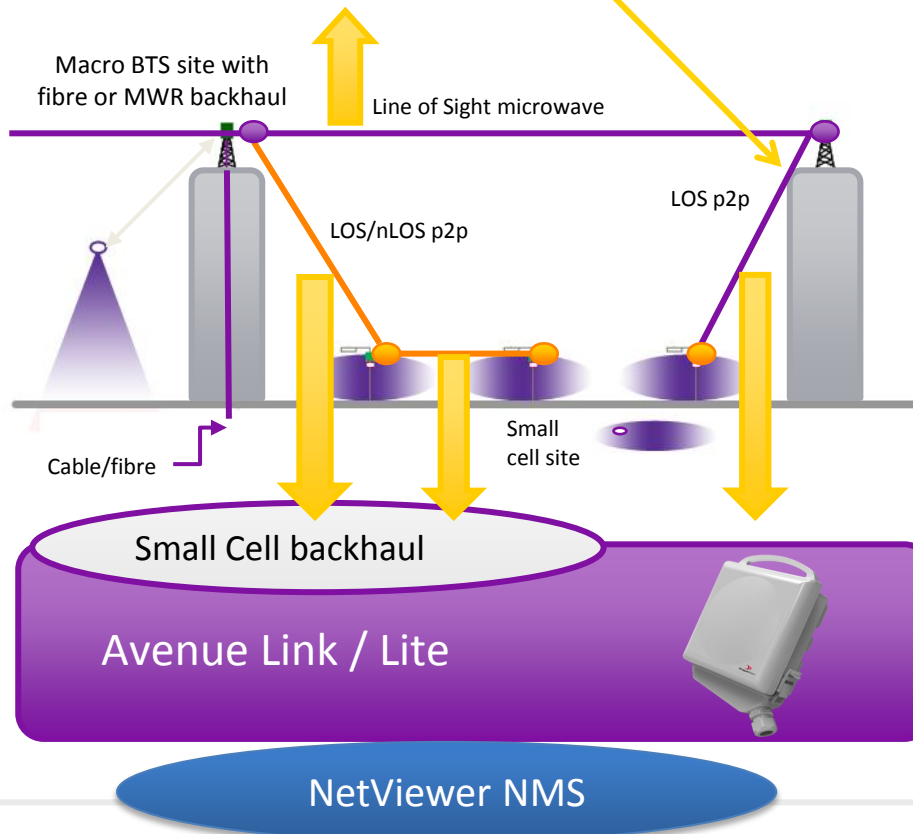
DragonWave End-to-End Network



Small cell backhaul

Macro BTS backhaul

- Horizon/Harmony & **E-Band**
- Traffic aggregation: Hub 800 IDU



Key technical requirements



Macro BTS site



Micro/pico BTS



Macro-layer backhaul



Micro-layer backhaul



- Site close to ground level (<10m)
- Lamp-post mounting
- NLOS / nLOS support
- Low-impact installation
- Short distances
- Evolution path toward protected network architecture

Horizon – Packet Microwave

**Horizon
Compact+**
6-60 GHz



**Horizon
Quantum**
6-38 GHz



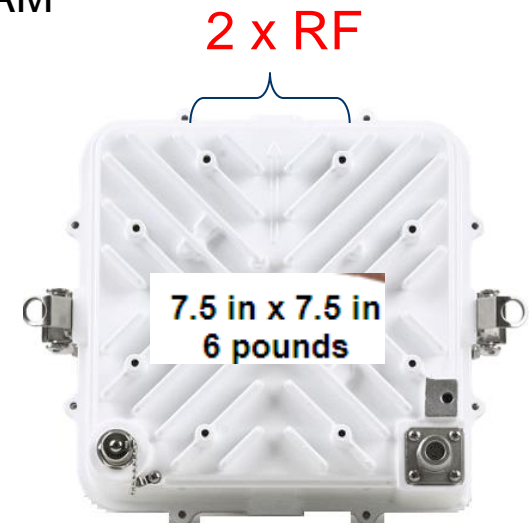
**Horizon
E-Series**
70/80 GHz



Quantum – Split Type Radio

◆ Radio Feature

- Frequency: 6 – 60 Ghz
- Channel Bandwidth: 7 / 14 / 28 / 40 / 56 Mhz
- Adaptive Modulation:
 - QPSK, 16 / 32 / 64 / 128 / 256 / 512 / 1024 / 2048 QAM
- Automatic Power Control (ATPC)
- XPIC support for bandwidth doubling
- **Dual Channel support with Single Radio**
- High Power Performance Direct Mount Antenna
- Space & Frequency Diversity
- 1+0, 1+1HSB, 2+0, 4+0



Native 4Gbps per Link

Quantum – Split Type Radio

◆ Indoor Unit Feature

- **Dual Channel support with Single IDU**
- Bandwidth Accelerator
 - Up to 2.5x Spectral Efficiency
 - **Up to 4Gbps per link**
- **Build-in L2 Switch (6x GE/FE electrical + 2x SFP)**
- Advance QoS support (802.1p/q, MPLS, DSCP, ToS)
- Integrated Ring/Mesh Switching (RSTP)
- Packet Size 9600 Bytes
- Management
 - CLI, Web GUI, and SNMP
 - In-band or out-of-band management
 - DragonVision EMS



Native 4Gbps per Link

Horizon Quantum Configuration Options

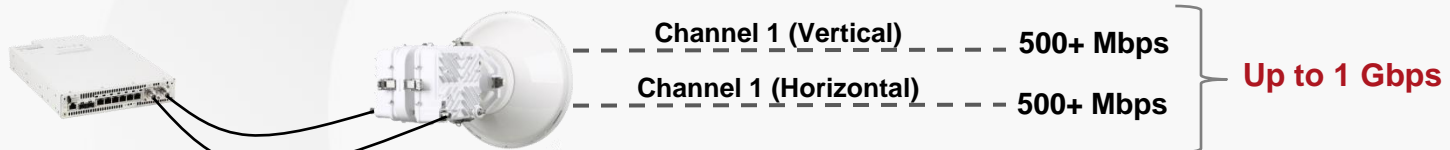
Dual Channel Single Radio



Dual Channel Dual Radio



Dual Channel Dual Radio (with XPIC)



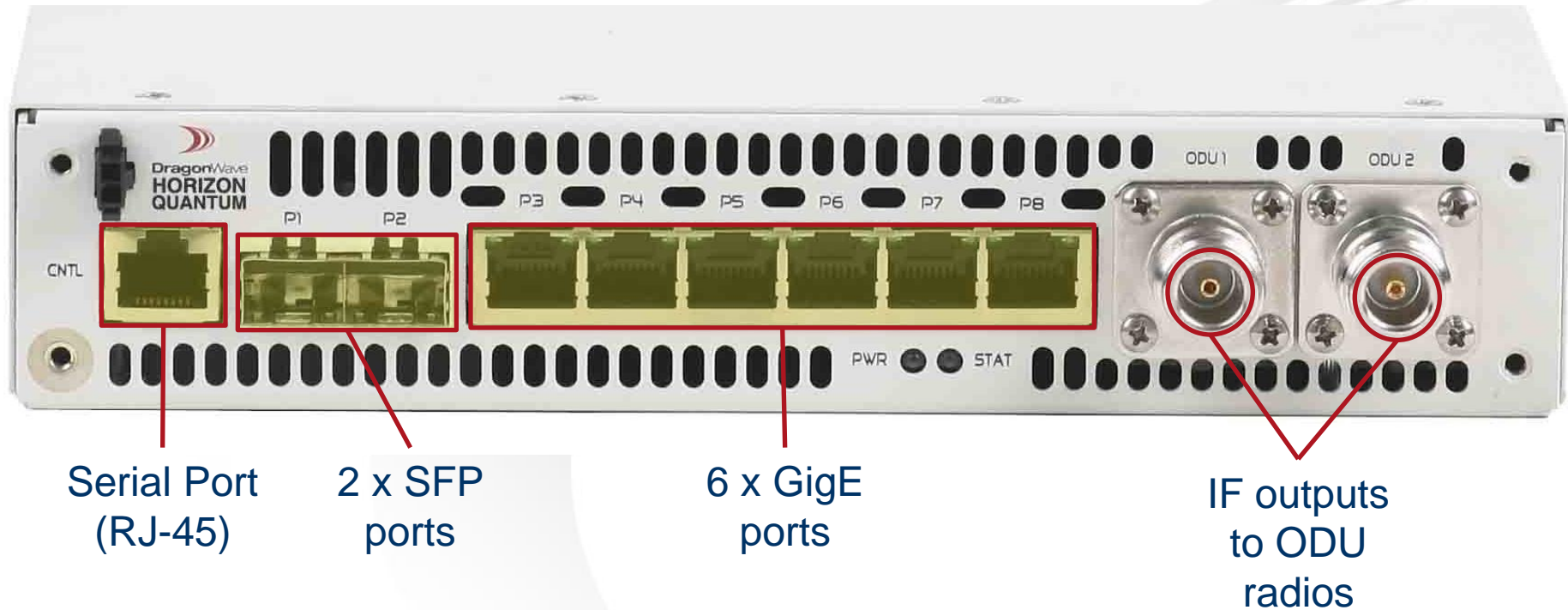
2x Dual Channel Dual Radio



With XPIC: Channel 1 & 2 Vertical + Channel 1 & 2 Horizontal

Note: Assumes 50 MHz Channels

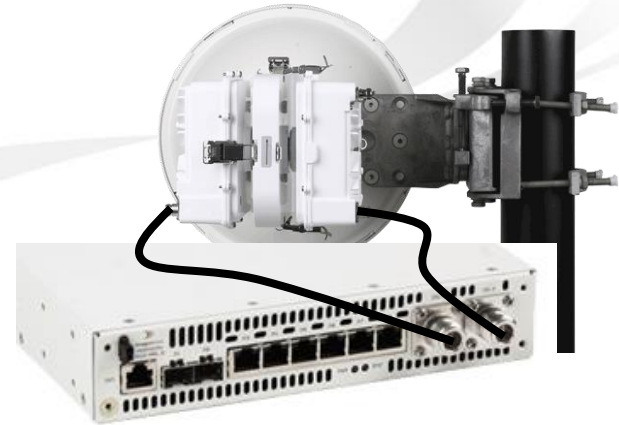
Horizon Quantum IDU – Front Panel Features



Redundancy Option

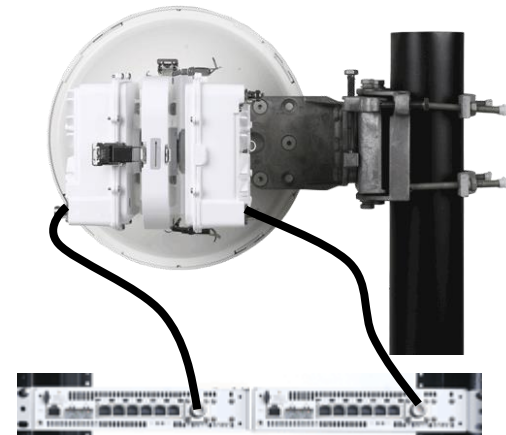
◆ 1+1 Horizon Quantum

- Single IDU
- Redundant Radio



◆ 1+1 Horizon Quantum

- Two IDU
 - Single Rack Unit
- Redundant Radio



Horizon Compact+

■ Zero Footprint Packet Microwave

- Radio and modem are integrated into a single outdoor unit
- Reduced rack congestion, collocation costs, power consumption, cabling
- Rapid deployment

■ Unmatched All-Outdoor Performance

- Only all-outdoor solution supporting XPIC
- Highest spectral efficiency
 - 500 Mbps to 1 Gbps per 28 MHz channel
- Bulk compression and header optimization with DragonWave's Bandwidth Accelerator
- Service Aware Hitless Automatic Adaptive Modulation (HAAM)
- Network synchronization with SyncE support and optimized transport of 1588v2
- Pay-as-you-grow with automatic remote scalability
- Advanced security with integrated 256-bit AES encryption
- Comprehensive Ethernet OAM support (802.3ah, 802.1ag, Y.1731)
- Advanced QoS support with 8 levels of prioritization
- Lowest total cost of ownership
- Flexible operation from 6 to 60 GHz



Power-Over-Ethernet

◆ Power-on-Ethernet (PoE) Feature

- Option: (1) Outdoor type (2) Indoor Type
- Integrated Lighting Surge Arrester
- Build-in Over voltage/current protection

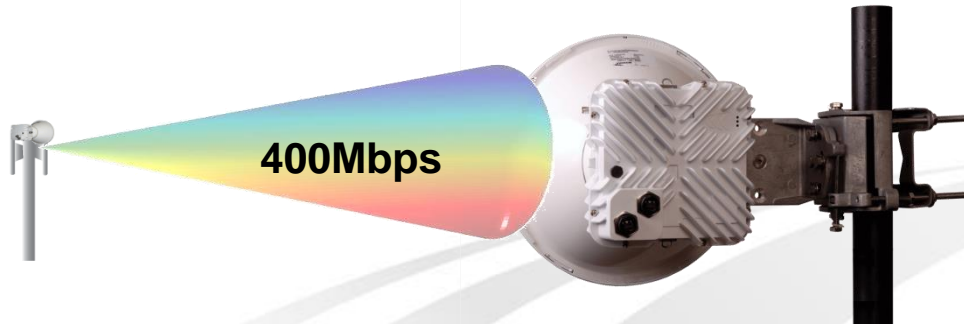


Indoor POE



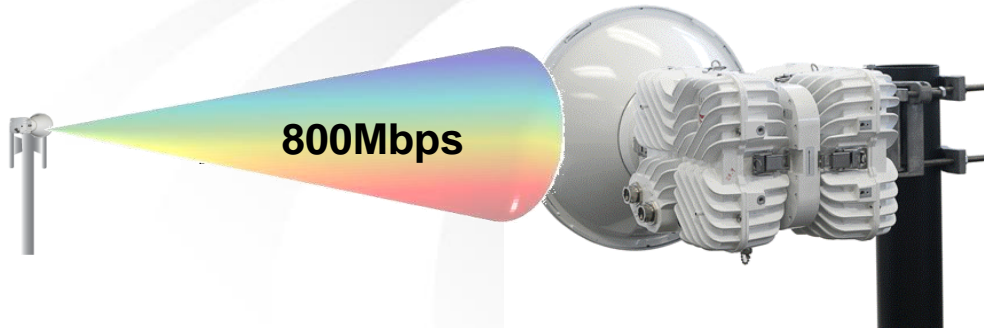
Outdoor POE

Horizon Compact+ Configuration Option



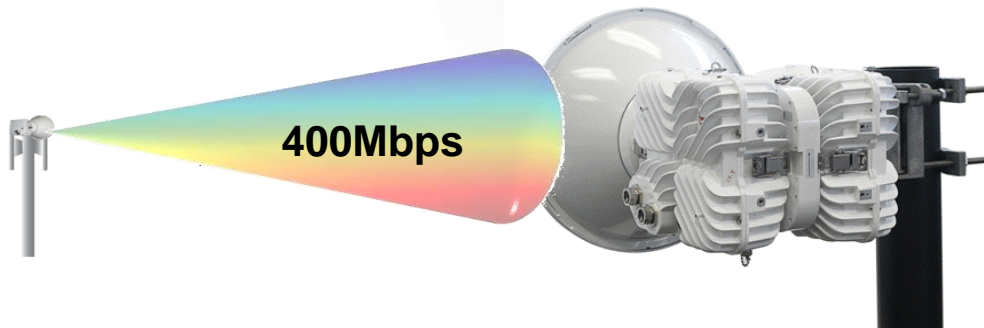
Direct Mount 1+0

200Mbps @ 1x 28Mhz
400Mbps @ 1x 56Mhz



Direct Mount 2+0 (with Link Aggregation)

400Mbps @ 2x 28Mhz
800Mbps @ 2x 56Mhz



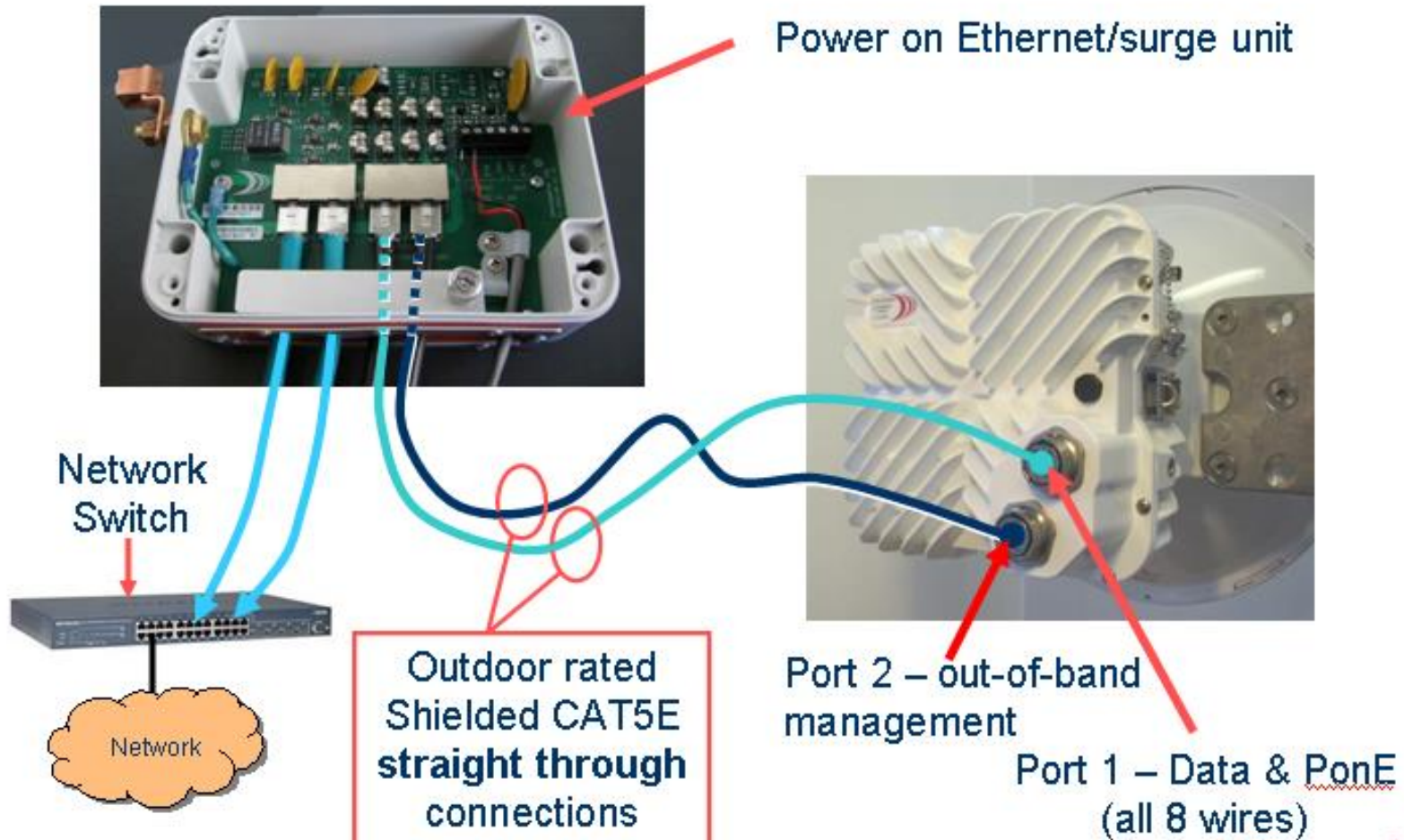
Direct Mount 1+1 HSB

200Mbps @ 1x 28Mhz
400Mbps @ 1x 56Mhz

Horizon Compact+ Front View

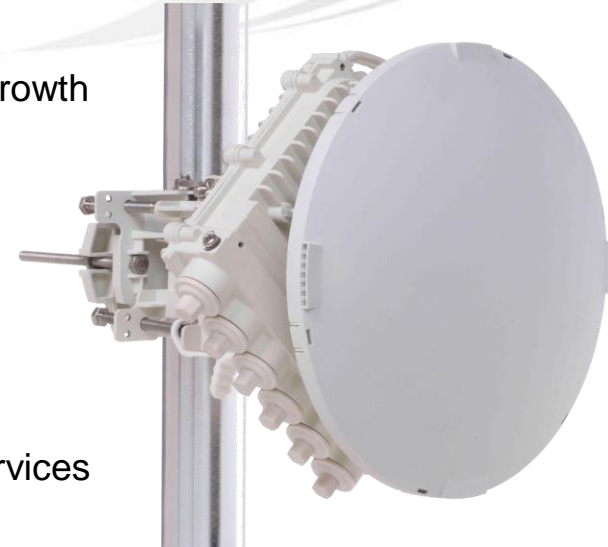


Simple Connections



Horizon E-Series Product Highlights

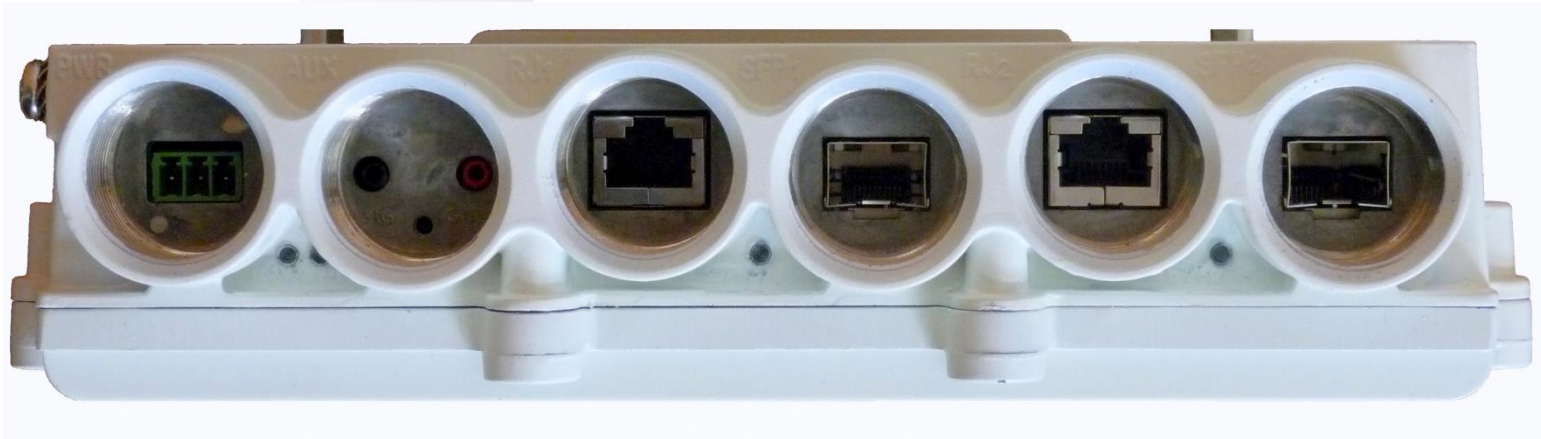
- ◆ Uses uncongested and interference free licensed E-band 70/80 GHz wireless spectrum
- ◆ 1 Gbps throughput future-proofs the backhaul network to meet data growth demand
- ◆ TDD operation for added flexibility
- ◆ Carrier-class, standard-based Ethernet capabilities
- ◆ Bandwidth aware QoS mechanism differentiates between multiple services
- ◆ Advanced timing over packet handling (SyncE, 1588)
- ◆ All-outdoor unit eliminates collocation fees and indoor-associated costs and allows fast deployment
- ◆ Low power consumption delivers 80% energy savings vs. traditional systems



Data Interfaces

◆ Supported Ethernet Interfaces:

- 2 x 100/1000Base-T (RJ45)
 - 2 x 1000Base-X (SFP)
 - Supported SFP Types: 1000Base-LX (1310 nm), SX (850 nm)
 - Standard IEEE 802.3at-2009 Power over Ethernet
- ## ◆ Any combination of 2 Ethernet interfaces may be used at a given time



Harmony – Hybrid Microwave

Harmony Packet/Hybrid Microwave

Harmony Radio, Hub 800 & First Mile 200

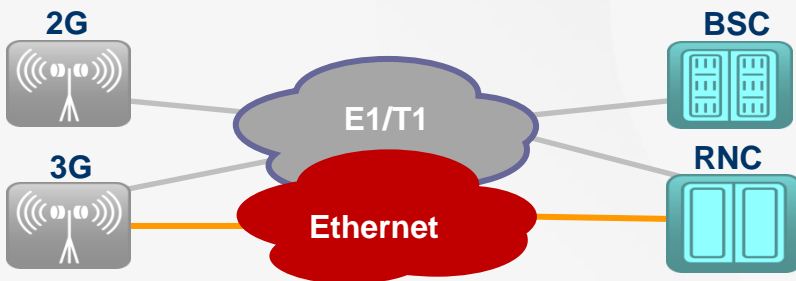
Hybrid / Full-packet / Dual Traffic



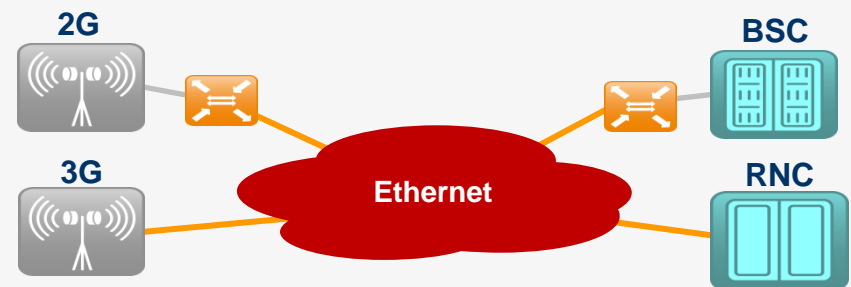
Harmony Radio

- Harmony Radio can easily be configured as full-packet or hybrid via software.
- In hybrid mode Harmony Radio processes and transports both TDM and Ethernet traffic natively (no Pseudowire emulation is performed)
- In full packet mode, TDM traffic is converted into Ethernet packets with Pseudowire. All traffic is therefore processed and transmitted via Ethernet services.

Hybrid scenario



Full Packet scenario



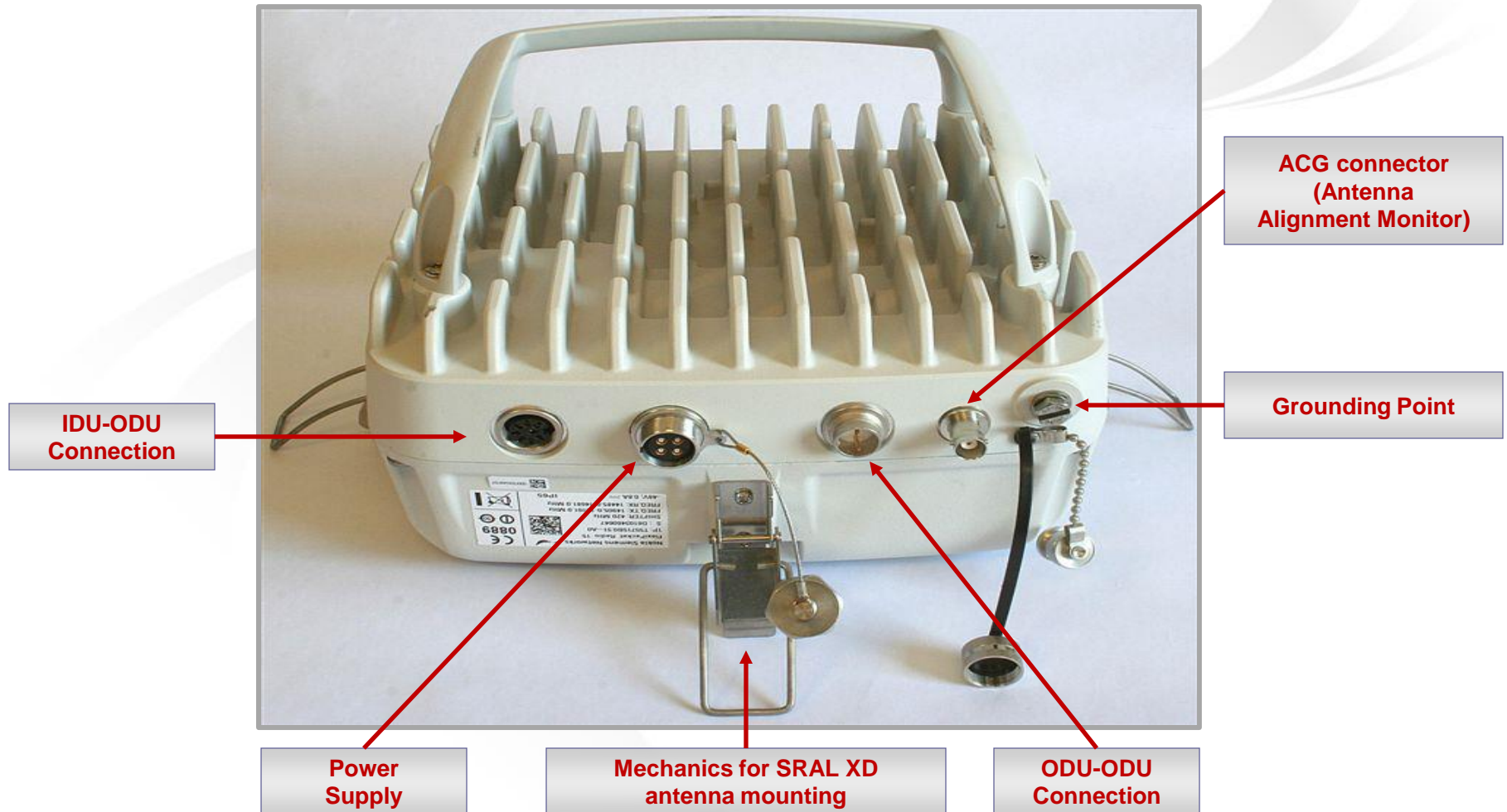
Harmony Radio Features

- **High performance radio & modem**
 - High throughput with Ethernet header & overhead compression, N+0, XPIC
 - Digital pre-distortion and LDPC coding
 - High spectral efficiency with 256 QAM in all channels
 - In-house modem design using best-in-class customized components
- **Full-featured Carrier Ethernet platform**
 - 8 classes of traffic (8 queues) + WRED congestion avoidance
 - SLA enforcement including policing and shaping
 - Packet fragmentation technique bringing latency to zero
 - UNI MEF interface
 - Ethernet OAM with Y.1731 & 802.1ag
- **Zero-footprint**
 - Direct connection of ODU to BTS or 3rd party switch/router
 - Direct interconnection between ODU's
- **All-in-one for simple network evolution**
 - Hybrid, full packet and CET in one product
 - Shift from hybrid to full packet via software configuration



**Broad frequency support
from 3.5 to 42 GHz**

Harmony Radio Interfaces



Harmony First Mile Features

■ Carrier Ethernet Switch

- 8 Gbps switching throughput
- L2 standard bridging
- Advanced QoS
 - 8 queues, policing, shaping, WRED
- Ethernet OAM 802.1ag and ITU-T Y.1731

■ Resiliency/Traffic Protection

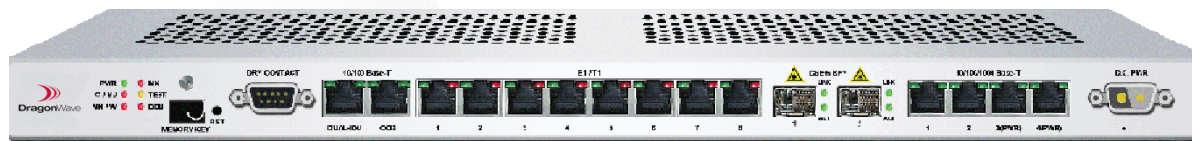
- Network protection
 - RSTP/MSTP, G.8031, G.8032
- IDU 1+1 protection
- Interface protection
 - LAG

■ Synchronization

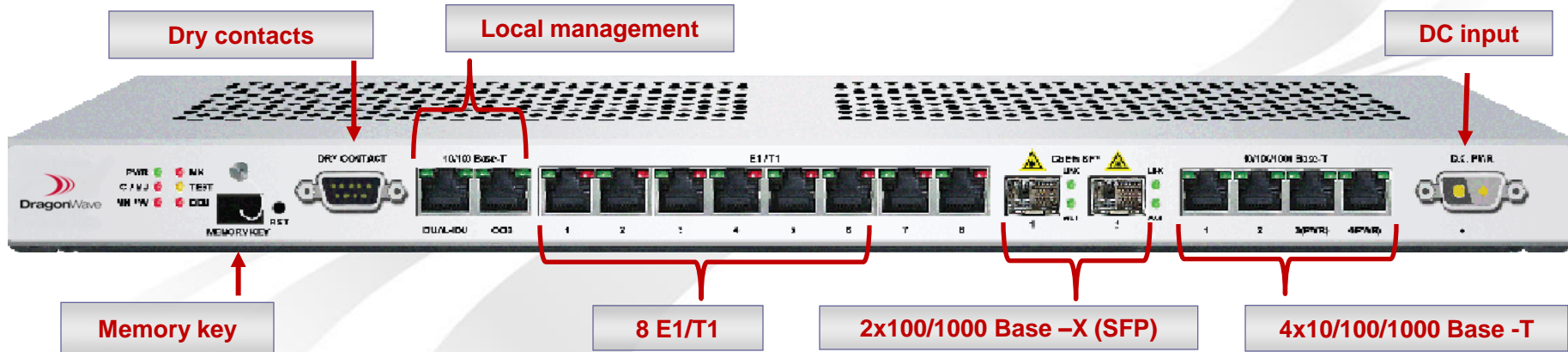
- Adaptive Clock Recovery (ACR)
- Differential Clock Recovery (DCR)
- Synchronous Ethernet with and without SSM

■ Multiservice platform

- E-Line and E-LAN service
- E1/T1/J1 CESoPSN (RFC5086)
- E1/T1/J1 SAToP (RFC4553)



Harmony First Mile Interfaces



■ Ethernet Interfaces:

- 6 x Ethernet ports
 - 4x GbE electrical (10/100/1000BaseT)
 - 2 ports with embedded power to Harmony Radio
 - 2x GbE (SFP)

■ TDM Interfaces:

- 8 E1 / T1

■ Other Interfaces:

- 1 Local management port
- 8 E1 / T1
- Dual IDU interface
- DC input -48V
- Memory key (config. backup/restore)

Harmony Hub Features

■ Carrier Ethernet Switch

- 20Gb/s switching throughput
- L2 bridging
- E-Line, E-LAN MEF services
- Advanced QoS
 - 8 queues, policing, shaping, WRED
- Ethernet OAM 802.1ag and ITU-T Y.1731

■ Resiliency/Traffic Protection

- Network protection
 - RSTP/MSTP, G.8031, G.8032
 - TDM traffic protection via SNCP-like
- IDU 1+1 protection
- Interface protection
 - LAG
 - MSP/APS 1+1 on STM-1

■ Synchronization

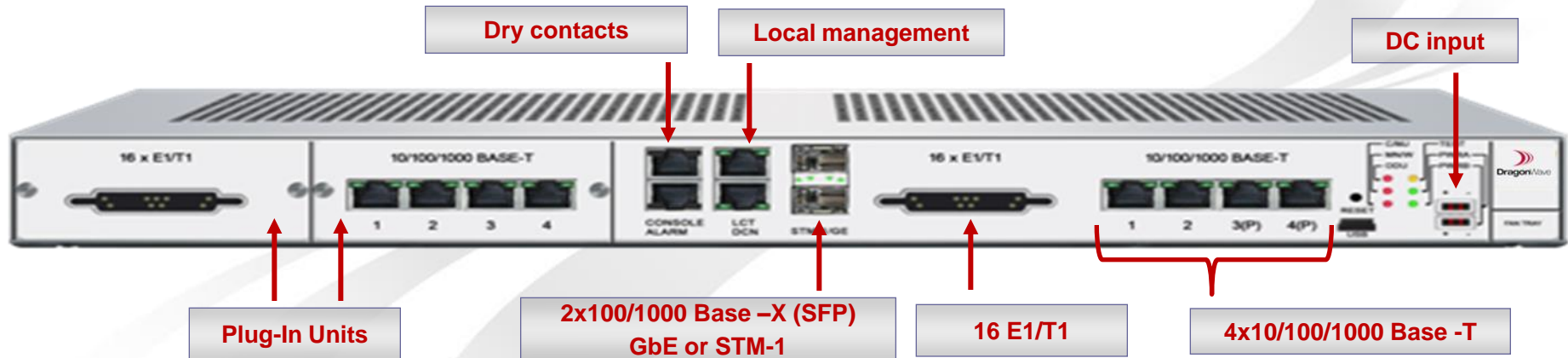
- System clock source from physical I/F or ToP slave
- ToP 1588v2 slave
- SyncE from/to all ports

■ Multiservice platform

- CESOP
- SATOP
- Ethernet over SDH (GFP)



Harmony Hub Interfaces



■ High density Ethernet

- Main Board 4 x 100/1000BaseT
- Main Board 2x SFP
- 4 x GbE line card

■ High density TDM

- Up to 48 E1 per system: 16 E1 in main board, 16 E1 line card
- 2xSTM-1 interfaces in Main Board

■ Other interfaces /Cards

- Local management: LCT port (10/100BaseT)
- DCN port (10/100BaseT),
- 2 in and 2 out dry contacts
- 2 x DC input -48V
- Memory key (config backup/restore)
- Power injector card for PoE

Avenue – Microcellular Solutions

Avenue Microcellular Solutions

Avenue Site

Integrated Microcellular Platform



Avenue Link

Microcellular Backhaul



Avenue Lite

Microcellular Backhaul



Avenue Link - Small Cell Backhaul

- Small cell-optimized backhaul
- Integrated flat-mini antenna
- Zoning-friendly, environmentally hardened enclosure
- Flexible mounting options
- Unparalleled backhaul performance:
- Pay-as-you-grow bandwidth scalability
- 500 Mbps capacity per hop
- Bandwidth Accelerator for 25-150% bandwidth increase
- Service-aware Hitless Automatic Adaptive Modulation
- QoS with 8 levels of prioritization
- Support and optimized transport of 1588v2
- Integrated 256-bit AES encryption
- 1+1 (hot standby), 2:0, Ring, and Mesh protection options
- Comprehensive management
- Support 24/26/28/31/38/60GHz



10.5"w x 10.5"h x 7"d

**The Avenue Link
solves the
microcellular
backhaul problem**

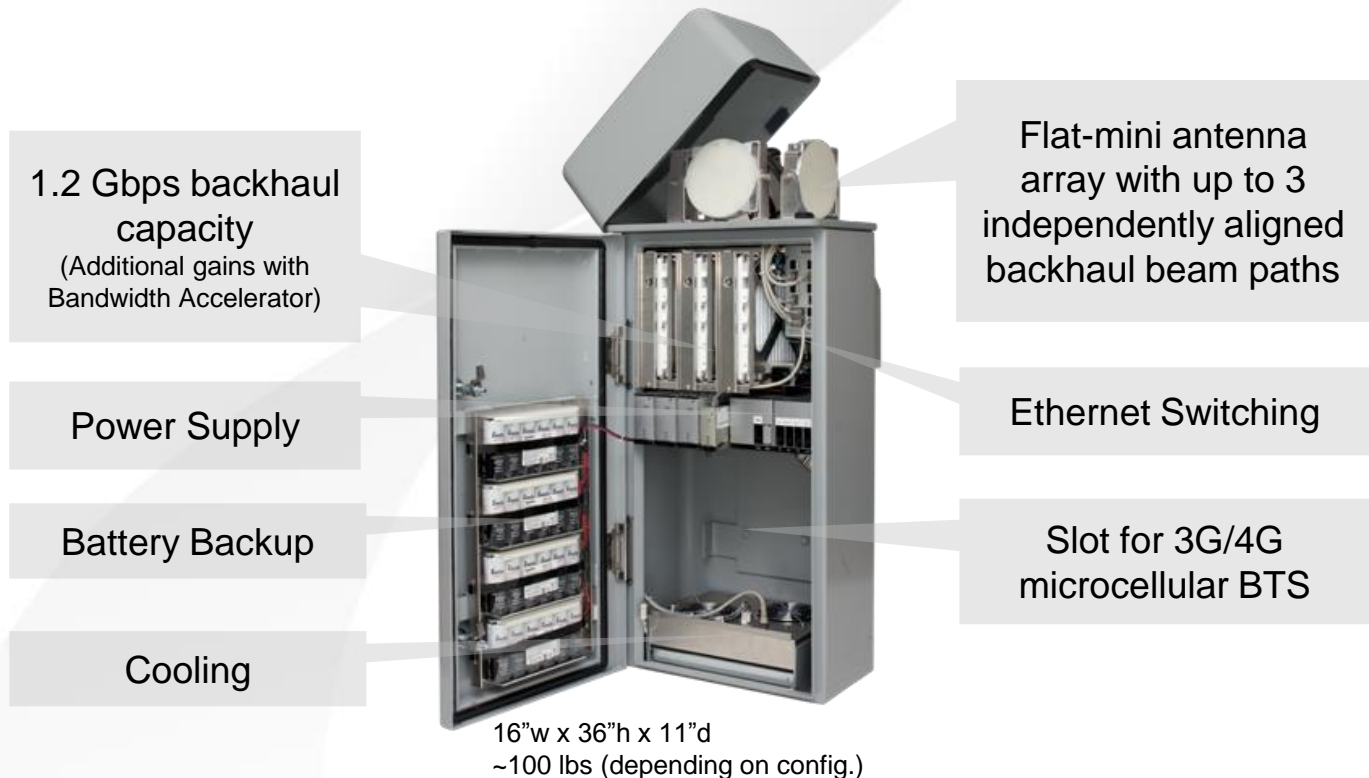
Avenue Lite – Small Cell Backhaul

- Point-to-point fully-outdoor solution
- Full IP - Ethernet transport
- Site solution with Flexi Lite BTS, Flexi Zone, Flexi Compact or as stand-alone solution
- 2x FE / GE interfaces with embedded Ethernet switching and power-supply chaining capabilities
- Both P+E and PoE+ supported
- Green product : < 15 W of power consumption
- Fast and easy installation
- Compact size : 19cm x 19cm x 5cm
- Available in several frequency bands : 3.4...3.8 / 5.150...5.875 / 2.3...2.6 GHz enabling nLOS / NLOS deployments
- RF channel spacing : 5 / 10 / 20 / 40 MHz
- TDD with configurable TX : RX ratio
- Modulation: OFDM with 2x2 MIMO – Adaptive
- Advanced QoS (8 queues)
- Advanced Ethernet features (UNI, E-Line / E-LAN services, Eth OAM, Performance Monitoring)
- Full micro-BTS synchronization support
- Advanced interference avoidance (site synchronization, Dynamic Frequency Selection, Transmit Power Control)



“Avenue Site” Integrated Microcellular

The industry's first
fully-integrated
microcellular
platform



- 24/26/28/32/38/42/60 GHz operation
- Supports ring, hub, linear and daisy-chain architectures
- Aggregation of traffic in microcellular layer to hand off to macro layer and/or metro fiber
- Zoning-friendly, environmentally hardened enclosure
- Minimize TCO through complete site enclosure – minimizes integration & installation time/cost.

Management Functions (FCAPS)

Security Management

Access control
Domain concept
Access rights
User classes



Performance Management

Performance monitoring
Performance reporting



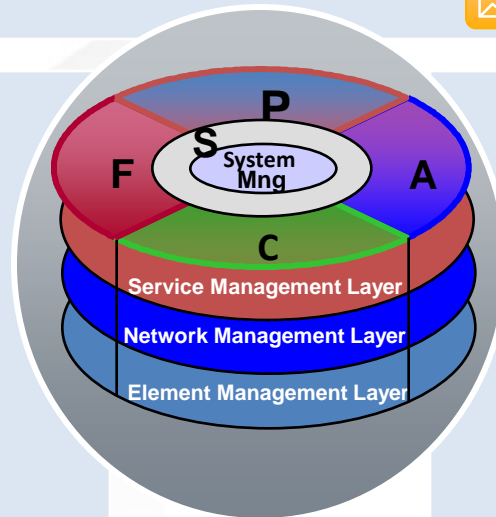
Accounting Management

User history log



Fault Management

Alarm reporting
Alarm localization in map
Alarm logging
Alarm acknowledgement



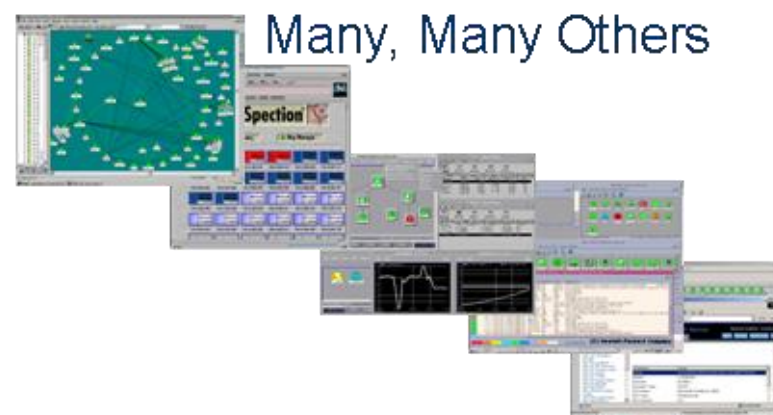
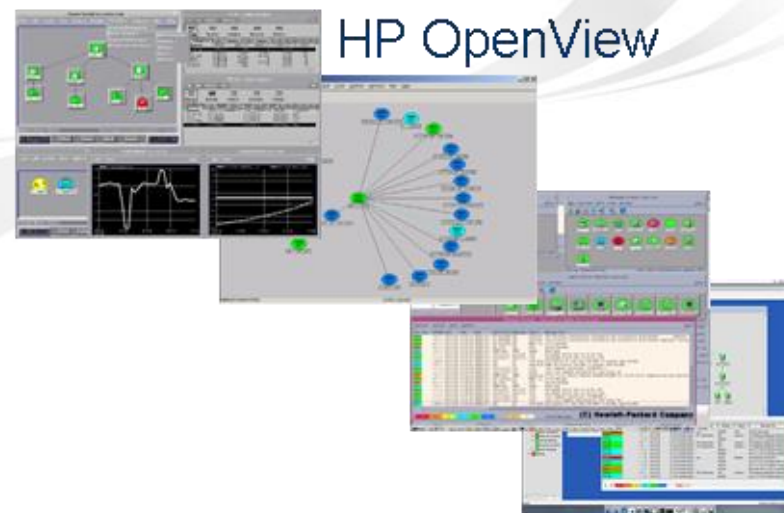
Configuration Management

Network configuration
Path provisioning
Software download
MW Radio configuration



DragonWave Confidential Information

Integrates into Any NMS

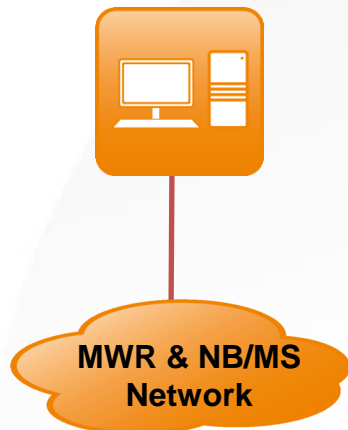


Entry Configuration

NV Entry Notebook



NV Entry



Entry Notebook

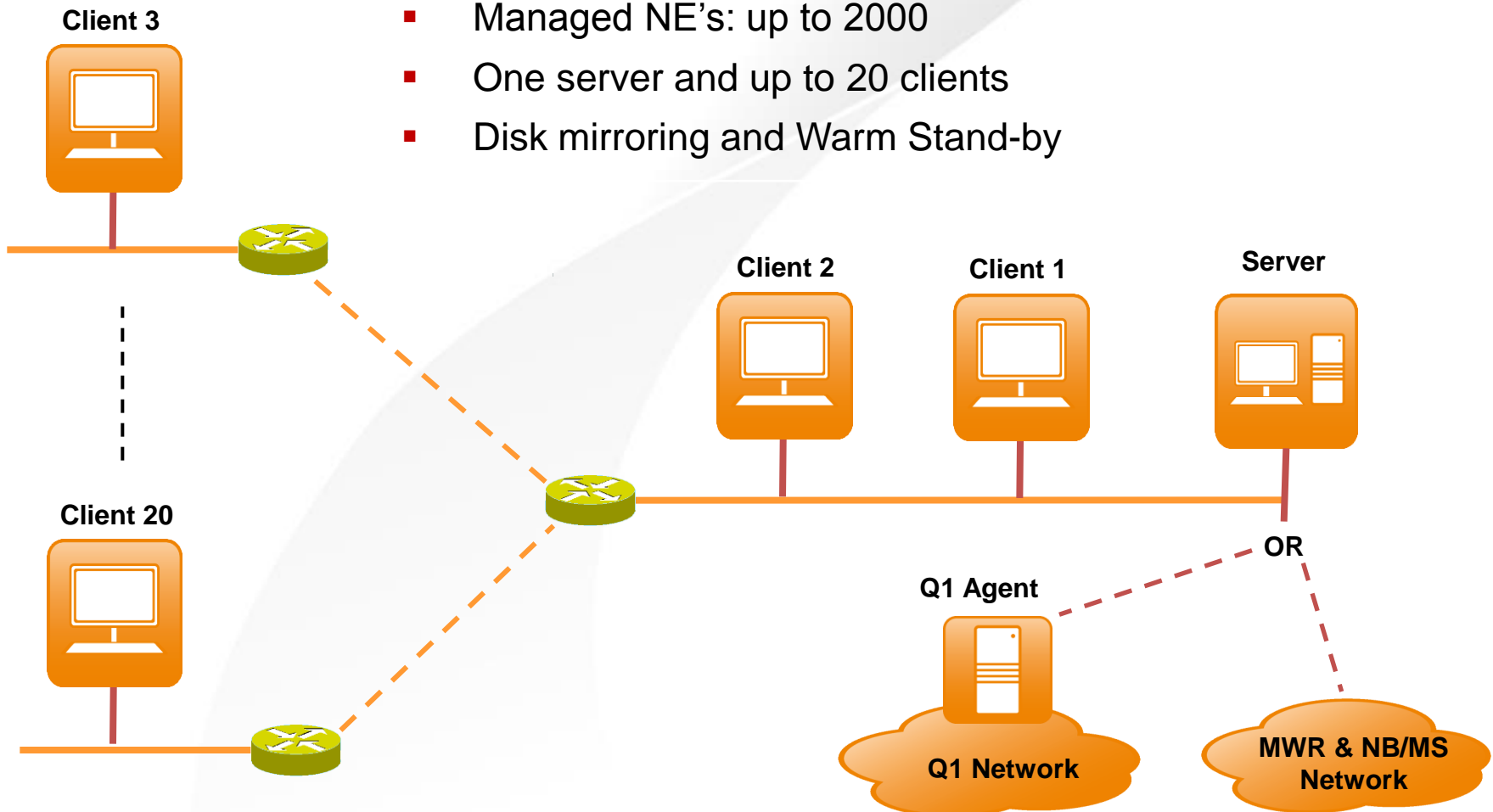
- Managed NE's: up to 100
- Client and Server in the same Notebook
- No additional software modules
- All-in-one configuration:
 - Q1 Agent + DragonView + Node Manager(s) on same HW

Entry

- Managed NE's: up to 200
- Client and Server in the same Notebook
- No additional software modules
- All-in-one configuration:
 - Q1 Agent + DragonView + Node Manager(s) on same HW

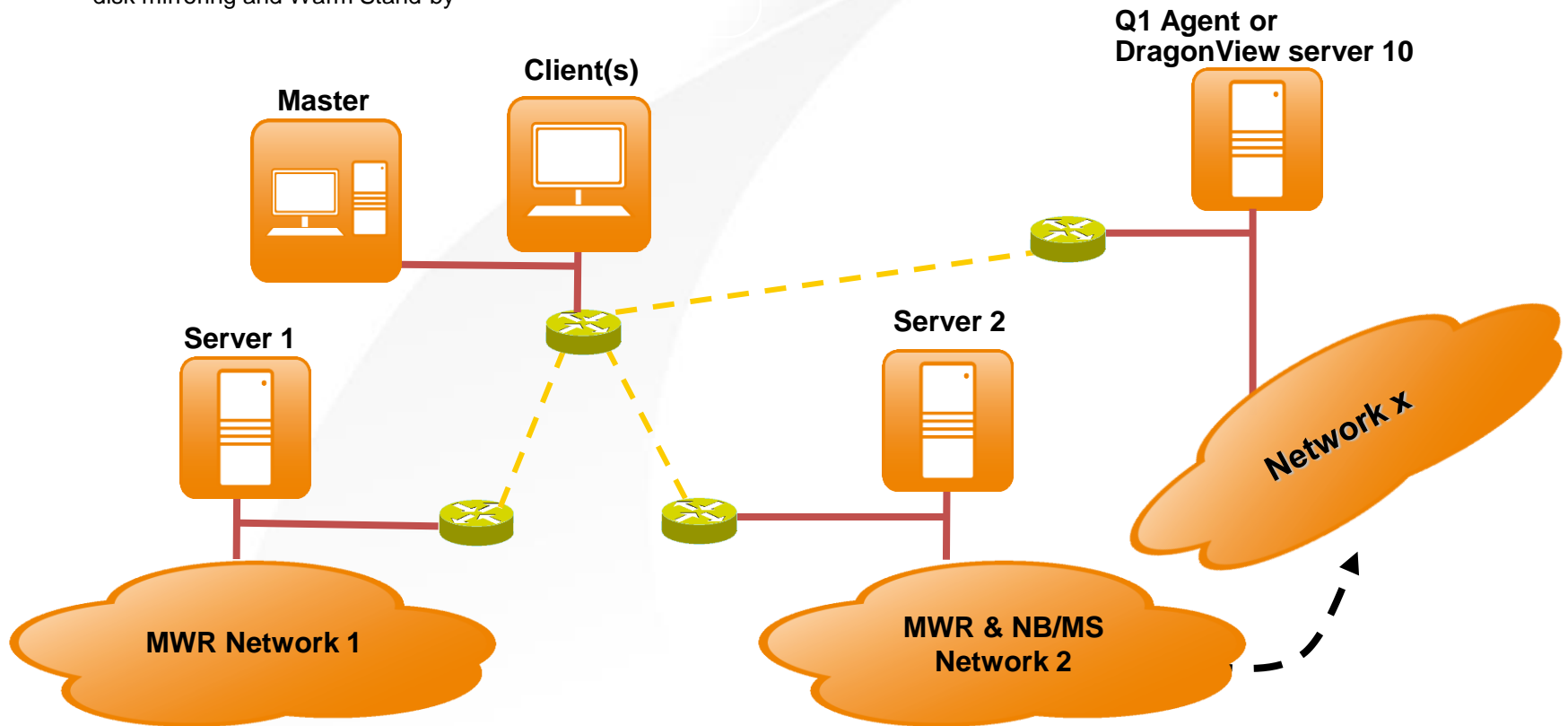
Single Server Configuration

- Managed NE's: up to 2000
- One server and up to 20 clients
- Disk mirroring and Warm Stand-by



Multi-Server Configuration

- Managed NE's: up to 10.000
- One master server and up to 10 slave servers
- Up to 20 clients
- master server: no as subserver
- disk mirroring and Warm Stand-by





N넥스처컴
BEYOND MOBILE TECHNOLOGIES

Network transformation with 4G force

We have lift off. Are you ready?