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Business Case for MulteFire Technology

February 27, 2018

Key Trends in Future Wireless Market

- MNOs challenged keep up with continuous increase in CapEx to meet growing demand
- Need for ubiquitous, high speed mobile connections always increasing
- IOT networks invading almost all business processes
- New opportunity created for shared infrastructure providers to sell capacity to major MNOs
- Licensed Spectrum cost and demand can close off opportunity for alternative carriers to implement their own wireless networks.
- Advanced wireless technology now allows fixed wireless services to compete and surpass wired technologies for rural and urban deployments
- New kinds of strategic private networks can be built for targeted industries

MulteFire Business Advantage

- MulteFire can create business advantage in addition to strategic technology advantage
- Take advantage of the volume production of LTE networks and radios
- Coverage advantage reduces CapEx and OpEx with efficient infrastructure
- Use of unlicensed spectrum reduces initial investment and enables new types of operators or users.
- Managed networks can add new services easily
- Multi-operator networks can reduce cost and enable new business models

MulteFire can provide benefits across a wide range of use cases

Use Cases for White Paper

Case #1- Harbor Private IoT Network
Study Case- Port of Singapore

Case #2- Enterprise Office Building
Study Case- 590 Madison Ave

Private IoT Networks with MulteFire

- Enterprise Controlled- Closed, independent network, no obligation to MNOs
- High Performance- Tuned for coverage capacity, applications, latency needed
- Flexible deployment and Secure- Unlicensed spectrum, managed services, security from LTE

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Private IoT Harbor Use Case

- Existing deployment models and challenges

Capacity: Hundreds of Wi-Fi access points are deployed to accommodate multiple-services; adding more APs increases interference and decreases capacity

Coverage: Signal blocked by complex surroundings (containers, cranes, trucks) that interrupt connectivity links

Mobility: Requires low latency (<100ms), high link stability with high mobility 24/7

Use Case #1- Port of Singapore

Port of Singapore is one of the largest ports in the world, covering a vast area along 16 kilometers of the waterfront along Singapore Strait.

- Total coverage area- 20 square kilometers
- Berths for docked ships- 65
- The port hosts 37,000 ships annually
- Over 32 million containers pass through the port annually.

Use Case #1- Port of Singapore

Key Functions of the Network

- **Asset tracking.** Each container that is in the port has a sensor on it to provide its ID and location to allow all assets to be tracked in real time.
- **Transportation and autonomous vehicles.** Real time communication and planning for all transportation moving goods around the port.
- **Environmental sensors**. Weather and environmental sensors, air quality and toxic sensors could be spread around the port.
- **Communications with arriving ships.** An information connection would allow data and sensors from docking ships to share information.
- **Video and surveillance**. A network of cameras could provide wide coverage video surveillance across the port to a central security facility.

Use Case #1- Port of Singapore

Number of IOT Sensors

Combination of high capacity and low capacity devices

Number of Berths= 65 x 50 devices per berth= 3,250 devices

Number of Boats= 100 x 20 devices per boat= 2,000 devices

Number of Containers = 176,000 containers x1 device per container= 176,000 devices

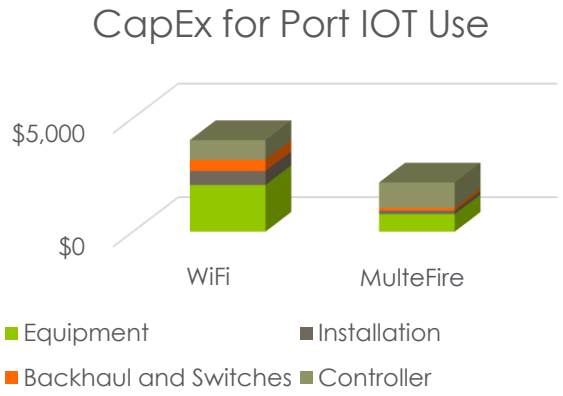
Total number of devices= 181,000 devices

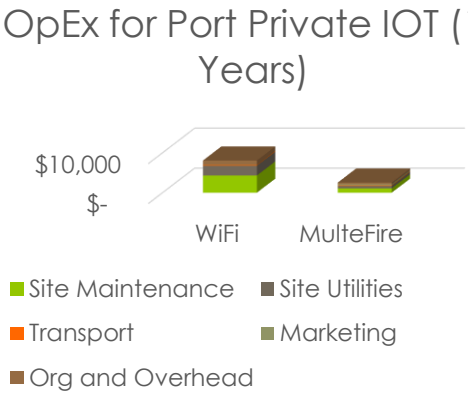
Use Case #1- Port of Singapore

- **Key Assumptions**

Key assumptions	MulteFire	Wi-Fi (802.11ac)
Range	200 m	100 m
Capacity	100 Mbps	75 Mbps
Cost	$3,000	$2,000
Number of coverage units	257	1027

IOT Harbor Case Study Results: CapEx and OpEx





Analysis results show the 50% cost savings in CapEx and 70% OpEx savings, mostly stemming from more efficient infrastructure

Use Case #1- Port of Singapore Conclusions

- For a use case requiring a large coverage area, MulteFire brings significant advantages
- Cost savings can be more than 50% for CapEx and 70% OpEx over 10 years vs a Wi-Fi deployment
- Network can support narrowband and high capacity sensors without the need to add capacity
- Additional operational savings can be supported through security and managed network capabilities to add new services

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Enterprise Office Networks with MulteFire

- Flexible Deployment- Could be deployed by building owner, enterprise, Neutral Host or MNOs
- Multi-operator network- A single network of small cells can support subscribers of all MNOs
- Flexible deployment and Secure- Unlicensed spectrum, managed services, security from LTE

Use Case #2- 590 Madison Ave

590 Madison Ave is a 40 story office tower in Midtown Manhattan

Number of floors- 40
Total coverage area- 93,000 sqm
Total population- 6250

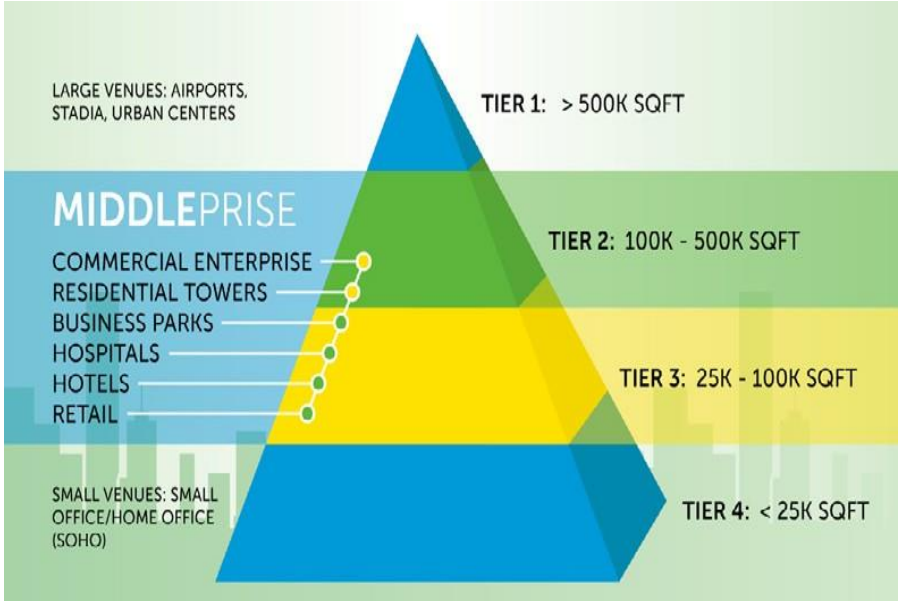
Use Case #2- 590 Madison Ave

Key Functions of the Network

- **Indoor Mobile Coverage.** Provide coverage for all major MNOs with "5 bars" of coverage
- **WiFi support.** It is assumed that all tenant offices would be covered with the own enterprise WiFi. Much of the typical daily data traffic (80%) is assumed to go over the WiFi network.
- **Multi-operator support**. Would implement unlicensed bands with MulteFire, therefore can assume that all subscriber phone eventually would have MulteFire support
- **Neutral Host support.** This case assumes that they network is deployed by a third party neutral host, and completes a deal with the MNOs to provide support for their subscribers

Use Case #2- 590 Madison Ave

MulteFire cost savings enables improved economics to support Middleprise buildings



Use Case #2- 590 Madison Ave

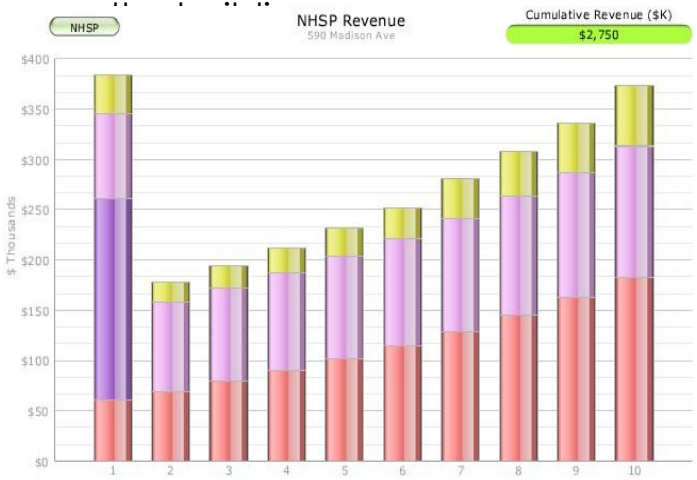
Value Proposition for the MulteFire Network

- Cost savings, both CapEx and OpEx
- Support multi-operator small cell support. Typical small cells require support of an in-building small cell network for each operator (x4, in this case)
- Managed network capability to facilitate support for multiple operators, enable monetization of the network
- Network security to ensure key functions in the network

Use Case #2- 590 Madison Ave

Revenue Streams

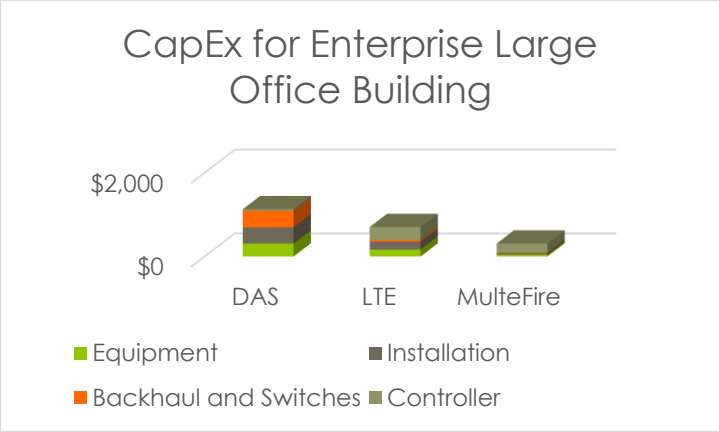
- In this example, it is assumed that the neutral host has a contract with each of the MNOS to provide connectivity for all of their subscribers in

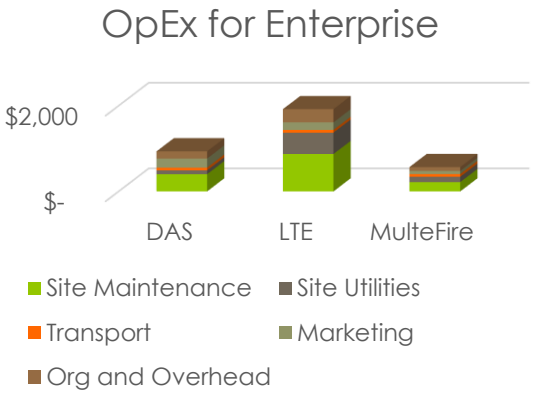


Revenue could be derived from three sources.

- A CapEx contribution from each participating MNO as the network is deployed
- A monthly fee to deliver capacity to each of the MNO's subscribers
- A usage fee on a per GByte basis

Enterprise Case Study Results: CapEx and OpEx





Analysis results show up to 70% cost savings in CapEx and up to 70% OpEx savings, mostly stemming from multi-operator support

Use Case #2- 590 Madison Ave Conclusions

- Being able to support a single infrastructure for multiple operators is a major advantage for MulteFire
- MulteFire provide significant CapEx savings over DAS and significant OpEx savings over typical small cells.
- Additional operational savings can be supported through security and managed network capabilities to add new services

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Conclusions

- MulteFire is developing as one of the **key new technologies** in the wireless industry.
- The capability to develop a **high performance LTE-like network in unlicensed spectrum** creates new possibilities for wireless use cases and business model.
- **The economic benefit of MulteFire** can drive lower cost, new revenue streams, and better deployment models.
- By providing economic benefits for anyone who wants to deploy a wireless network, MulteFire can expand rapidly as a key technology for the ever-growing expansion of wireless networks around the world.