NEXT GENERATION BACKHAUL NETWORKS

AVIAT NETWORKS

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Adaptive

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Evolving Backhaul Requirements

- Base Stations with 50 Mbit/s or more can now be anticipated thanks to 3G and 4G HSPA/LTE and WiMAX Applications
- Current BTS capacity is limited to a few T1/E1's based on voice TDM traffic
- In between BTS capacity needs to evolve, especially where a mix of data and voice traffic needs to be transported

Cost Effective Solutions Needed

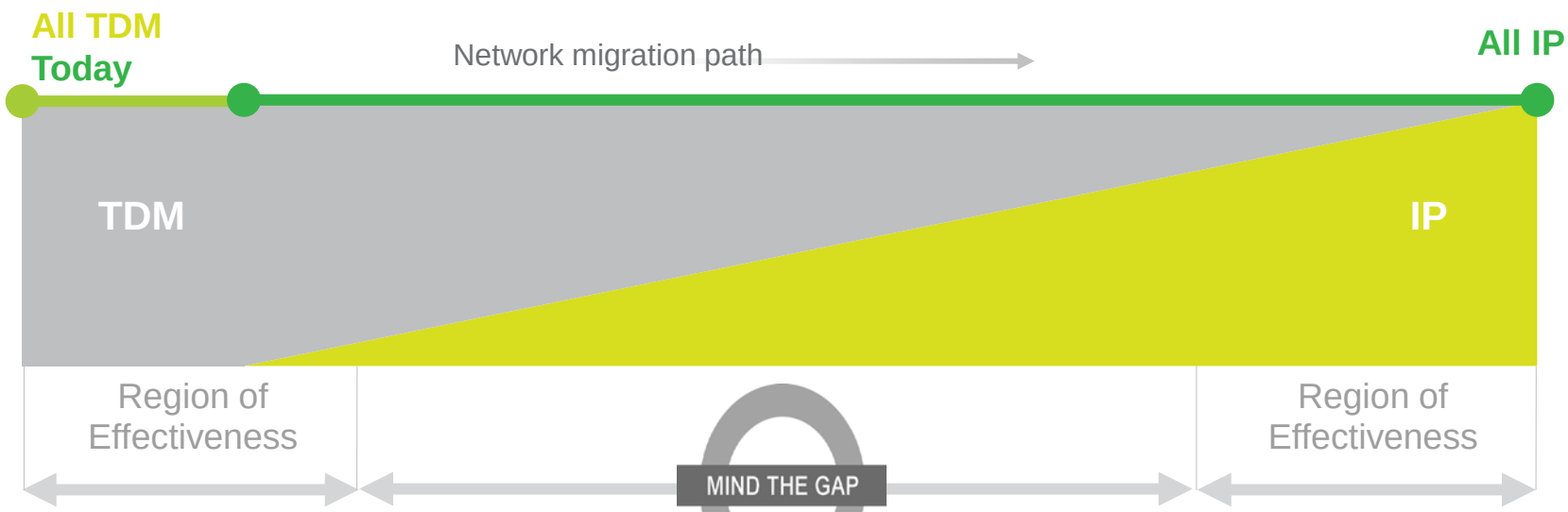
- Going forward best solution is carrier ETHERNET – scalable, flexible, QOS, MPLS PBB-TE

- Given existing BTS backhaul networks - which are based on TDM - need cost effective solutions to expand capacity to transition to full Ethernet solutions

Ethernet vs TDM

- Cost: Ethernet delivers more cost-effective bandwidth than other technologies
- Scalability: Ethernet supports speeds from a few Mbit/s to many Gbit/s
- Flexibility: Ethernet supports easy convergence of mobile backhaul with other network applications, including network security
- QoS: Ethernet supports operator prioritization of traffic, e.g. voice vs. non-real time data

Landscape: Network Migration Plans and Today's Microwave Systems



TDM ONLY Radio

- Legacy TDM radio
  - Legacy systems
  - Optimized for TDM
  - Not designed for IP – poor efficiency

IP ONLY Radios

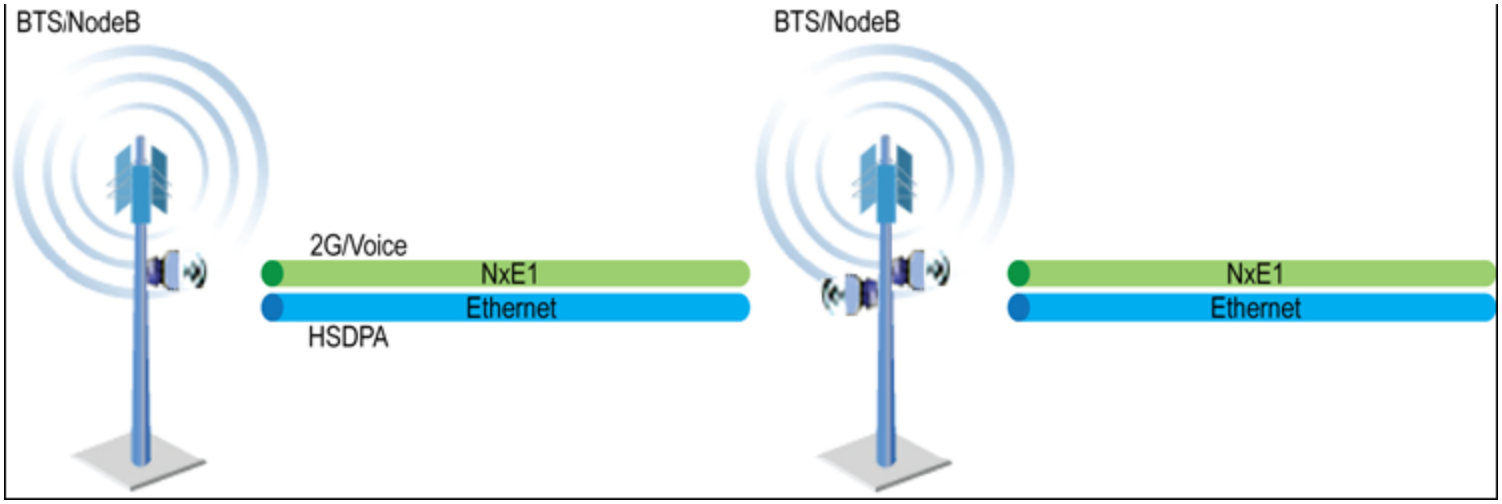
- New IP radio
  - Built to carry IP
  - Typically no native TDM (force use of pseudowire)

HYBRID Radio

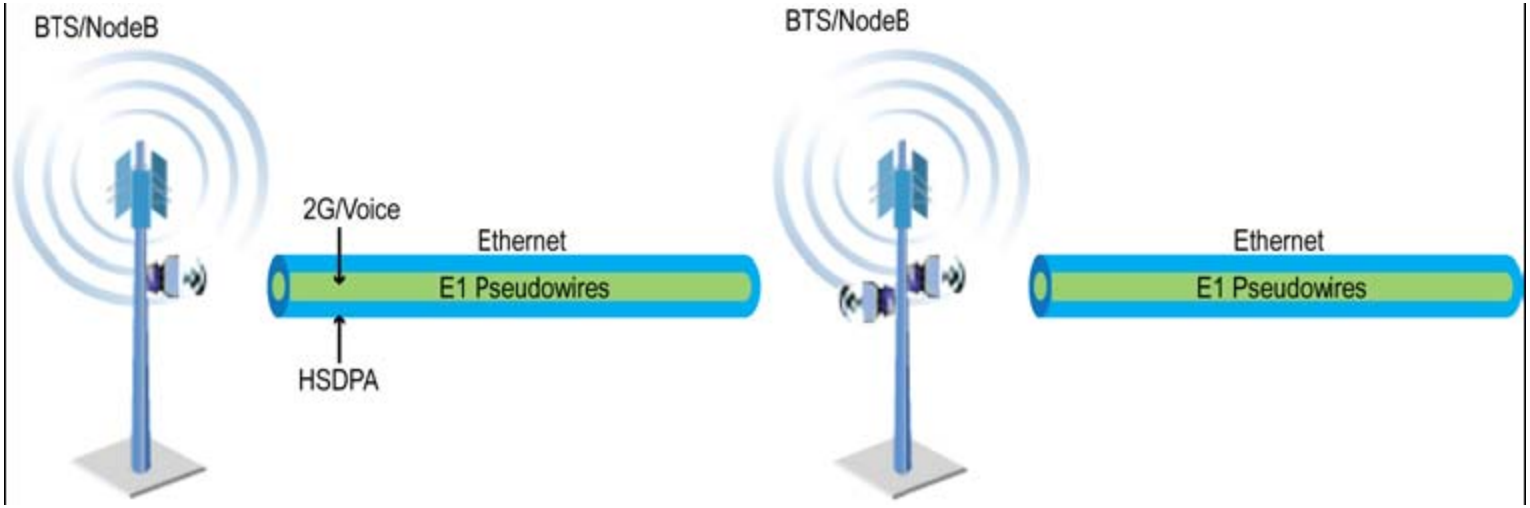
- Native TDM, Native IP Transport for effective migration to IP

Mixed Mode

Growth by overlaying Ethernet on to existing TDM; maximizing existing infrastructure and preparing for growth beyond it

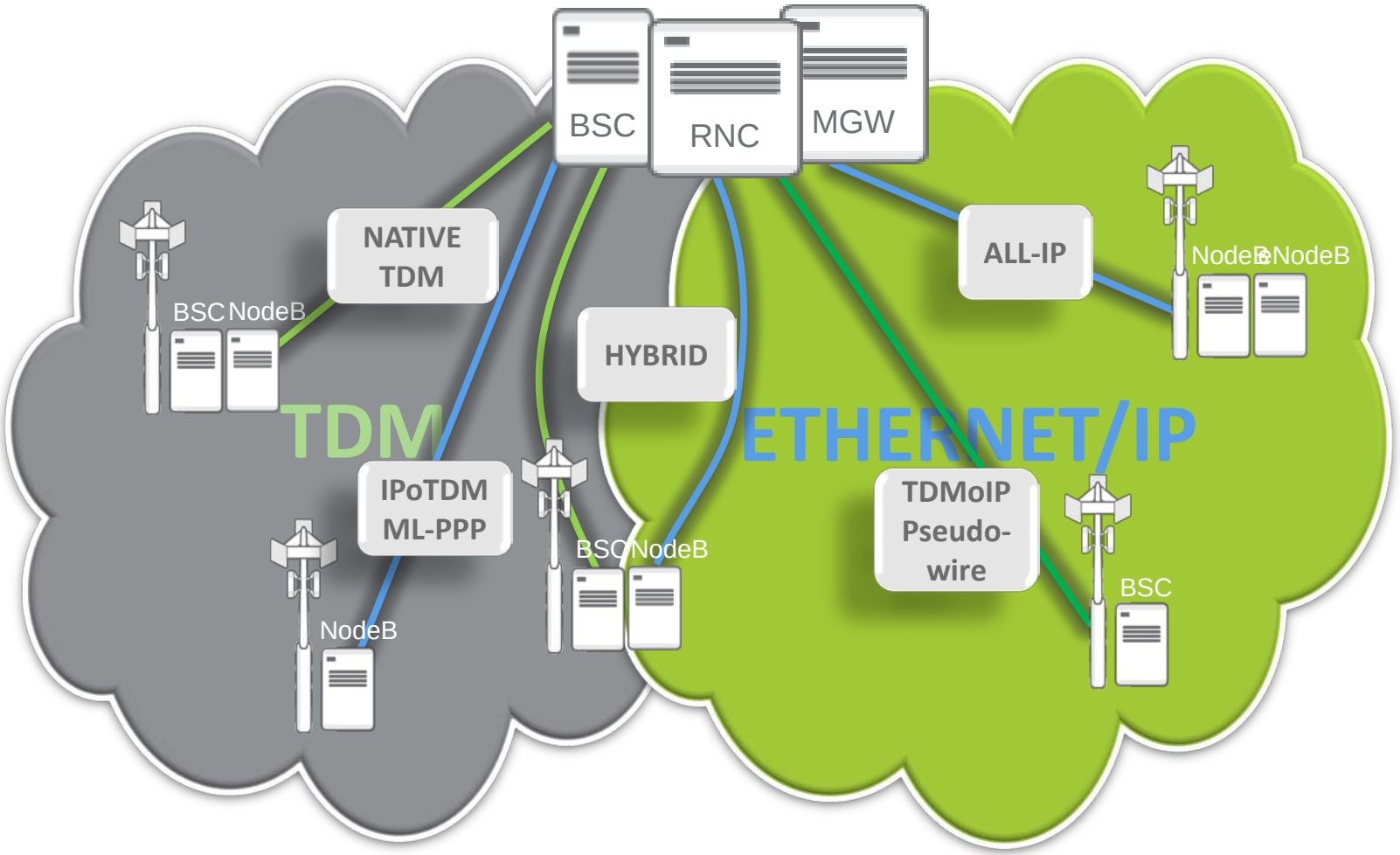


All-Ethernet and Pseudo-wires



- Replace existing TDM with Ethernet but provide for existing TDM connections using Pseudowire
- Loss of overhead and synchronization is an issue
- Economics of replacement is an issue

Eclipse Multi-Transport Technology Options



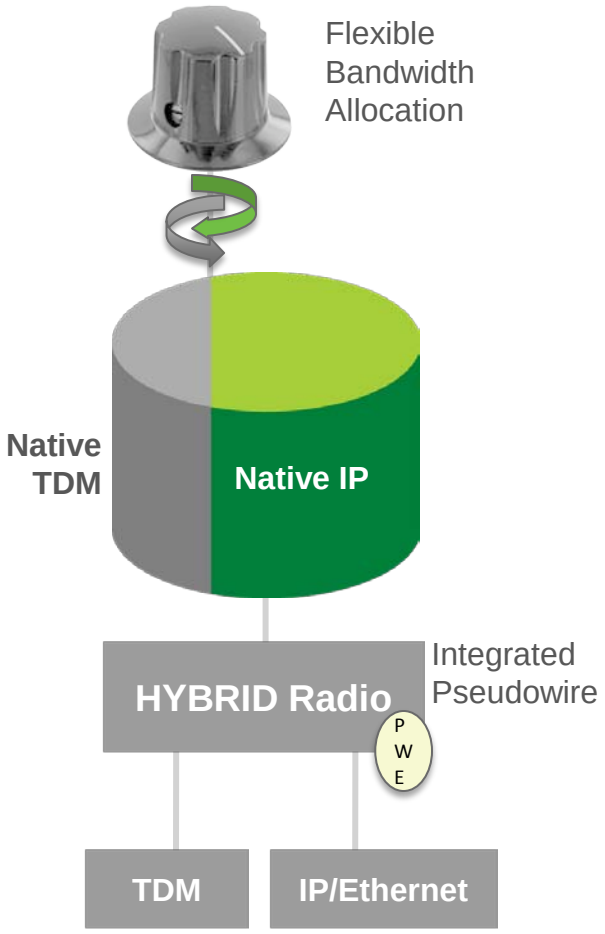
Hybrid Microwave Radio

HYBRID Microwave Radio Enables Seamless Migration While Supporting ALL-IP Future

Hybrid Enables:

1. All - TDM
2. All - IP
3. Emulated TDM over IP

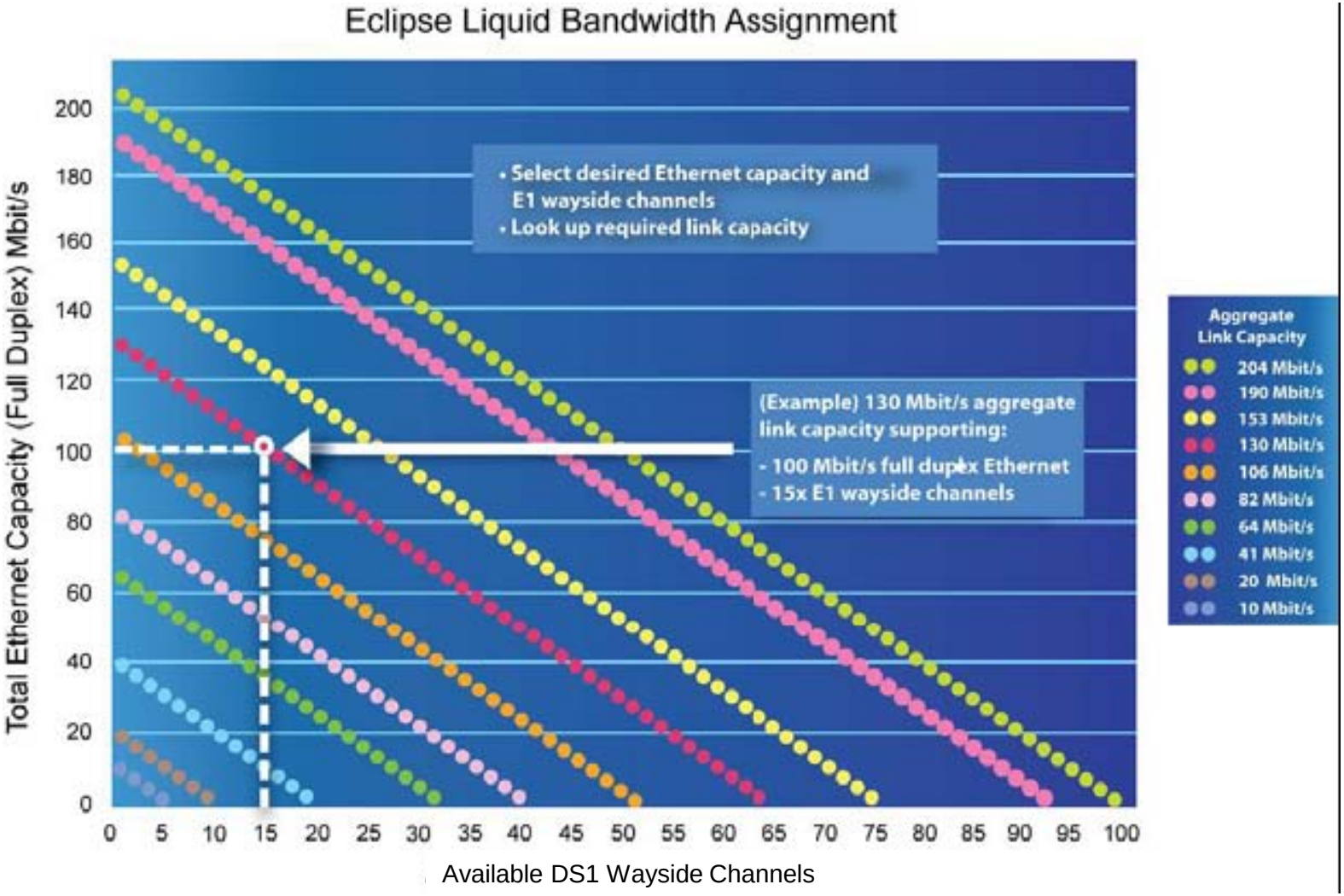
OR Any combination of the three



All-IP ⊄ **IP-only**

HYBRID Microwave Radios combine traditional microwave requirements with new IP features – all in a single platform

Example Trade-Off



Equipment Capabilities Required for Ethernet Operations

- The extended packet switch plane should support multiple GigE user interfaces
- It should also provide for pseudowires to enable transport of legacy PDH service over the packet switched network
- Network Synchronization IEEE 1588 v2
- A hybrid approach should also be retained to allow for some TDM for traffic requiring high synchronization not available by pseudo-wire.

Other Capabilities Required for Backhaul

- IP/MPLS and edge routers for connection to the core network
- Bandwidth optimization and traffic aggregation
- Higher order modulation, e.g. 256 QAM
- Adaptive Coding and Modulation (ACM)
- Cross Polarization Interference Cancellation (XPIC) and Co-Channel Dual Polarized (CCDP) links
- Resilient Ring Protection technology (e.g. RSPW), Virtual LAN Capability, Advanced OAM, etc

Multi-Protocol Label Switching

- Accepts multiple protocols, including IP, ATM, Frame Relay and transport layers such as Ethernet, SDH, PDH, SONET
- Encapsulates protocol, destination and other relevant information for onward transmission
- Requires edge routers for traffic ingress and egress

Data Optimization/Traffic Aggregation

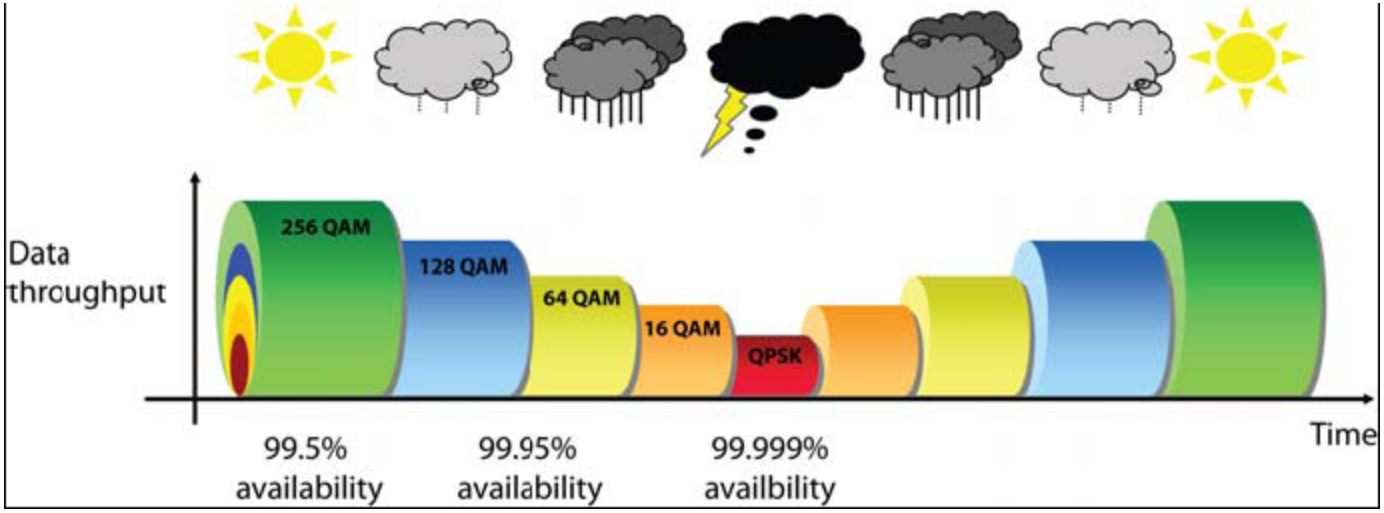
- Reducing or compressing data can provide dramatic capacity efficiencies on backhaul connections; 2G and 3G circuit-switched connections are converted to packet-based data and aggregated (multiplexed) using the aggregation capabilities of a layer 2 Ethernet switch
- Aggregation permits dynamic use of trunk capacity for data when voice traffic is reduced

Higher Order Modulation

- Higher order modulation yields maximum througMb.s in hput per channel, e.g.
  - 189 30 MHz with 256 QAM
  - 365 Mbit/s in 56 MHz with 256 QAM
  - 1 STM-1 (63 E-1) in 28 MHz for SDH signals

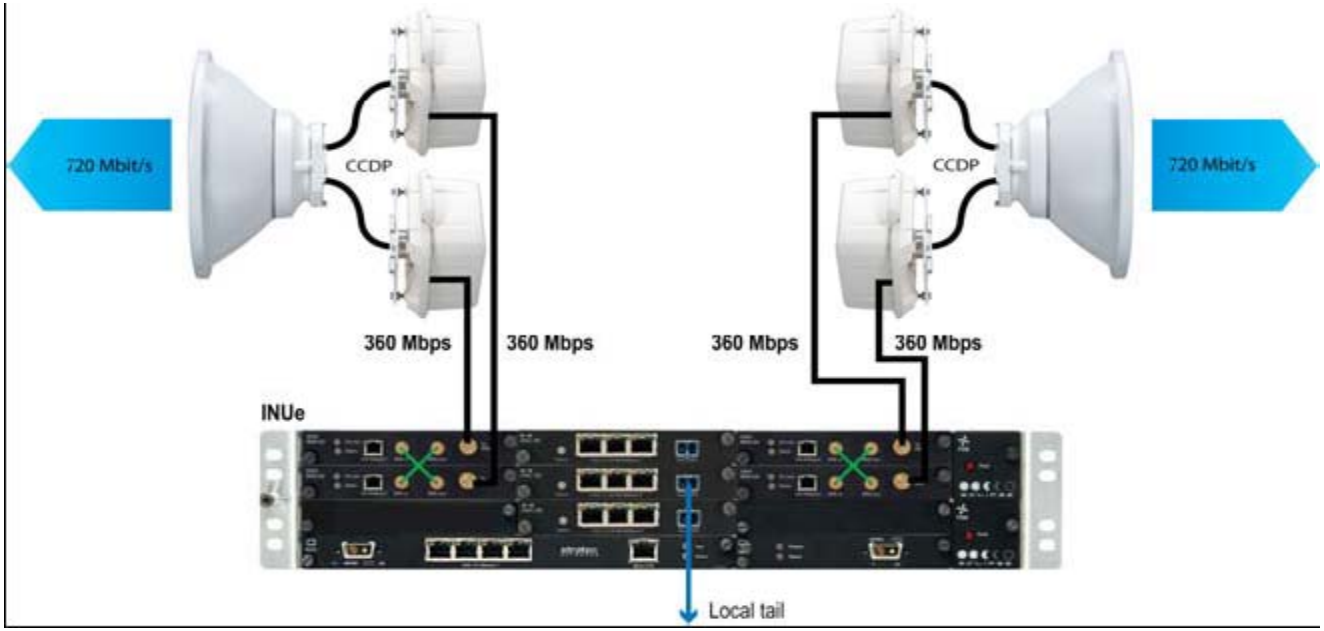
- These capacities can be doubled using XPIC with co-channel dual polarization (CCDP)

Adaptive Modulation



- Permits high data rate throughput during clear air and high reliability voice and other time sensitive traffic during clear air
- In clear air 256 QAM; in fades, down to QPSK

XPIC and Co-Channel Dual Polarized links



- The XPIC option provides two parallel communication links on the same RF channel.
- Both vertical and horizontal polarizations used with CCDP

Conclusion

- Due to rapid growth in demand for mobile back haul generated by 3G and 4G the call for increased capacity in existing networks is anticipated
- Ultimately IP/Ethernet based backhaul links will be required to meet capacity demands
- To grow from existing plant cost effective growth solutions are needed
- This presentation has discussed how some manufacturers have prepared for this evolution through the use of hybrid network solutions in which systems can evolve from native TDM to pseudowire TDM and from IP over TDM to IP only.

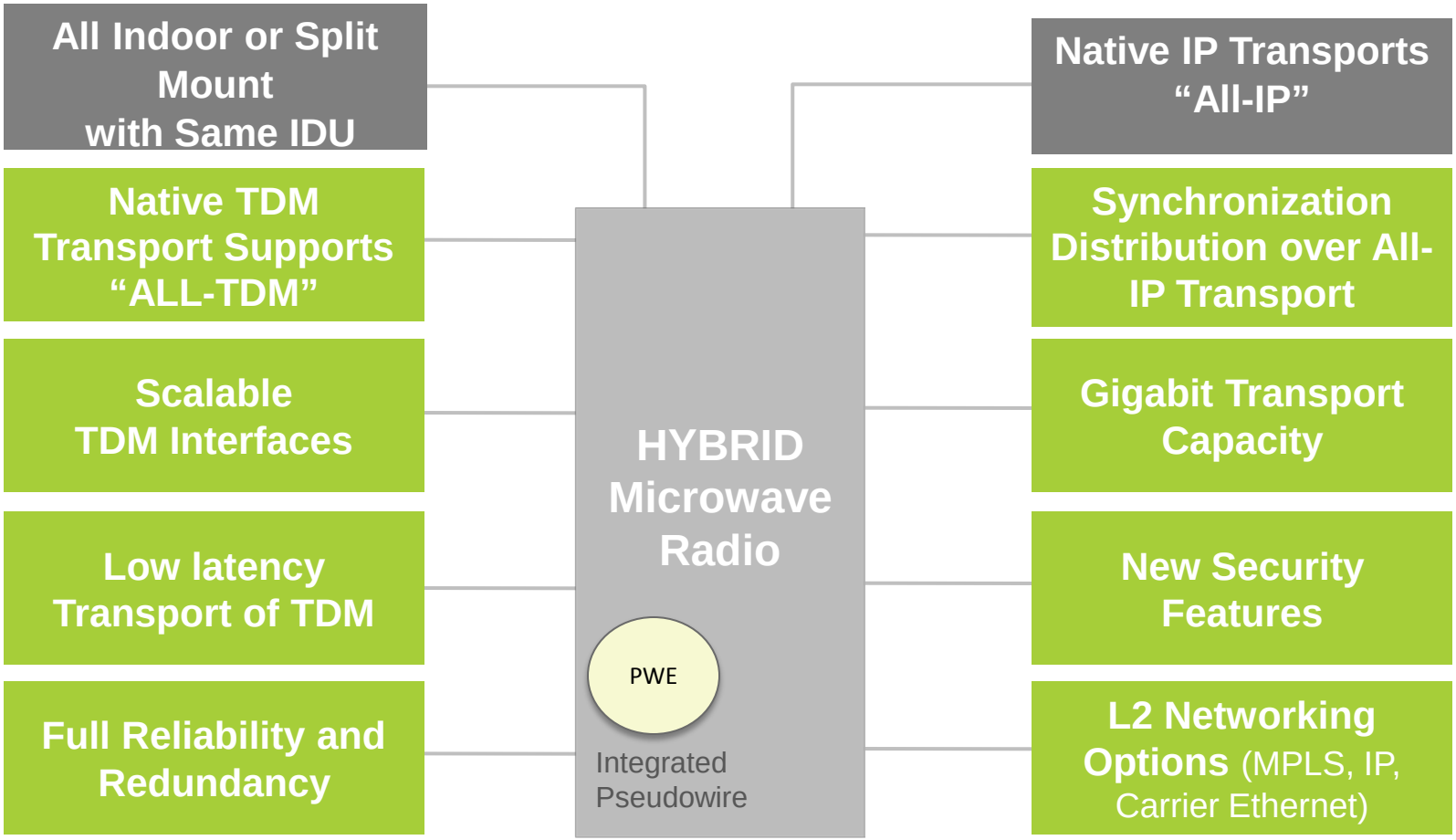
ADDITIONAL SLIDES

Aviat NETWORKS

Comparison of Radio Architectures

CAPABILITY	TDM ONLY	IP-ONLY	HYBRID
High TDM throughput	YES	NO	YES
High System Gain	YES	NO	YES
Low TDM latency	YES	NO	YES
High Redundancy	YES	YES	YES
Scalable TDM interfaces	YES	NO	YES
High IP Throughput	NO	YES	YES
Synchronization in All Packet Network	NO	NO Risky Packet Sync	YES Keeps TDM Sync
Easy migration to IP without antenna upgrade	NO	NO	YES
MPLS or Carrier Ethernet Support	YES	YES	YES
All indoor or split mount options with common IDU	NO	YES	YES
Integrated pseudowire	NO	Maybe	YES
New security features	NO	Maybe	YES

What is a HYBRID Microwave Radio?



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