Small Cells

Joseph M. Sandri
SVP, FiberTower Corp.
National Spectrum Managers Association (NSMA) Annual Meeting
Arlington, VA
May 16th, 2012
jsandri@fibertower.com

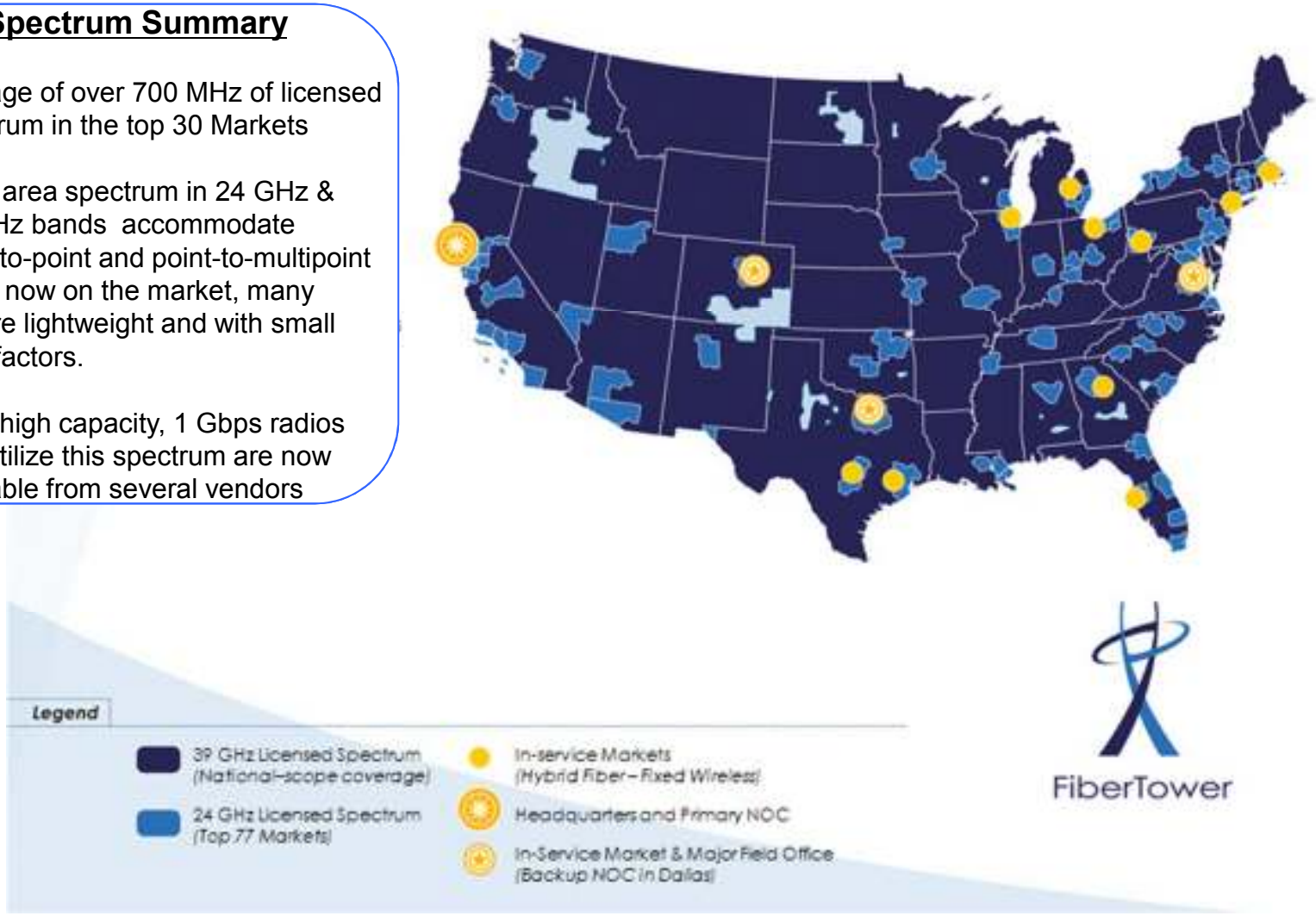
Overview

- What are small cells?
- Market Forecasts
- Design, Deployment and Operations Challenges
- Spectrum
- Open Discussion

National Spectrum

Spectrum Summary

- Average of over 700 MHz of licensed spectrum in the top 30 Markets
- Wide area spectrum in 24 GHz & 39 GHz bands accommodate point-to-point and point-to-multipoint radios now on the market, many that are lightweight and with small form factors.
- Ultra-high capacity, 1 Gbps radios that utilize this spectrum are now available from several vendors



Ideal spectrum for rapid deployment of high capacity small cell site backhaul

What Are Small Cells?

- Macrocells are the original, wide area high power bases stations that cover areas typically reaching up to 20 miles radius (there are exceptions).
- Small cells are the generic umbrella term for a variety of smaller underlay cell technologies. Small cells do *not* replace Macrocells, and instead support and feed back to Macrocell networks.
  - Picocells are operated and managed by the network operator who also pays for site rental, and transmission back to the core network.
  - Femtocells are semi-autonomous systems. They are installed, powered and connected by the end user or business with less active remove management by the network operator who remains responsible for them.

	Macro	SmallCell
Radio	1-3 miles	0.1-0.5 miles
Per site capacity	-150 to 500 Mbps	-100 to 300 Mbps
Aggregation capacity	-500 to 2000 Mbps	-300 to 1000 Mbps

Cell metrics

- **1980s to the Present**
  - **3 Million mobile base stations operational worldwide**
  - **˜25 years to construct**
- **Present to 2019**
  - 60 Million commercial mobile LTE base stations worldwide
    - 10-15% in the U.S.
      - Backhaul Wireline: +50%
      - Backhaul Wireless: 20-to-50%
        - Low band
          - Unlicensed
          - Licensed
        - High band
          - Unlicensed
          - Licensed
  - Ratio of Small Cell to Macro: 5:1 to 20:1 in Dense Urband

Other Uses

Other uses not included in the commercial network tabulation:

- National First Responder Network
  - 45,000 Macro sites
- WiFi
- WISPs
- SmartGrid
- Intelligent Vehicle
- Electronic bill boards
- Stadium & Festival events
- Video
  - Surveillance
  - News
- Inside buildings

National and local level challenges to handle any A&E drawing, leasing, zoning, permitting or construction needs

Network Deployment Process: Street Level Requires Different Thinking

Rev. 3.0 Design

- **Final Design with Field Verification**
- Design details provided to Deployment & Service Delivery
- Ascetics & Size Make Enormous Difference

Pre-NTP

- **Site Design and Lease Application**
- Pre-Construction site walks
- Construction drawings, structural analysis and lease application

NTP

- **NTP to Construction**
- Lease execution, zoning approval and building permit
- Space and power readiness confirmation

Build

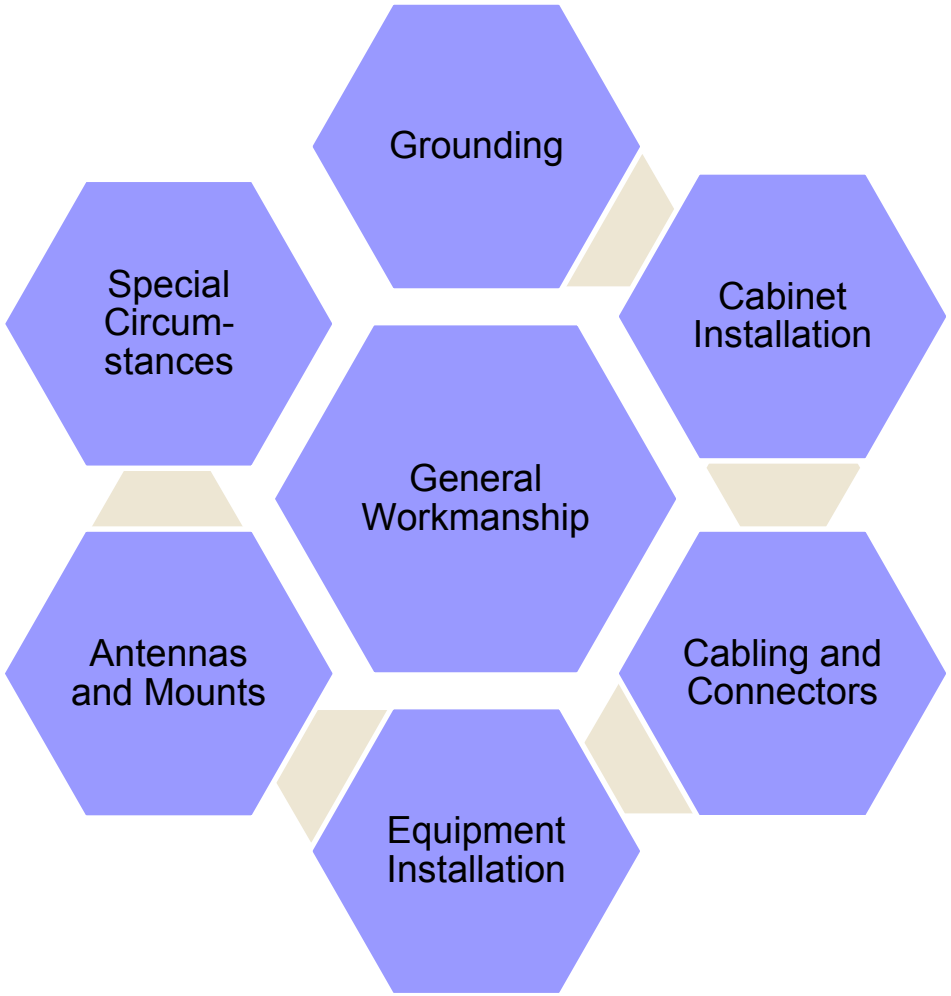
- **Site Construction**
- Equipment installation and cabling
- Pathing and RF link testing
- Site acceptance

Test & Acceptance

- **Link Test & Acceptance**
- Service provisioning and service testing
- Handover to customer

Deployment: Construction Standards

- Detailed library of construction standards to cover all Metro authorities
- Cross-functional teams must continually review and update based on field feedback
- Contractors are trained on the standards; Field Operations verifies compliance upon site acceptance

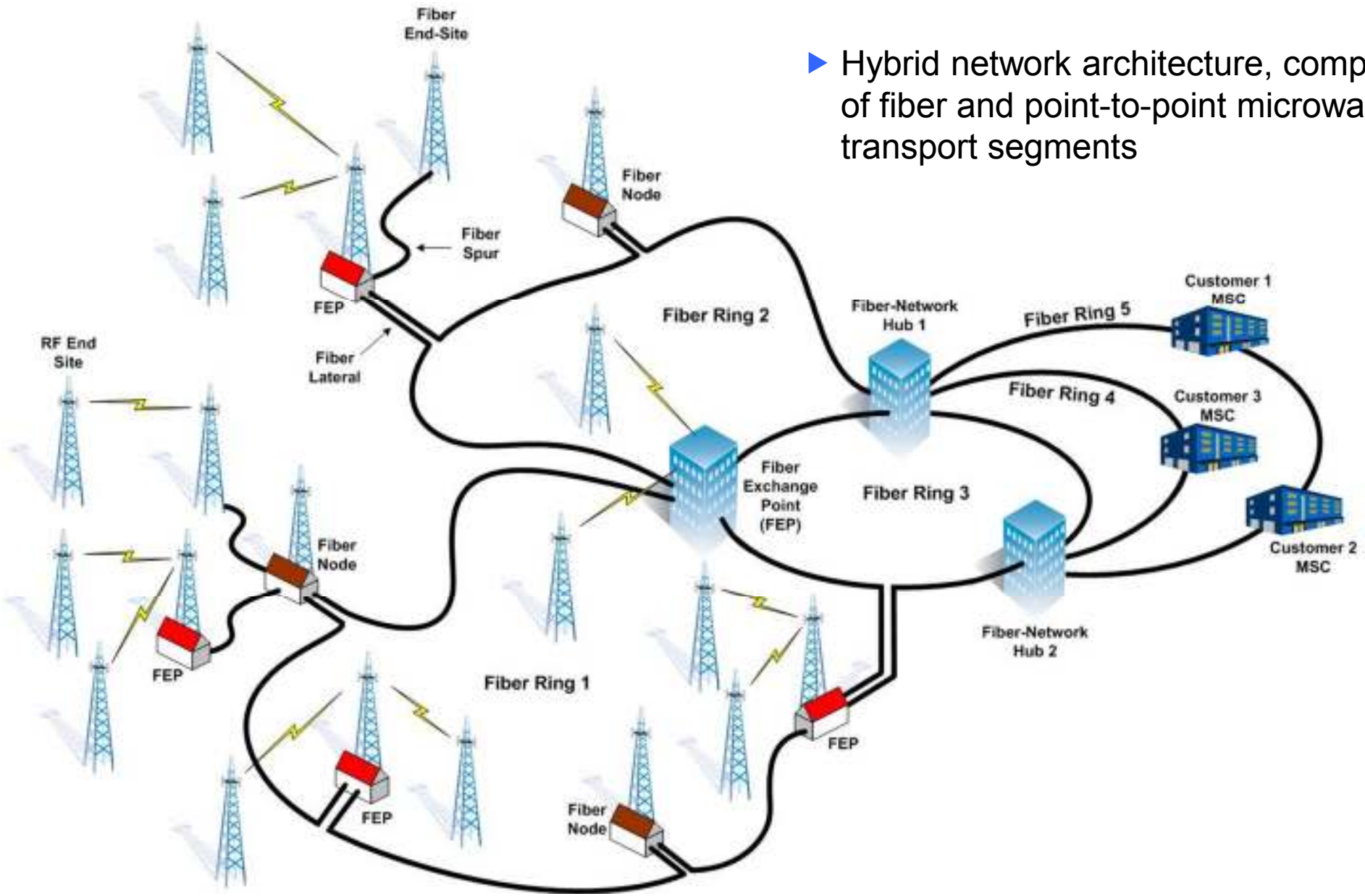


Project Macro and Small Cell Backhaul Network Architecture

Small Cell Accelerators

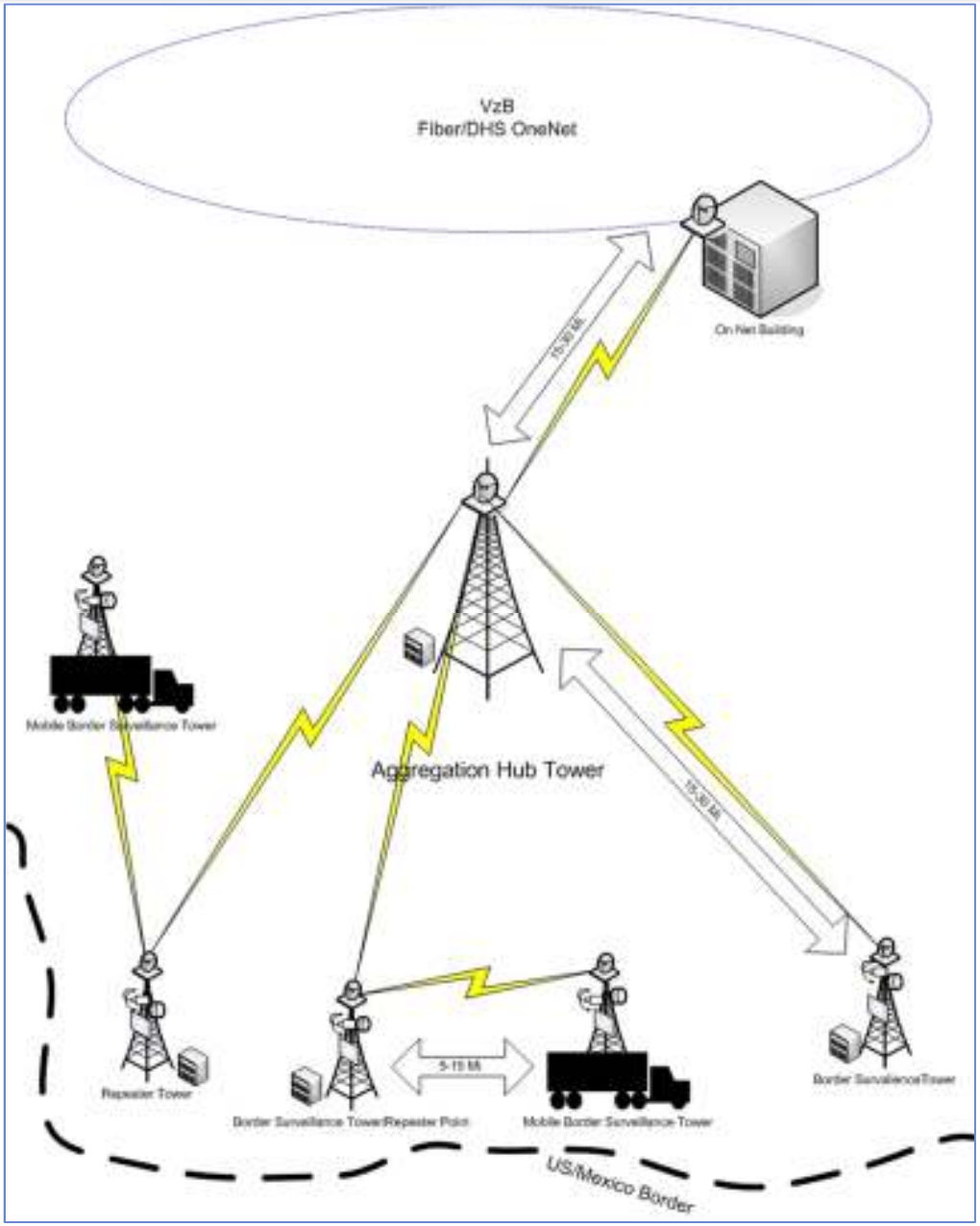
- **LTE Arriving: Funded projects**
  - **Verizon well underway**
  - **AT&T, TMO, Sprint, Others in the early stages**
  - **National 1st Responder Network (45,000 sites; Funded Feb. 2012, Pub.Law 112-96).**
- **FCC Pole Attachment Order**
  - July 2011: Utilities must make poles ready within 45 days
    - Typically $12 per year rent
      - Compared to $200+ per month on typical towers and rooftops!
- Small cell backhaul gear developments
  - Low band
    - Unlicensed 928 MHz, 2.8 GHz, 5.8GHz
    - Lite License: 3.65 GHz
    - Wide-area Licensed : BRS, WCS, 1.4, others
  - High band
    - Unlicensed : 60 GHz ; Lite Licensed: 70-90 GHz
    - Point-to-point: 6, 11, 18, 23 GHz
    - Wide-area Licensed: 24 GHz (400 MHz); 28-31 GHz; 38.6-40.0 GHz

Generic Backhaul Network Architecture



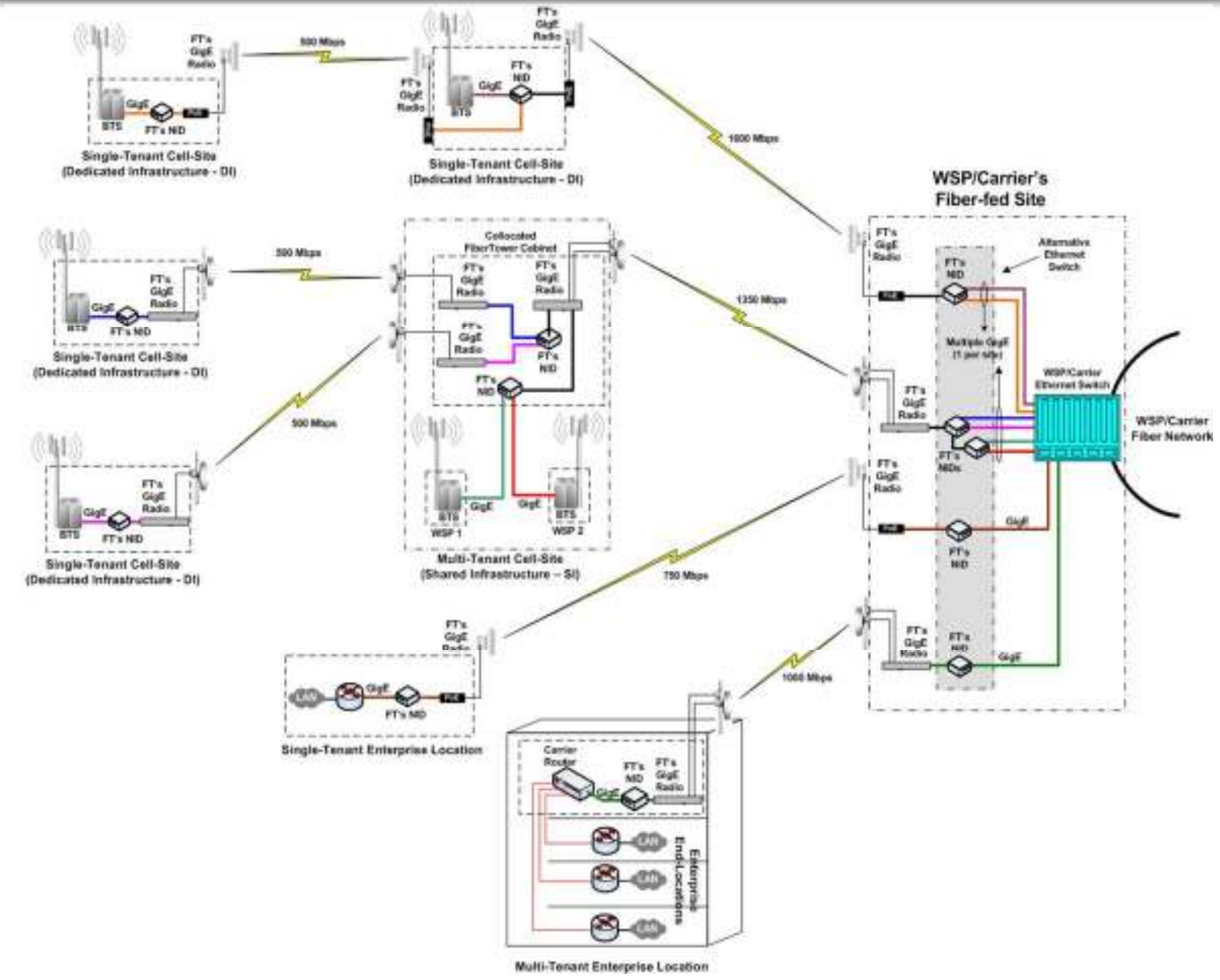
- Hybrid network architecture, composed of fiber and point-to-point microwave transport segments

Small Cell Project Backhaul Network



- Primary Network Nodes:
  - Fiber exchange points
    - On-net buildings/towers
    - Off-net buildings/towers
  - Aggregation hub trooftops/owers
  - Small-cell host poles/towers/buildings
- Microwave Backhaul Links
  - Macro Aggregation links
  - Small cell access links
    - Lightpoles/Power poles
    - Towers/Rooftops
    - Portable

Sample Radio Network Architecture



Open Discussion

Selected References

- FCC Small Cell and DAS program (Feb 1, 2012): http://www.fcc.gov/document/fcc-workshop-das-and-small-cells-february-1-2012
- CTIA Small Cell program (May 2012): http://www.ctiawireless.com/events/eventdetails.cfm/1468
- AT&T Small Cell pilot due late 2012; early 2013: http://www.engadget.com/2012/05/08/att-small-cell-site-pilot-due-late-2012-2013/
- Lightreading: DragonWave small cell product with FiberTower spectrum: http://www.lightreading.com/document.asp?doc_id=213881
- Wikipedia Femtocell: http://en.wikipedia.org/wiki/Femtocell
- Wikipedia Macrocell: http://en.wikipedia.org/wiki/Macrocell
- Inacon Picocell: http://www.inacon.de/glossary/Pico-cell.php
- ITU-T (July 2011) (see p.11): http://www.itu.int/dms_pub/itu-t/oth/06/4D/T064D0000020072PDFE.pdf
- IWPC small cell workshop Jan-Feb 2012: http://www.iwpc.org/Workshop_Folders/12_02_SmallCell_Backhaul/12_02_Agenda_Backhaul.html
- Telecom Pulse (showcase Alcatel-Lucent cube): http://telecompulse.com/2011/02/12/small-cell-technology-that-can-replace-cellular-towers-to-be-showcased-at-mwc-2011/
- ITU-R P.1411-1: http://symoon.free.fr/scs/ofdm/biblio/Transmission%20pour%20micro%20drones%202004/Netographie/Modelisation%20de%20canal/ITU_R_P1411.pdf
- Instat Small Cell study: http://www.instat.com/mp/10/IN1004712GW_Sample.pdf
- EFYMag (Jan. 2011): http://www.efymagonline.com/pdf/Femto-Cells_Jan11.pdf