Thoughts on the future of Small-Cell Backhaul

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Cisco projects mobile data traffic will increase 18-fold by 2016 with mobile video traffic (e.g. Facebook, Netflix, Pandora, YouTube) as the primary data consumer.

Capacity can be improved using 4G spectral efficiency, new tower builds, and purchasing spectrum. In aggregate, these options improve capacity by 4-5x from current levels vs. 18x the increase in demand.

It is projected at least 100,000 small cells will be required over the next few years to meet the demand.

WiFi offload has helped the capacity bottleneck, but is not a long-term, complete solution.

Small Cells with fiber and high-speed wireless backhaul remain two reliable options to address the issue.
Small Cell Wireless Backhaul – It’s all about capacity

Legacy Network

Cell Radii = 1-3 miles

Future HetNet

Small Cell backhaul over MW or MMW Spectrum (LOS & NLOS)

Cell Radii = 0.1-0.5 miles

Macro Cell-Site

Microcell

DAS

Fiber Backhaul

LTE/WiFi Small Cell

Picocell

DAS
Microwave/MMW Spectrum for Backhaul

- **6-38GHz (licensed) used traditionally – Macrocell backhaul**
  - Per link license typically $2K fee
  - Long distance with lower frequency
    - 6GHz up to 50 miles, 38GHz up to 3 miles
  - Optimized for speeds up to 350Mbps

- **60GHz unlicensed (free)**
  - Excellent for short distances (1/2 mile)
  - Gigabit speeds and urban environment friendly

- **70/80GHz**
  - Per link license typically $100 fee
  - Gigabit speeds
Some Key Technical Takeaways for Microwave/MM Small Cells

- Higher frequencies are range limited but offer higher bit-rate thanks to wider bandwidths and less interference (narrower antenna lobes).

- Higher frequencies gain more from larger antennas but also become more sensitive to pointing errors. Small antennas are required for small cells.

- Lower frequencies (sub 6 GHz) are more spectral efficient and more tolerant to NLOS propagation but don’t offer high bit rates due to smaller bandwidths.

- Mid-range block licensed frequencies could also be considered for LOS & NLOS backhaul links.

- Combination of frequencies bands may be required to implement the full small-cell architecture.
MMW Propagation

- 60GHz:
  - Absorption of $O_2$ ~14dB/Km
  - 0.1 – 1 mile for 1Gbps links @5’9s

- 80GHz:
  - 1 – 3 miles for 1Gbps links @5’9s

- Neither is impacted by:
  - Selective fading (multipath) due to relatively short links
  - Fog (<0.4dB/Km)

- Ideal for short range, high capacity connectivity
  - Immune to interference
  - Simple, quick licensing
Wait a second! - Fiber remains a very competitive alternative if it's already there

- Difficult to compete with fiber on bandwidth, reliability, etc.
- If fiber is already there, costs to deploy a fiber “lateral” is comparable to deploying a microwave or millimeter-wave radio link
- Fiber assets are considered more valuable by the industry
- Fiber will always be difficult to deploy however, due to municipal restrictions, regulatory framework, labor unions, taxes
- That means wireless does have a time-to-market advantage
- Fiber cannot be dismissed as is often is when pitching radio solutions
- Even in pure radio solutions, fiber is required at drain points
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<tr>
<th>Option</th>
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<th>Deploy</th>
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<th>Interference</th>
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**Exceeds current and future needs** ![Green](#)

**Meets current needs** ![Yellow](#)

**Not Suitable, Difficult, Expensive** ![Red](#)
## Small Cell Backhaul Options With Existing Fiber

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- **Exceeds current and future needs**
- **Meets current needs**
- **Not Suitable, Difficult, Expensive**
Summary of Small Cell Backhaul Options

- Each technology has shortcomings thus small cell backhaul is a hybrid solution in which all three have a vital role
Thank You

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