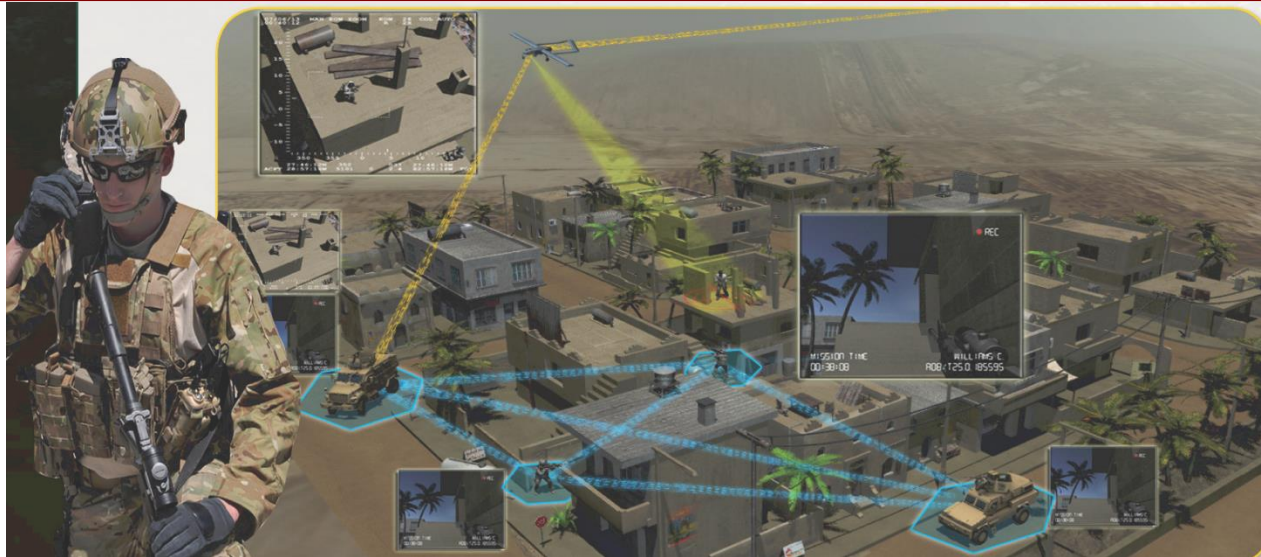


K Mesh MN-MIMO Radios

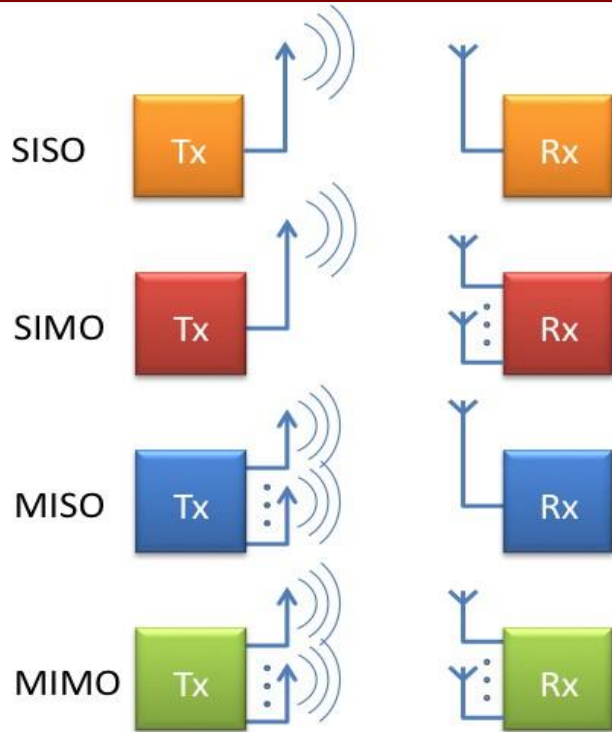


**MN-MIMO for
Unprecedented Voice + Video + Data
Mesh Connectivity**



865-671-4474

MIMO Fundamentals

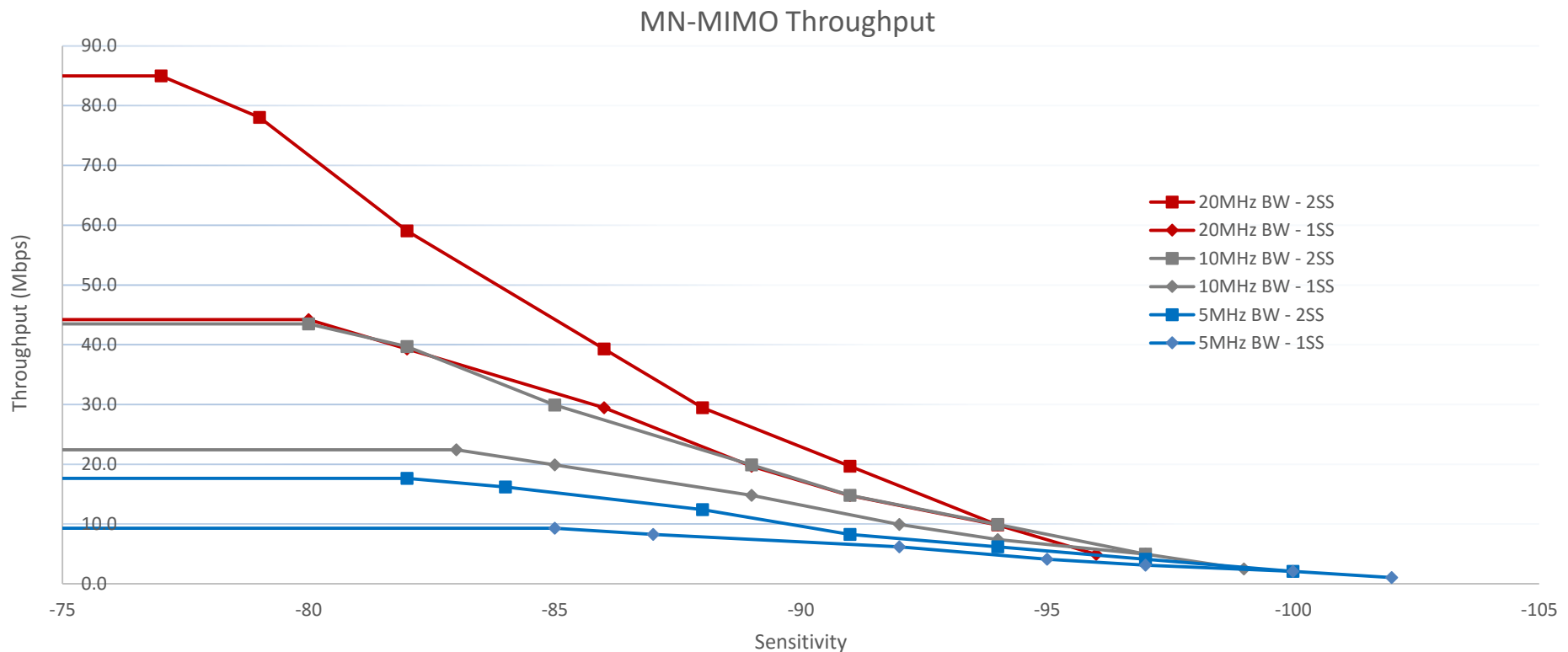


MIMO Terminology

- 2x2 MIMO
 - 2 Transmit Channels
 - 2 Receive Channels
- 4x4 MIMO
 - 4 Transmit Channels
 - 4 Receive Channels
- Traditional systems use a 2 dimensional signaling space (time and frequency)
- MIMO systems allow you to send multiple signals at the same time and frequency by exploiting a third dimension: **Space**
- Compared to SISO systems, MIMO provides one or more of the following: benefits
 - Higher data throughput
 - Improved range and robustness
 - Lower output power for a given distance
- Types of MIMO processing
 - Spatial multiplexing
 - Space-time coding
 - Receive diversity
 - Eigen beamforming & beamnulling
- InterLink's MIMO radios implement all combinations of MIMO processing.
- Our solution includes intelligence to automatically choose the optimum MIMO mode that maximizes per link and network wide throughput

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



List of Features

Radio Type	MIMO Coded-OFDM
Subcarrier Modulation	BPSK, QPSK, 16-QAM, 64-QAM
Channel Bandwidth	5, 10 & 20 MHz
Encryption	AES 128 or AES 256 (optional)
Frequency Stability	2 PPM over temp -40° - +85° C
Tuning Step Size	1 KHz
Data Rates	1 Mbps – 85Mbps
MAC Protocols	CSMA
Error Correction	1/2, 2/3, 3/4, 5/6
Antenna Processing	Spatial Multiplexing, Space-Time Coding, RX & TX Eigen-Beam Forming,
No. of Spatial Streams	1-4
No. of Antennas	2 or 4

Latency	10 ms per hop
Max number of hops	unlimited
Traffic types	Unicast, multicast, broadcast
Priority support	YES
Avg. node entry/exit time	2 s
Self Adaptive Mesh with Dynamic Route Selection	YES
Network wide spectrum scan	YES
CoT	YES

SC4200 Available 1Q 2016

- **SC4200 Features**

- TX power 2 Watts per antenna
- TX Eigen beamforming
 - Equivalent POut = 6 Watts for a 2 antenna device
 - Equivalent POut = 20 Watts for a 4 antenna device
- 20% lower power consumption
 - 8.5 hours of continuous 2 Mbps video streaming on single MBITR battery
 - 13 hour standby on single MBITR battery
- MBITR radio form factor
 - 2.6"x4"x1.5" without battery (2.6"x7"x1.5" with battery)

- **Forthcoming technical advances**

- Dynamic Spectrum Access (DSA)
- Spatial AJ

WiFi Mesh Coverage (50mW per radio @ 2457MHz)


TP-Link Mesh WiFi

Fc = 2.4 GHz


TX power = 50 mW



Legend

 1+ Mbps

 0.2 Mbps – 1Mbps

 < 0.2 Mbps

MN-MIMO

Fc = 2.4 GHz

TX power = 50 mW



Data sent from mobile to node 1
Antennas: 3 dBi omni



RELIABLE AND LONG RANGE DATA LINK for ROBOTIC CONTROL

- Two-way MN-MIMO digital data link transmission that allows totally reliable control over the robot, even in radio communication saturated areas, and the simultaneous transmission of several video feeds in real time without loss of resolution.
- Within line of sight, the range is up to 3 Km., and is 700 meters in urban areas.



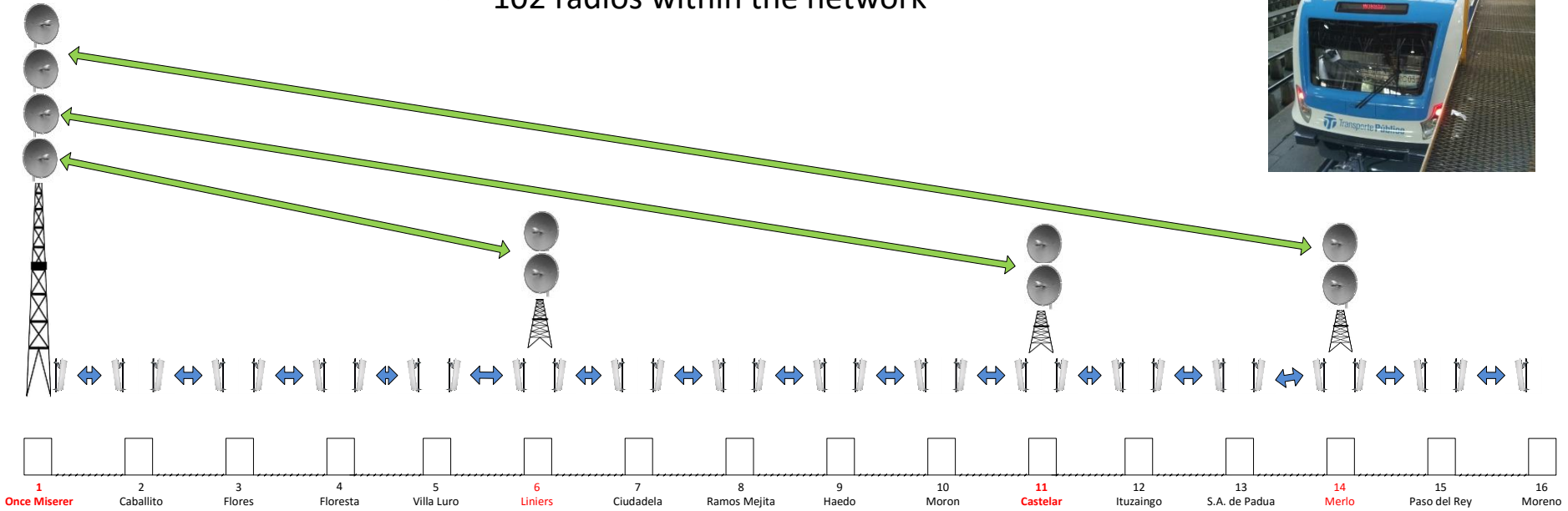
UAV & News Gathering



Infrastructure Railway Safety

Phase 1: Video for 32 trains and 16 stations

- 102 radios within the network



Naval Deployments

Dismounted soldiers (5) communicate video and PTT over 10Km from land to patrol boat which relays to mother ship

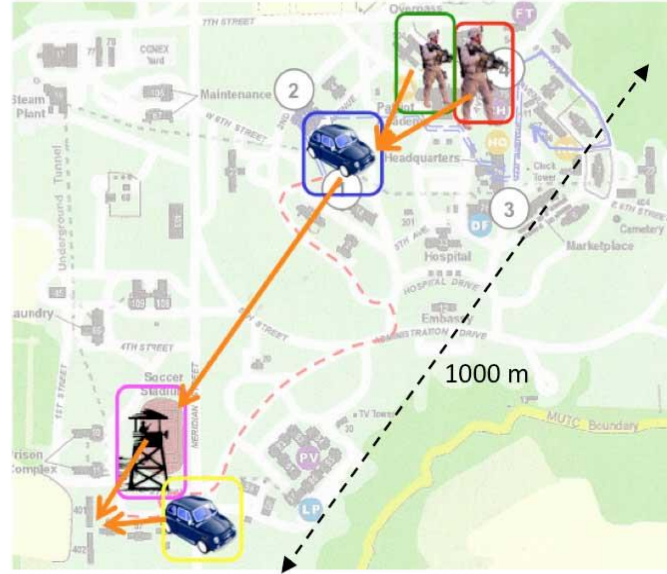


Urban Ops

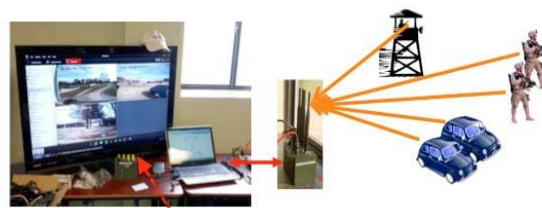
6 Node Ad-Hoc Mesh for Urban Ops

Full penetration into and around buildings

- All nodes start at the TOC with full motion video turned on
- Nodes move into position for neighborhood clearing mission
- TOC monitors dismounts at 1 km range while inside of buildings
- Two way video communications among all 6 nodes maintained throughout mission



TOC



TOC display showing all video feeds

3-Tier (Air + Land + Tunnel) 7 node video mesh

Airborne asset is transmitting SAR images to TOC via tower



Tunnel

416'

Dismount-1 is inside tunnel. It sends video to TOC via dismount 2 & tower

Dismount-2 is inside tunnel. It acts as relay for dismount-1. It also sends its own video to TOC via tower

156'

TOC

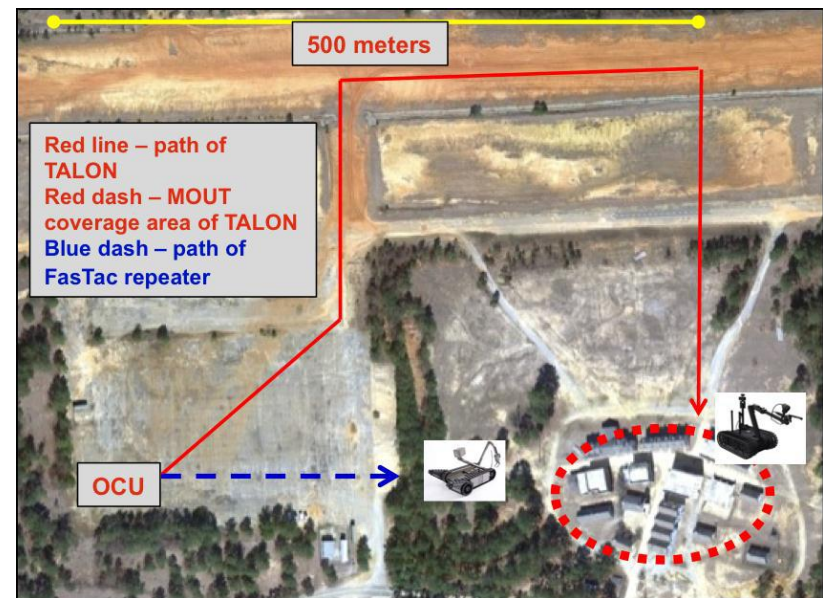
854'



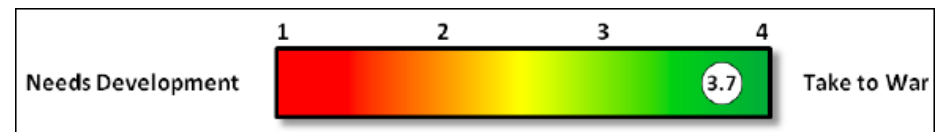
Military - UGV Application Example

Repeater capability demonstrated at Army Expeditionary Warfighters Experiment (AEWE) Spiral G

MN-MIMO Radio installed on Talon and FasTac
Omni antennas on UGVs and OCU
Robots used interchangeably to provide repeater
capability for long range missions
500m NLOS achieved amidst mountainous terrain
and dense foliage



US ATEC poll - 'Take to War' rating of 3.7 out of 4



Airborne Downlink - Application Example

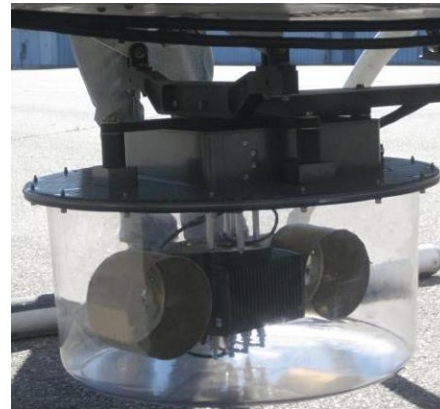
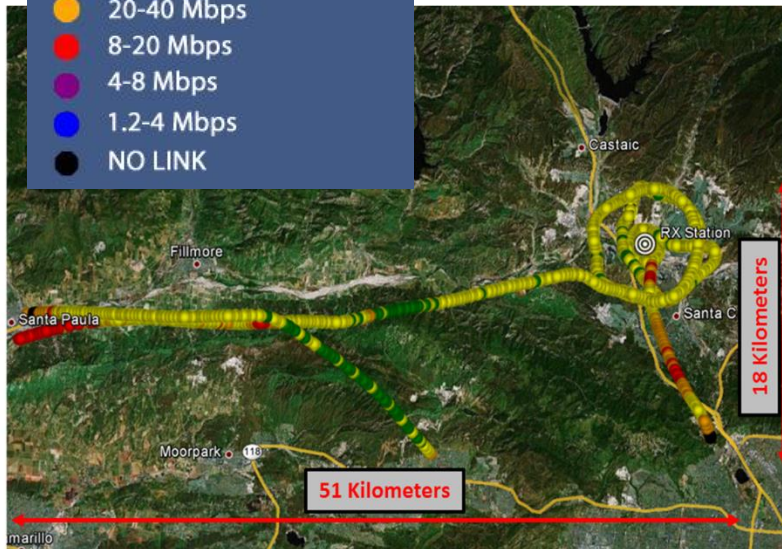
Troll Systems SkyLink IP System



44km range
20Mbps bi-directional throughput
18Mbps HD video
1Mbps data downlink
1Mbps data uplink
Directional tracking antennas
Only 1 Watt of transmit power

MIMO THROUGHPUT LEGEND

- > 80 Mbps
- 40-80 Mbps
- 20-40 Mbps
- 8-20 Mbps
- 4-8 Mbps
- 1.2-4 Mbps
- NO LINK



“Silvus’ MIMO technology has been chosen by Troll to create the new SkyLink IP Networking solution for broadcast, law enforcement, and military markets. MIMO enables robust high throughput bidirectional links from airborne assets to multiple ground locations. When combined with Trolls tracking antenna solutions, industry leading link ranges are possible.”

–Julian Scott, CEO, Troll Systems