SubOptic 2016
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Integrated Submarine and Terrestrial Network Architectures for Emerging Subsea Cables

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Emerging Subsea Networks

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EQUINIX

Celebrating 30 years of SubOptic

Presenter Profile

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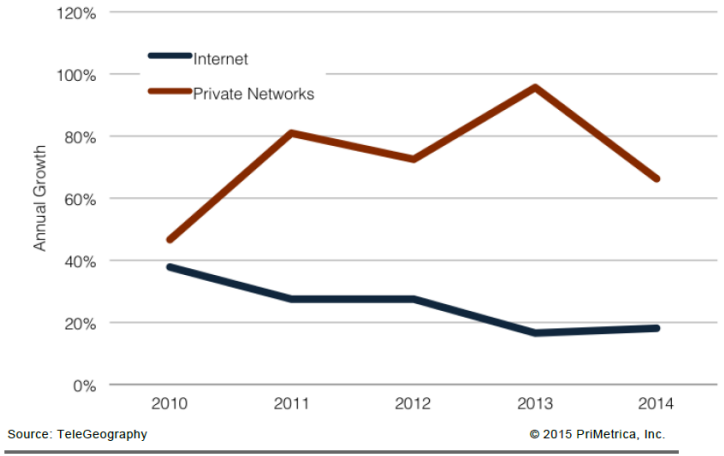
Tectonic Shifts in Emerging Subsea Networks

- New Subsea cable ownership model
  - Content / cloud providers and private ownership of dark fibers and/or spectrum
  - Private network traffic (DC to DC)
    - Content localisation / Edge caching
    - Distribution of data centers on different continents
- ‘Open’ Subsea cables
  - SLTE and wet plant vendor separation
  - Advances in line termination technologies
  - Faster SLTE technology refreshments
- CLS/SLTE termination at city POPs and data centers
  - Faster deployment
  - Open access and net neutrality



Trans-Atlantic Capacity Used by Source 2010 - 2014

Terminology

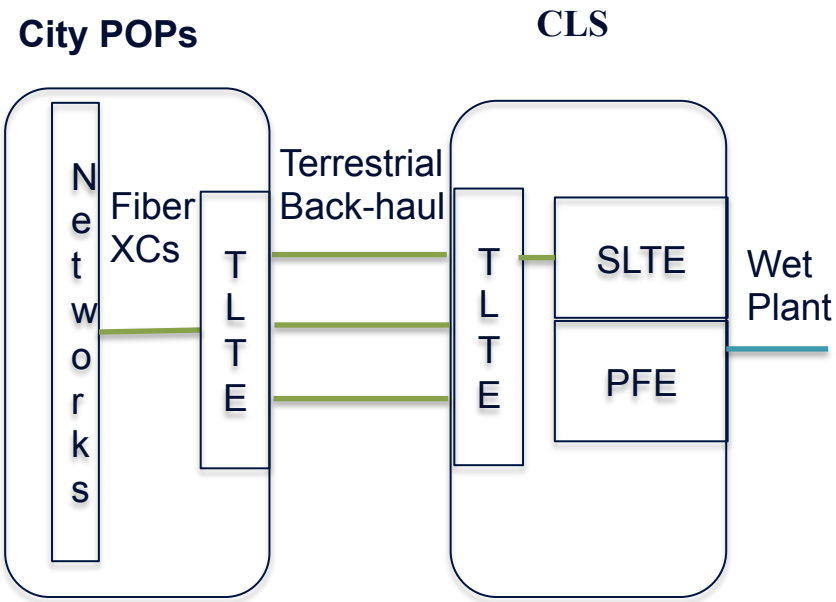
- Back-Haul
  - Terrestrial optical transport network between SLTEs at cable landing station to city point of presence (POP) or data center
- Front-Haul
  - Fiber plant (typically, wet plant fibers) and power cables from Beach Man Hole (BMH) to SLTE termination in city POPs or data centers
  - Fiber plant (typically terrestrial fibers) from PFE Station (near beach) to SLTE termination in City POPs or data centers

Data Centers as City POPs for Subsea Cables

- Colocation space and power
  - Colocation for SLTE, PFE (option based on distance to BMH) and EMS
  - Purpose built to meet PFE high power circuit requirements
  - Conditioned DC power options for SLTE
- Interconnections to customers
  - Fiber Cross-connects
  - Connections to cloud, content, and carriers
- Operations and maintenance support
  - On-site electrical & mechanical engineers
  - 24x7x365 operations support
  - Optional services like spares management
  - Shared support overhead structure between many tenants rather than dedicated O&M staff at traditional CLS

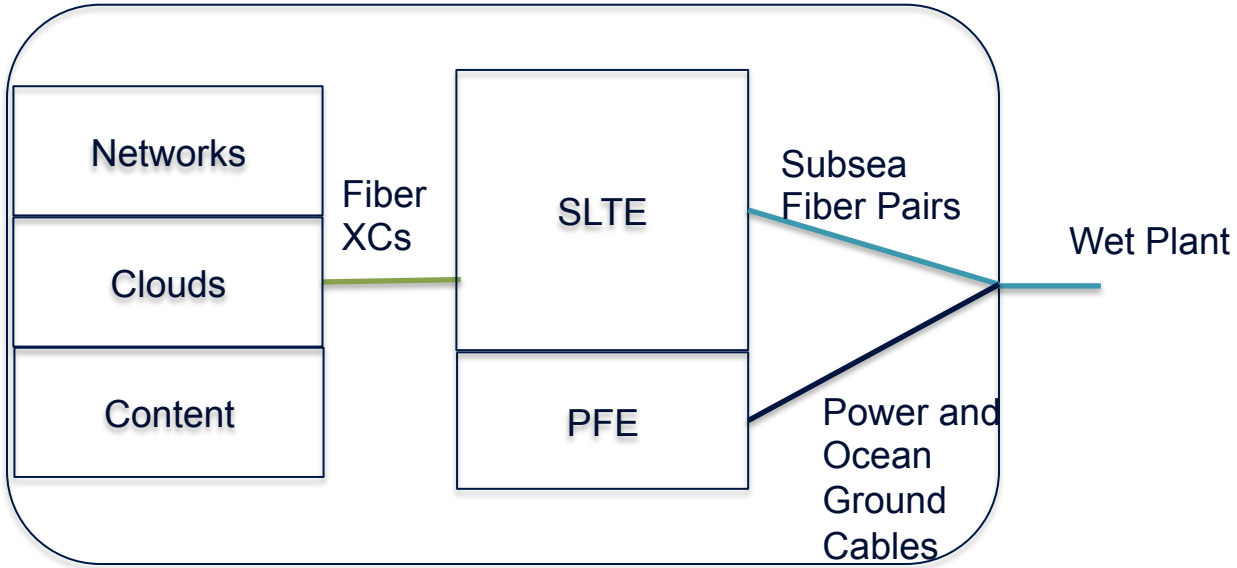
Back-haul Network Architecture: Traditional CLS

Challenges

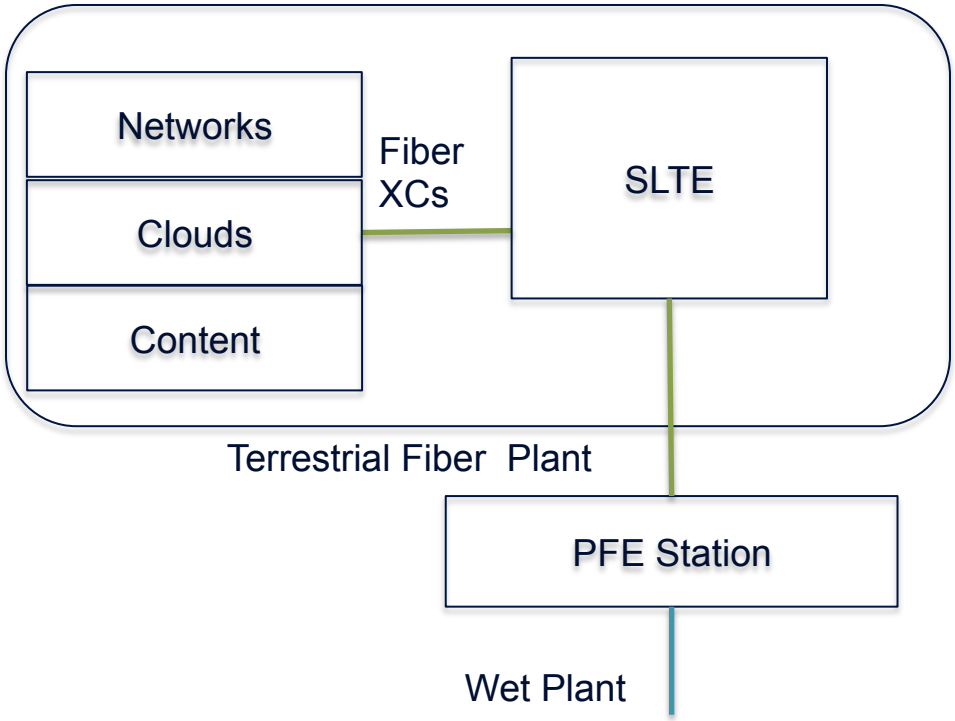


- Provisioning complexity and delays coordinating with back-haul providers
- Lower resiliency due to less architectural flexibility and “future proofing” due to back-haul provider dependencies
- Submarine system vendor lock-in with closed system for wet and dry plant equipment leading to slower technological developments for capacity upgrades
- Limited back-haul connection providers to Metro POPs with higher backhaul costs and increased latency
- Cost/complexity of managing cable landing station (CLS) and city POP infrastructure

Integrated CLS and Coastal City POP or DC

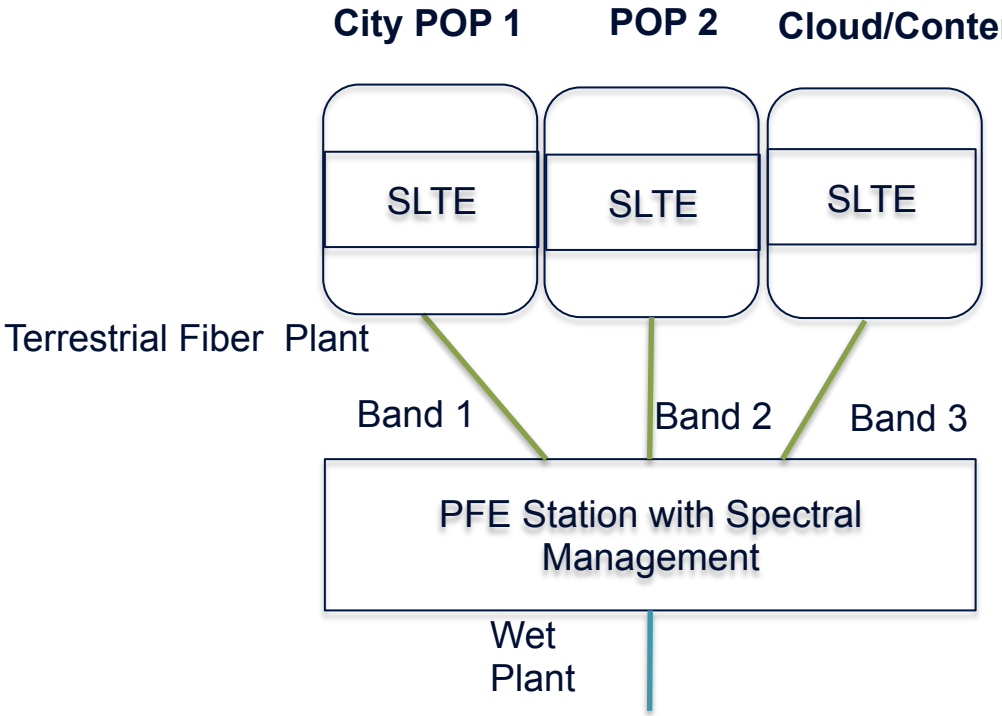


Integrated SLTE in City POP or DC



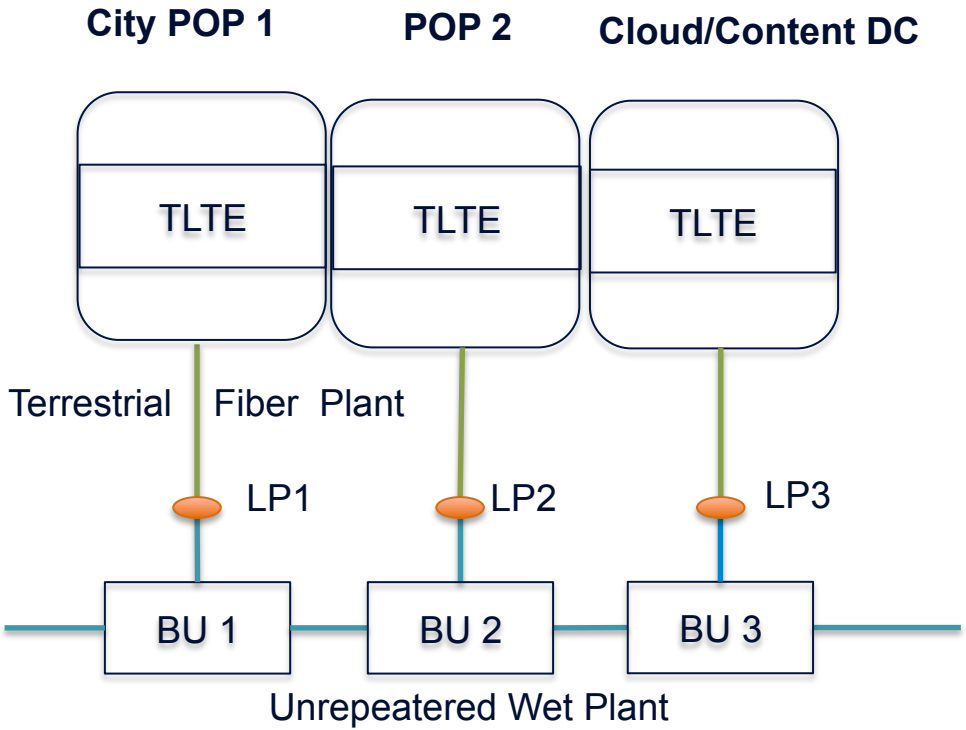
Integrated SLTE in City POPs or DCs

Spectrum Splitting to Multiple POPs or Data Centers



Unrepeatered / Festoon Wet Plant

Terrestrial LTEs in City POPs or Data Centers



System Design Considerations

- System Reach
  - Desk top studies and system design for POP to POP or DC to DC connectivity
  - Terrestrial fiber plant
    - Fiber distance, type, loss, and diversity
    - Placement of powered amplifiers or ROPAs
    - IRUs or fixed term contracts for terrestrial fiber routes
- Capacity
  - Modulation type based on reach (8/16 QAM, QPSK, or BPSK)
- (Re) Configuration
  - ROADM technology (fixed grid or flex grid)
  - Support for future data rates (400G, 150G Flex Ethernet etc.)
- Data Center or POP location
  - Open and carrier neutral location with security and reliable power supply
  - Customer density

Benefits of Front-Haul Network Architectures

- Ease of provisioning
  - Customer hand-offs with no back-haul transport systems
  - Improved provisioning cycles
- Improved resiliency with less active equipment
- Improved latency
  - Direct fiber cross connects to customers
  - Direct routes between major cities
- Better economics
  - CAPEX and OPEX savings with less equipment
  - Access to data centers with O&M staffing available 24X7 on demand rather than dedicated 24X7 staff at traditional CLS

Conclusions

- A combination of recent optical transport technology advancements and new submarine cable deployment strategies enable the consideration of various front-haul network architectures to integrate with emerging subsea cables and extend subsea optical signal termination to major city data centers.
- Application of these network architectures along with careful selection of city data centers for housing SLTE are beneficial design choices that lead to business success for subsea cable owners

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