K-Mesh for Ferries

High Capacity Ship to Shore Data Communications

Global InterLink Corporation

Provides

High Capacity Wireless IP Connections

Over Great Distances

With Near Zero Packet Loss

In a

Robust Meshed Peer-to-Peer Network Topology

With

Assured Levels of Data Throughput

Origins: Real-Time Multimedia Collaboration

Preparedness, Situational Awareness, and Response

Real-Time Multimedia Collaboration

INTERLINK Meshed IP over RF Networks

Mobile or Fixed with Real Time Multimedia Collaboration

Video in, Video Out, all radios, all phones.

Unmanned

Secure Private Wireless Networks For Airborne Surveillance

ROTARY

FIXED

Handheld Devices (tablets/ phones) have full secure access to Fusion Centers via Wi-Fi or LTE Video in, Video Out

Secure Tunnels through LTE Public Carrier Networks

Secure Media Portals for external viewing via browser when required. Enhanced Real Time Video

Other Agencies Or Commands as needed via Secure IP

Mobile Fusion Center(s) via Secure IP

Secure Private Networks (Wired and Wireless)

Secure Tunnels through Public Networks/Internet

Secure Private Networks (Wired and Wireless)

Fixed Fusion Center

Fixed and Wearable Personnel Surveillance with Fusion Center Access Over Private Secure Wireless orks video in and video out.

Vans and trailers

K-Mesh: High Speed Data Transport Using Classic RF

- A proprietary MIMO protocol developed to provide superior performance
  - Widely used by military and special forces around the world
  - Now available for commercial applications
- Selectable Frequencies in the range from 400 MHz - 6.0GHz
- Highly efficient meshing algorithm that allows many nodes with very low loss of data transport capacity
- Defeats distance – if required can carry traffic hundreds of miles to reach a fibre gateway
- Ethernet IP – It is layer 2 IP - straight plug and play
- No third-party coding required for interface or optimization

Buenos Aires: Background

The Once Tragedy

- In February 2012 a train entered Once - the central station – and failed to stop, crashing into the station while still travelling at 16 mph; there were 51 fatalities and over 700 casualties
- The authorities launched an aggressive programme to prevent any recurrence – including videos in the cabs with live streaming to central observation points
- K-Mesh provides the connectivity that carries the live video feeds from all 26 trains on the Sarmiento line
- Now that same technology is being deployed on 4 other lines in Buenos Aires

Buenos Aires Commuter Rail Lines

Lines:

- Sarmiento (Completed)
  - Central Station (“Once”)
  - 16 Stations
  - 26 trains
  - 4-tower backhaul
  - >30 km
- Mitre-3 Lines (in progress)
- San Martin (in progress)
- Roca (TBD)
- Belgrano (Norte and Sud, TBD)
- Urquiza (TBD)
- Going from 120 nodes to 1,000 over the next 12-15 months

Sarmiento Line Topology

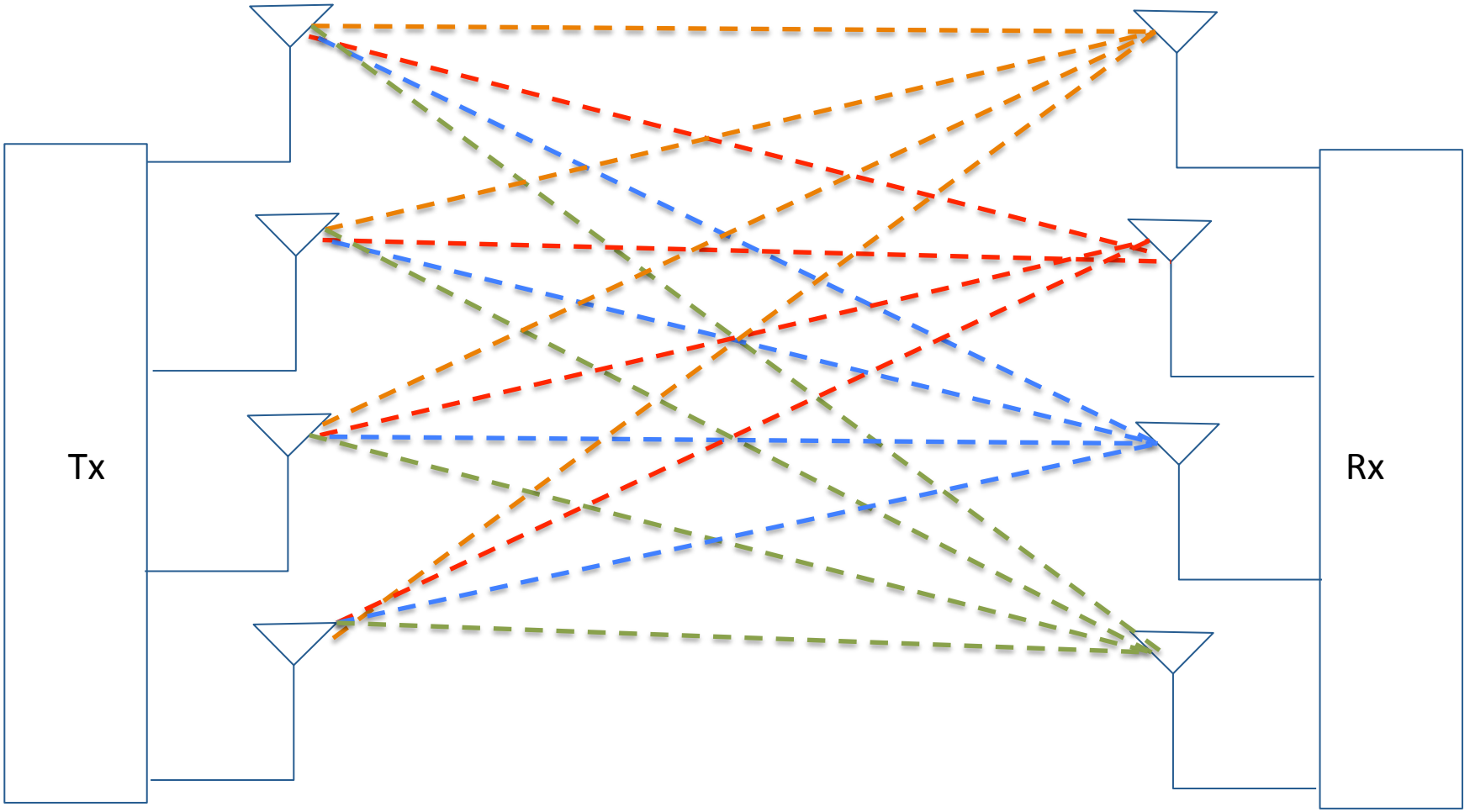
- 16 stations forming an end to end network
- Each station is a node as there is no fibre to the stations
- The specification is to provide a minimum of 30 Mbps to each train
- Streaming Video—Requires a Peer-to-Peer Network
- Each Train Brings with it its Own Contribution to Aggregate Network Capacity

MN-MIMO Technical Advantages

Due to the extraordinary level of real-time, packet-level control and the advantages of 4X MIMO, MN-MIMO advantages over conventional WiFi Mesh include:

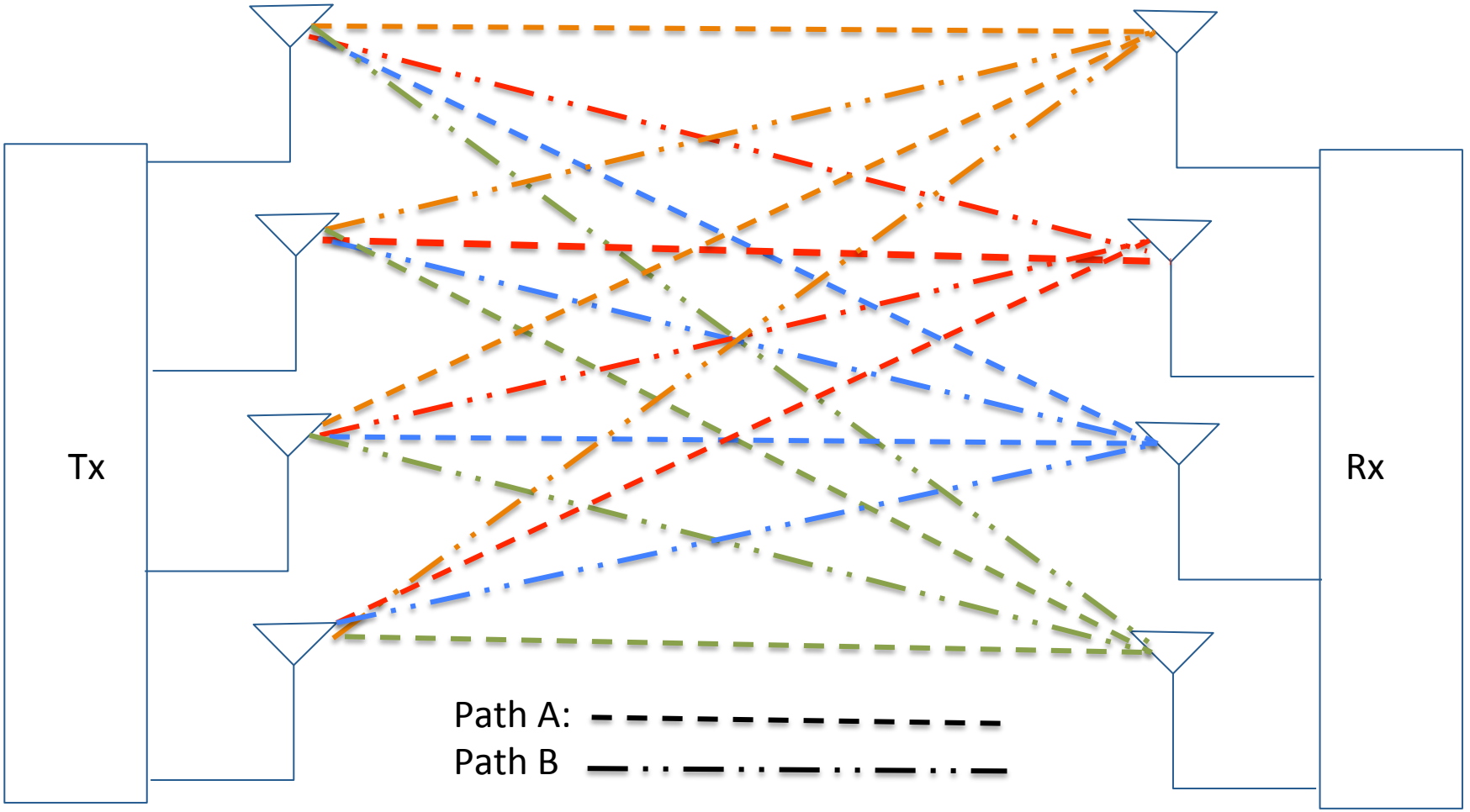
- Ability to route instantaneously each packet by the current optimal path
- Ability to select the optimal modulation scheme for each packet according to current conditions
- Space-Time coding distributes redundant copies of data across multiple antennas to improve robustness
- Spatial multiplexing permits multiple data streams to be sent simultaneously , increasing the capacity of the link
- Rx Beamforming allows radios efficiently to sum energy received by all receiving stations
- Tx Beamforming (in development) will soon allow radios to steer transmit beams toward the receiver on a real time basis

MIMO—Quadruple Redundancy?



16 paths

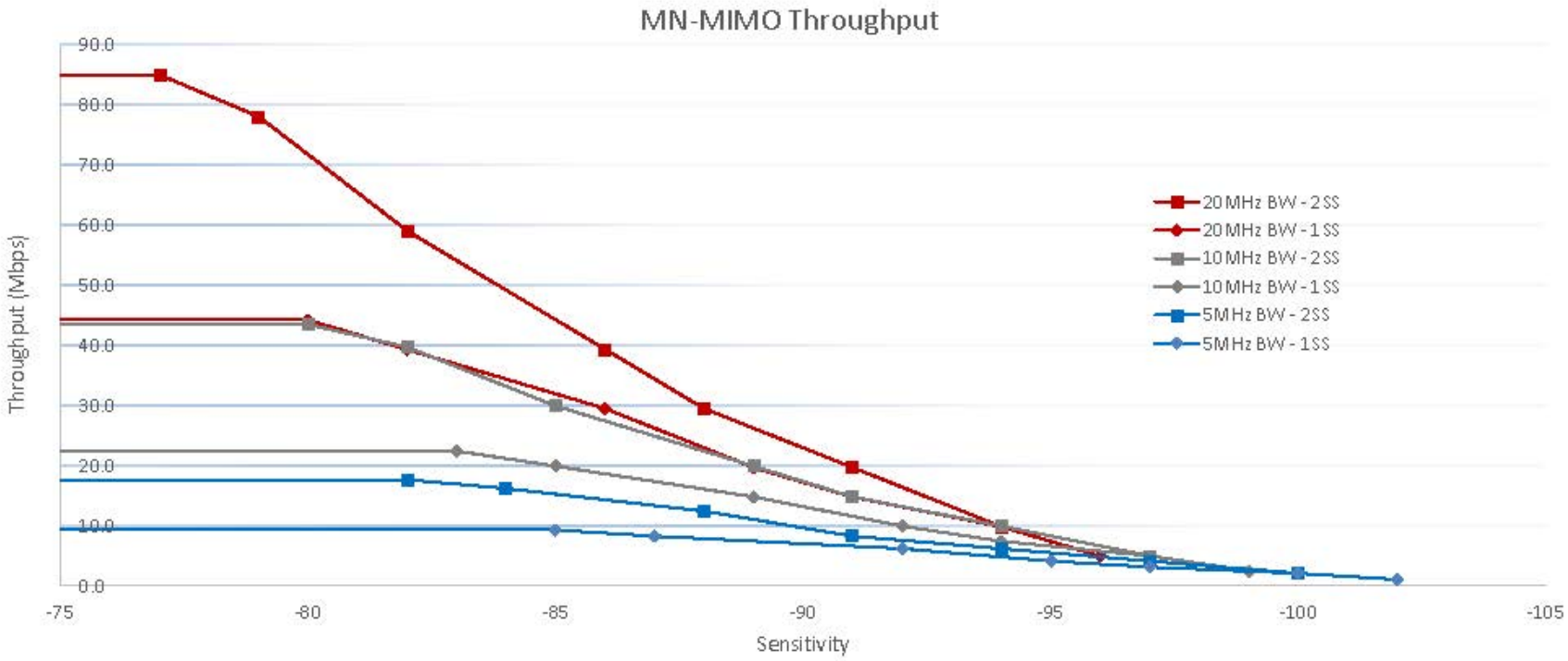
MIMO—Doubling the Data



Note that 8 carry <u>one</u> set of data and 8 carry a <u>second</u> set of data.

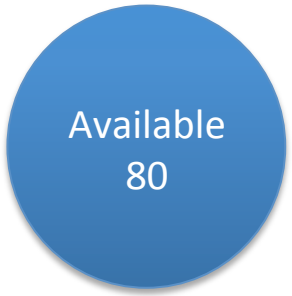
K-Mesh Throughput Modes

- Radios have several discrete modes that employ different modulation schemes, coding rates, and MIMO techniques
- Radios automatically and dynamically determine the best mode for transmitting to each of their neighbors individually
  - Will always select the mode which can provide the highest throughput



K-Mesh: Air Time With Consistent Offload

- InterLink radios operating in the same frequency channel will share the air time
- A single frequency mesh can support up to 85Mbps*, shared among all users
- If a relay is used, the effective network load is doubled
- Examples: The “Pipe” is 80 Mbs and each train transmits/recieves 30 Mbs



No Train

One Train

Two Trains

1

K-Mesh: Air Time With One Relay for Train 1

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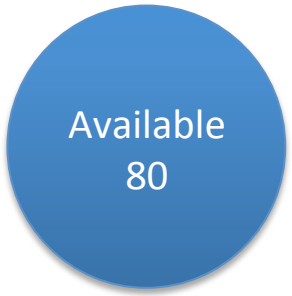

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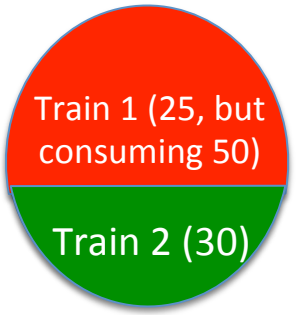

Two Trains

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K-Mesh: Air Time With One Relay for Both Trains

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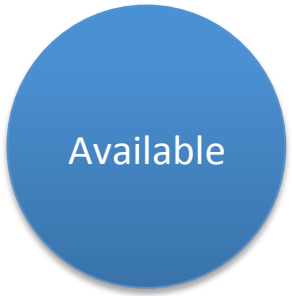
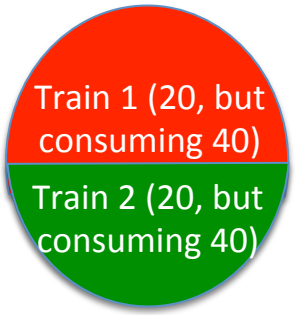


No Train

One Train



Two Trains

1

K-Mesh: Air Time With Two Relays for Train 1

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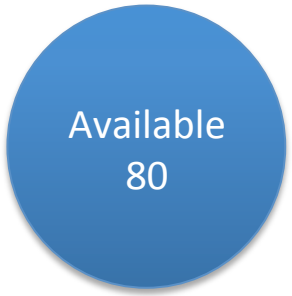

No Train

One Train

Two Trains

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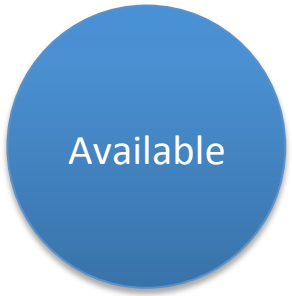

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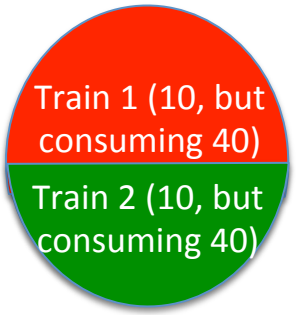
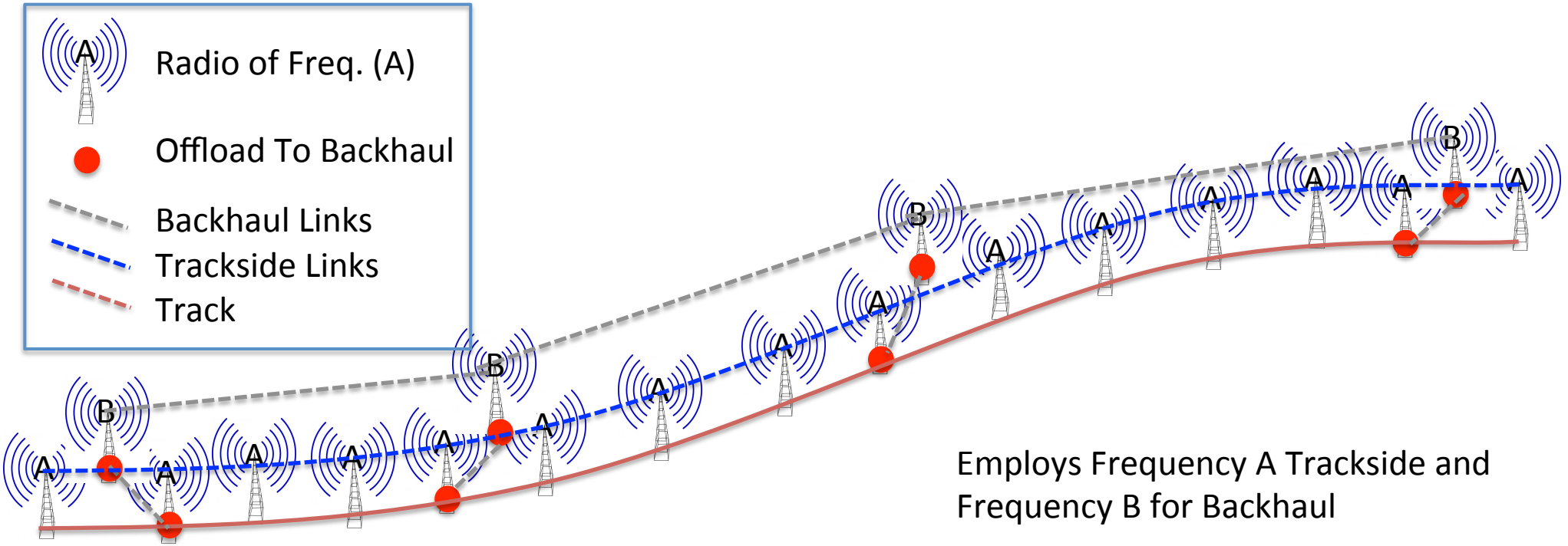


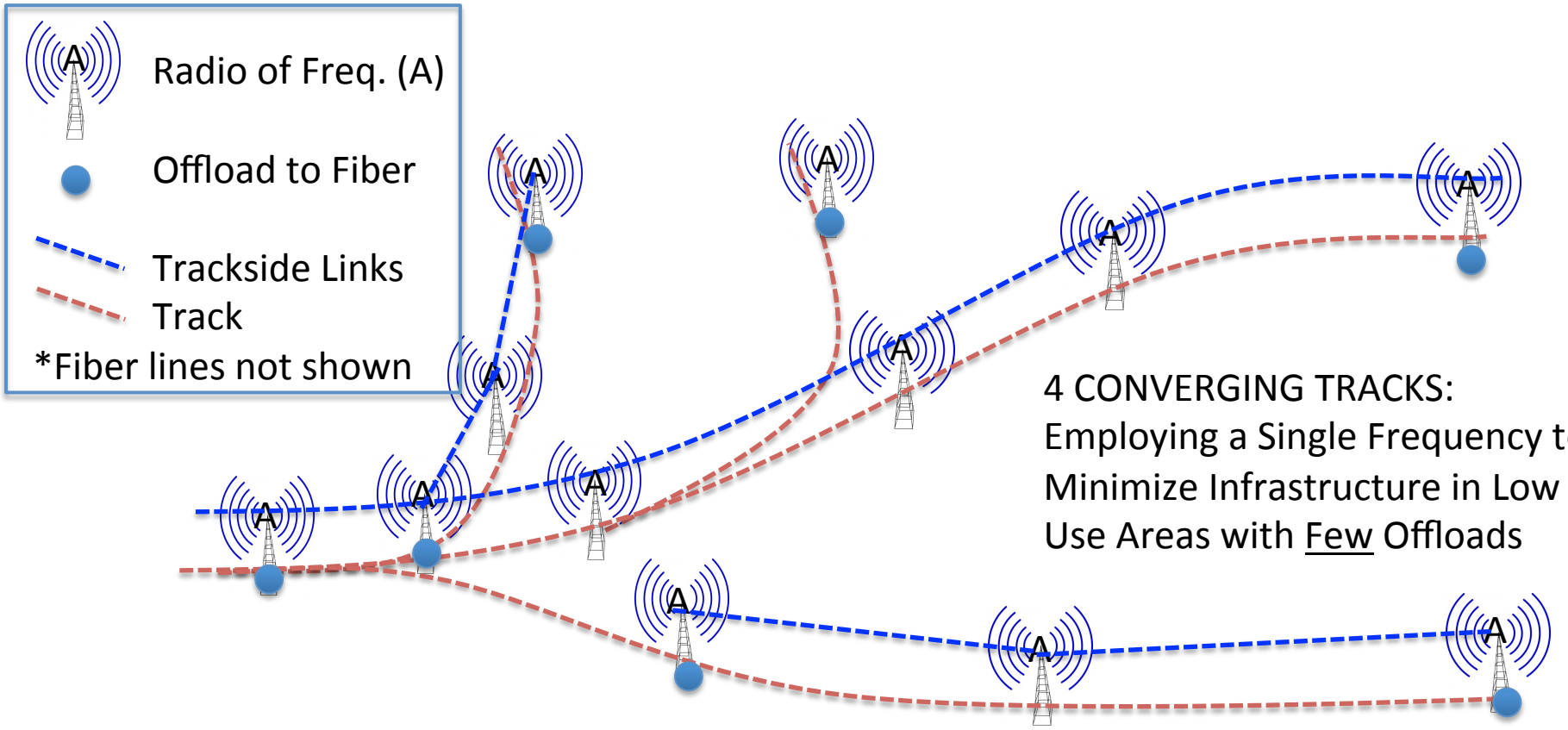
Two Trains

1

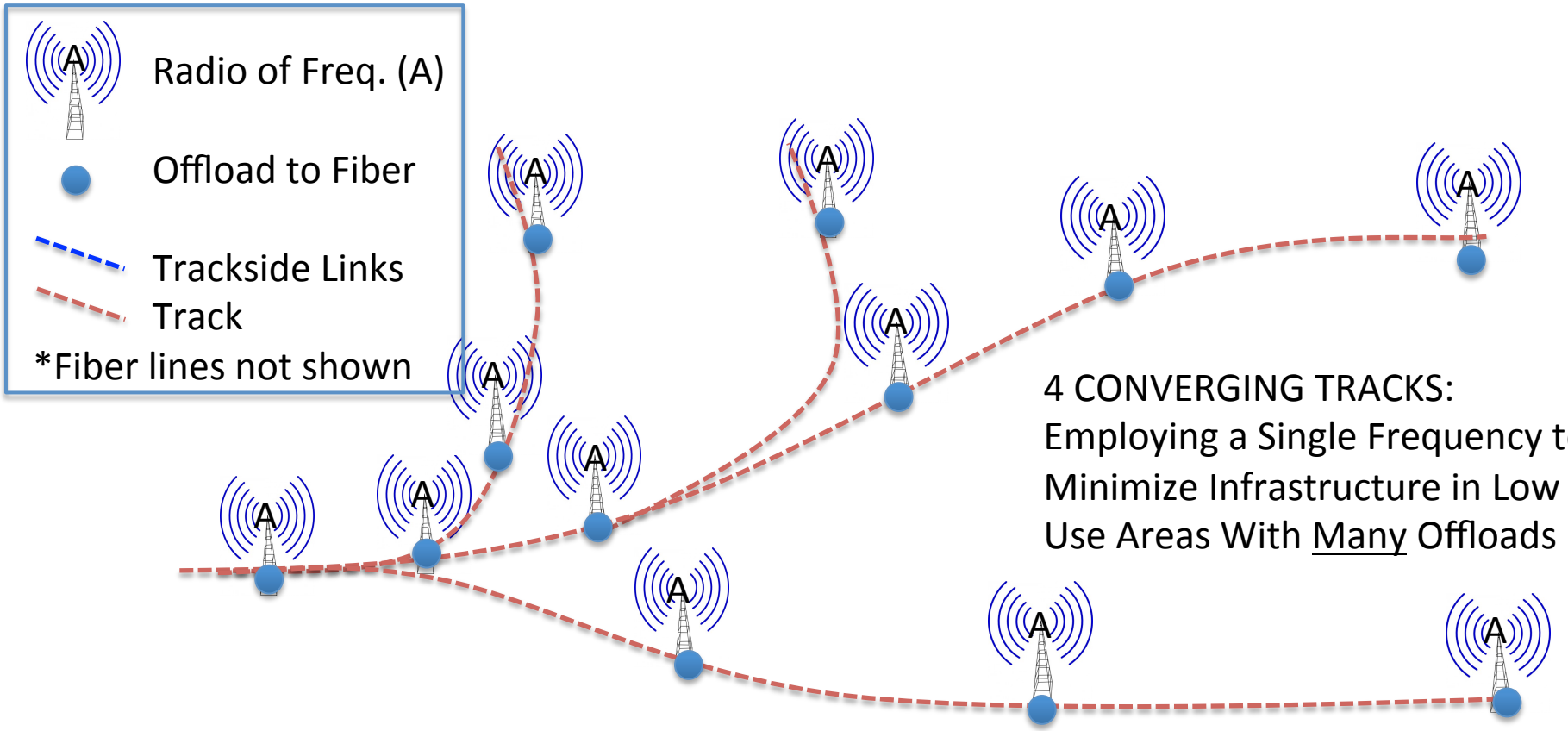
K MESH EXAMPLE DEPLOYMENT
Sarmiento Line



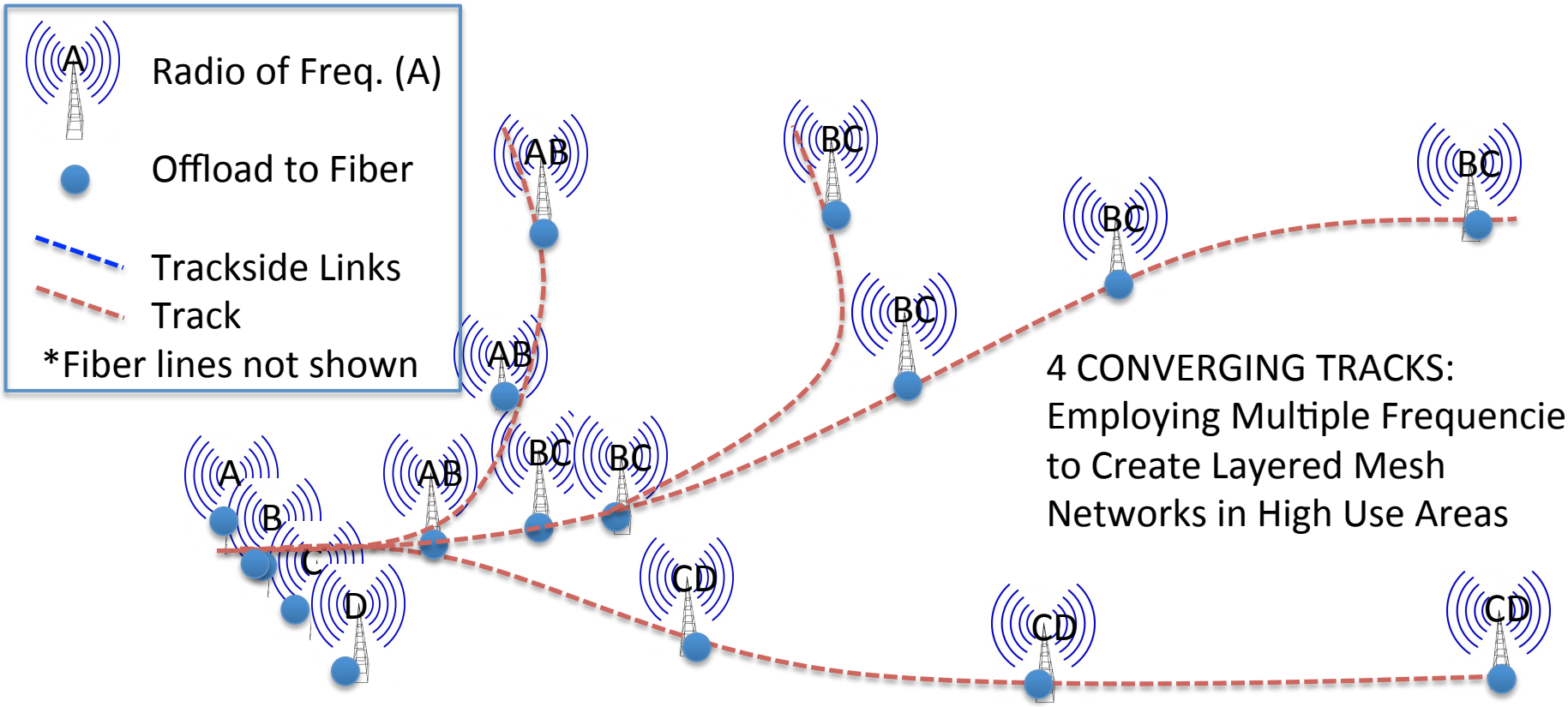
K MESH EXAMPLE DEPLOYMENT
Low Data Traffic



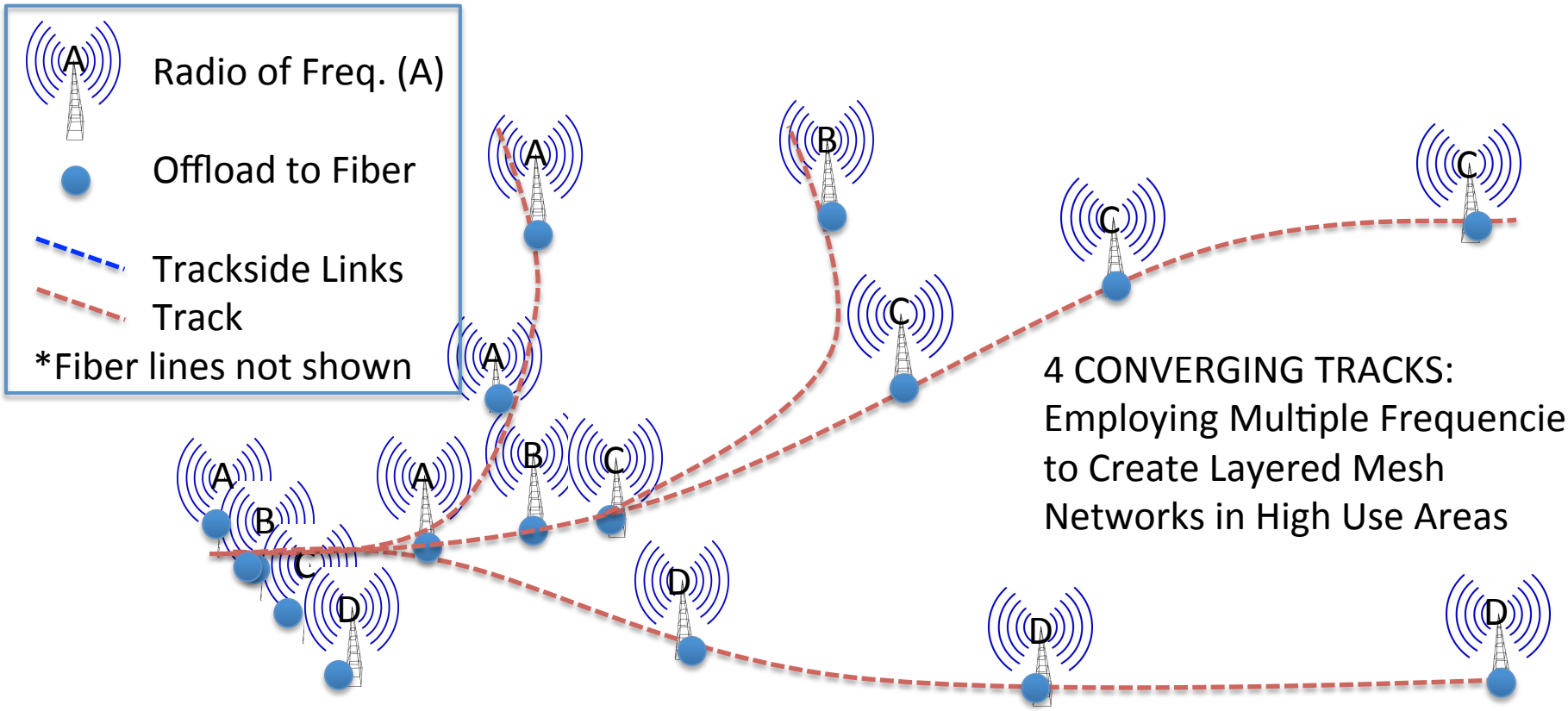
K MESH EXAMPLE DEPLOYMENT
Moderate Data Traffic



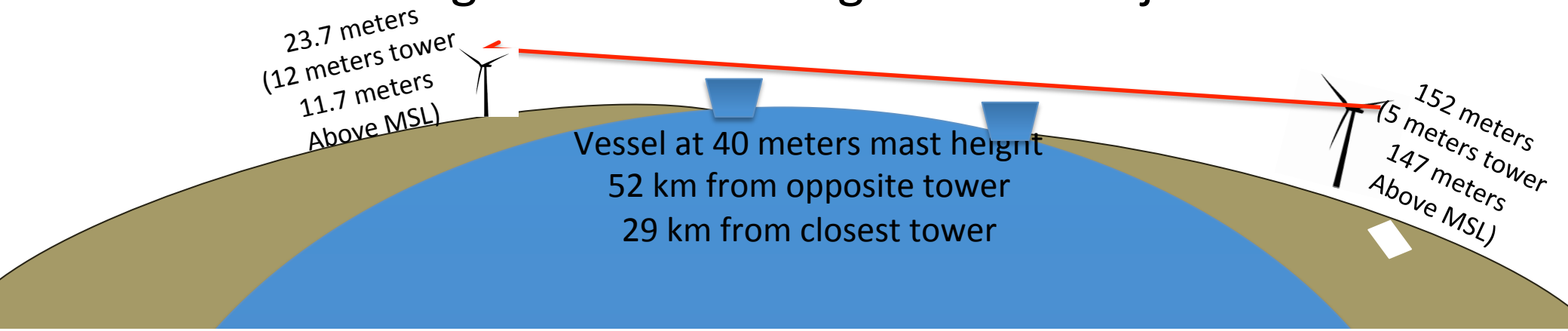
K MESH EXAMPLE DEPLOYMENT
Very High Data Traffic



K MESH EXAMPLE DEPLOYMENT
High Data Traffic



Determining Radio Line of Sight for an Object at Sea



$$\text{Horizon (km)} = 3.57\sqrt{\text{Mast height (m)}}*$$

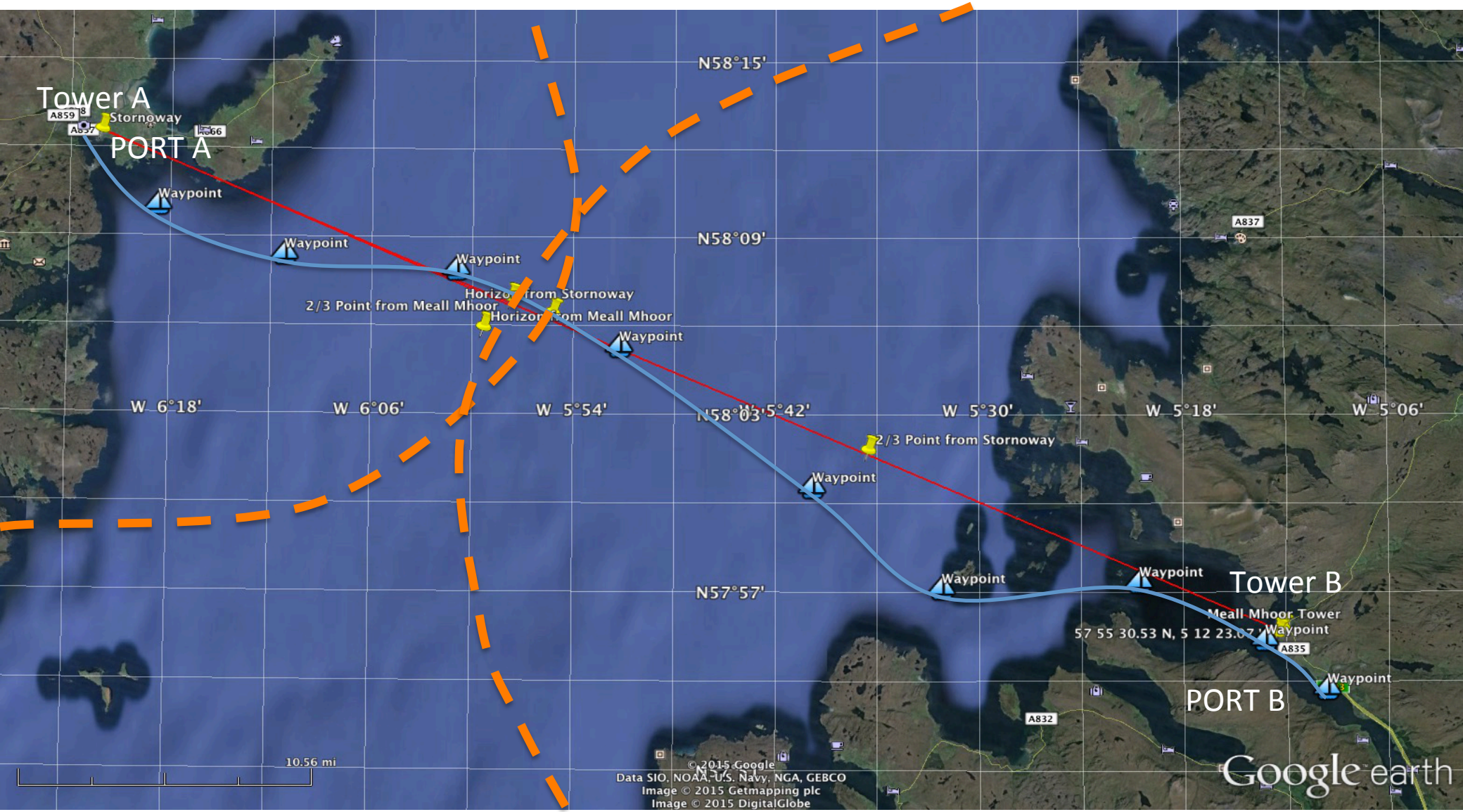
*or combined height of the mast and the tower

Tower A:
A point at 23.7 Meters above MSL will be Radio LOS at 40 Meters above MSL at a distance of 28 km

Tower B:
A point at 152 Meters above MSL will be Radio LOS at a distance of 49 km

The two towers would have an overlapping coverage of approximately 3 km.

Port A to Port B Ferry Scenario



Ferry Route

Tower A at 63.7 meters above MSL
58 12 14.62 N
6 22 20.50 W

Vessel masts at 40 meters above MSL

78 km from Port A to Port B

Tower B at 152 meters above MSL
57 55 30.53 N
5 12 23.07 W

The K-Mesh Advantage

- Using 0.5 or 1.0 Watts power it provides data throughput that would normally require an 8-15 Watt radio
- MANET Peer-to-Peer Network, not Hierarchical
- Packet Level Optimization
- Minimal Packet Loss
- No “handoff” from tower to tower
- Highly resistant to interference

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