Wireless Communications for Radiation Portal Monitors

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Overview

- Use of Wireless Communication
- Wireless Considerations
- Technology options
- Development of wireless technical solutions
  - Requirements
  - Constraints
  - Technology identification
  - Site Survey
  - Procurement and deployment

Use of Wireless Systems

- Wireless Applications
  - Mobile

  - Fixed - locations where wired solutions are not feasible or using fiber is cost prohibitive
    - Usually located at a distribution point and requires multiple radios for redundancy

Wireless Considerations

- Sharing infrastructure with other organizations
  - Not recommended
    - Security risks
    - Finger pointing
- Existing networks in use at a site
- Cost/benefit of running fiber optic and installing conduit and electrical
- Preventative maintenance
- Utilize existing mounting locations or to install new mounting locations (towers, poles, etc.)
- Mobile applications – required cell size and access point density
- Licensing
 - Can be by area or by link depending on country

Site Survey Process

- Team identifies that a site could use wireless communications
  - Mobile application
  - No other option is viable for fixed lane locations
- Conducts a passive survey
  - Spectrum Analysis
  - Determine existing wireless infrastructure and RF congestion
- Wireless Survey Report generated
  - Includes initial wireless options and bandwidth capabilities
  - Licensed requirements that will be required
- Active Survey conducted to determine wireless bandwidth and coverage requirements
  - Wireless Technical solution developed
- Contracting and installation
- Post-Installation
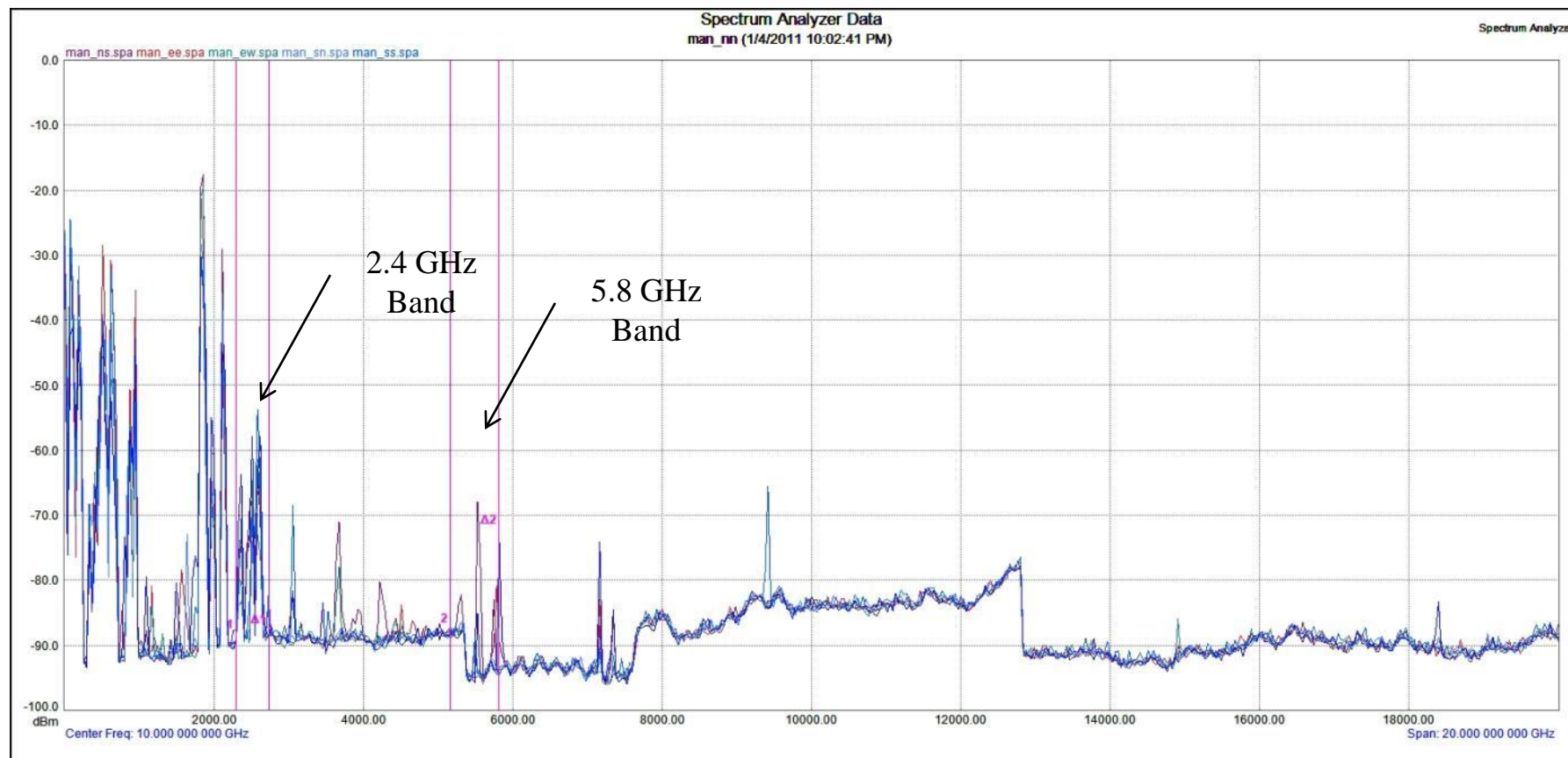 - Acceptance Testing
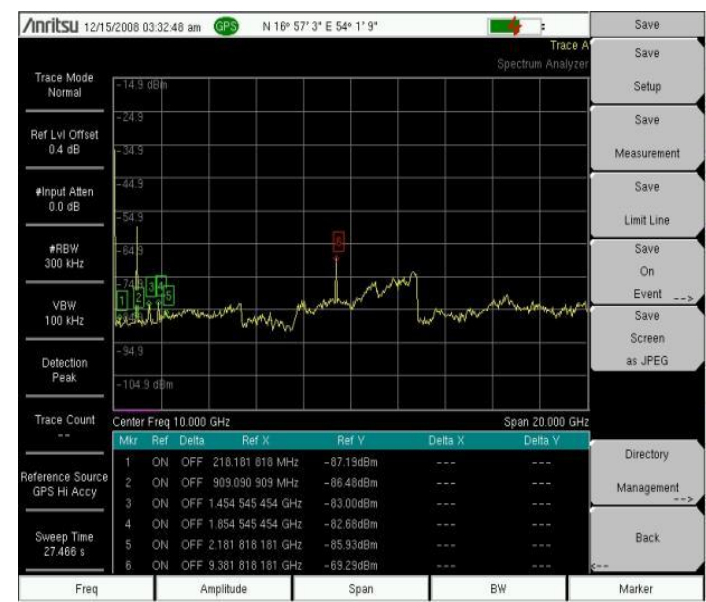
Passive Survey
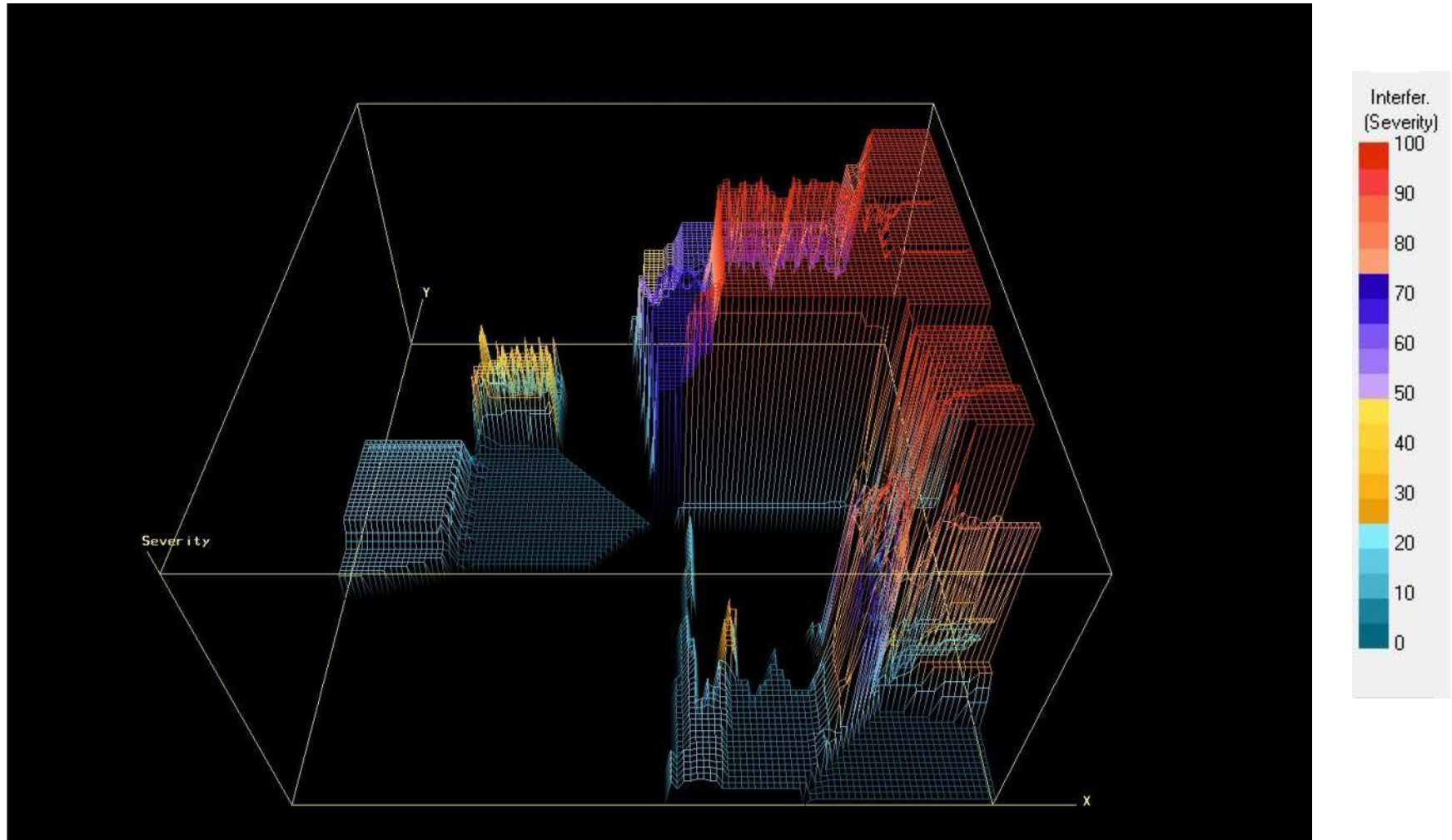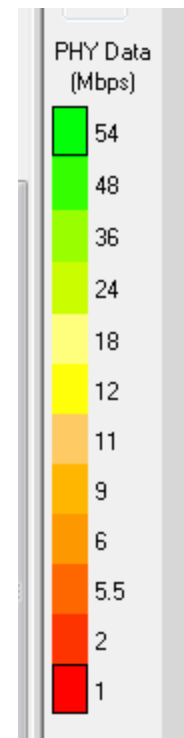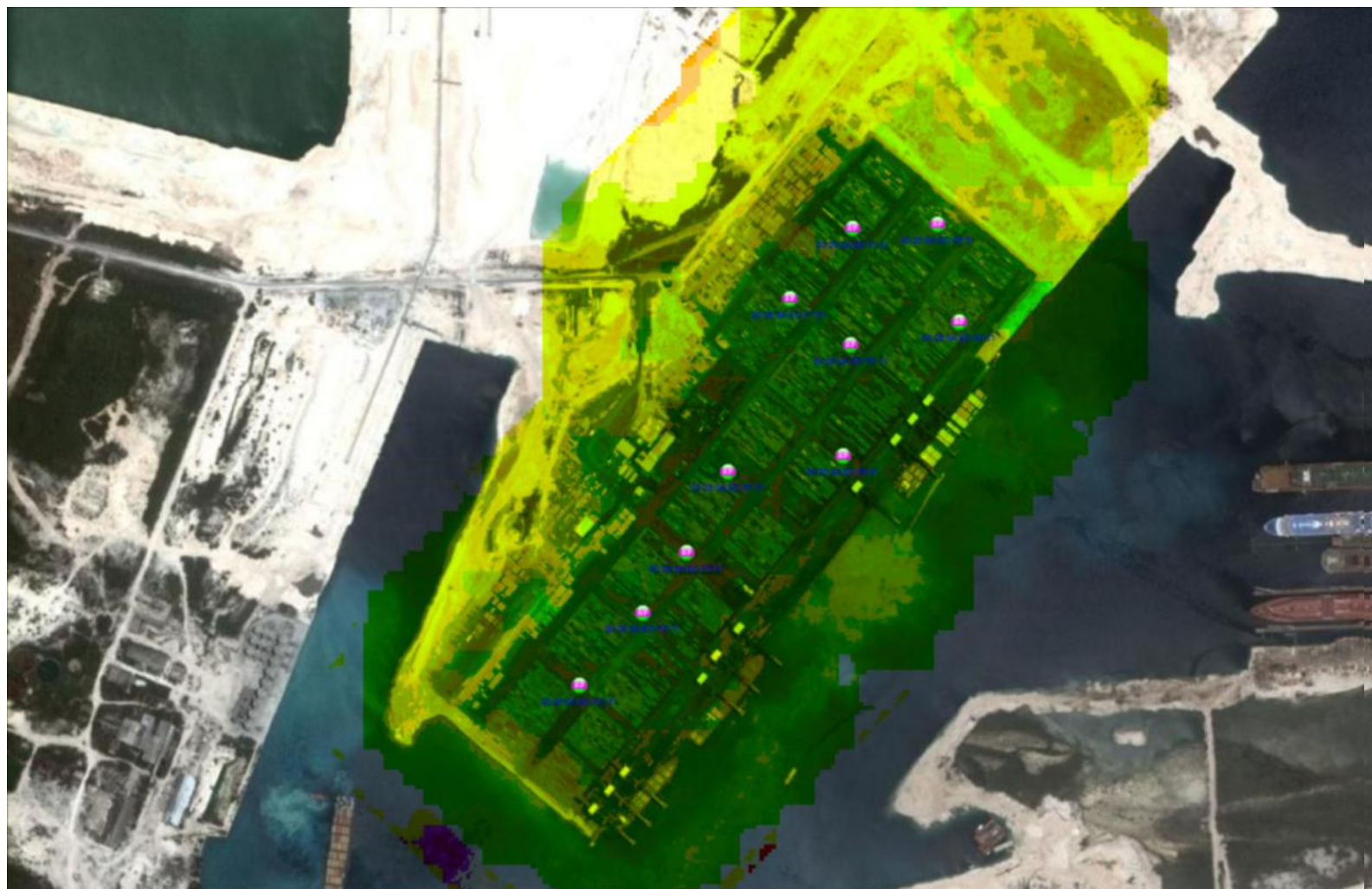

RF Interference – Case Study

Passive Survey (con't)
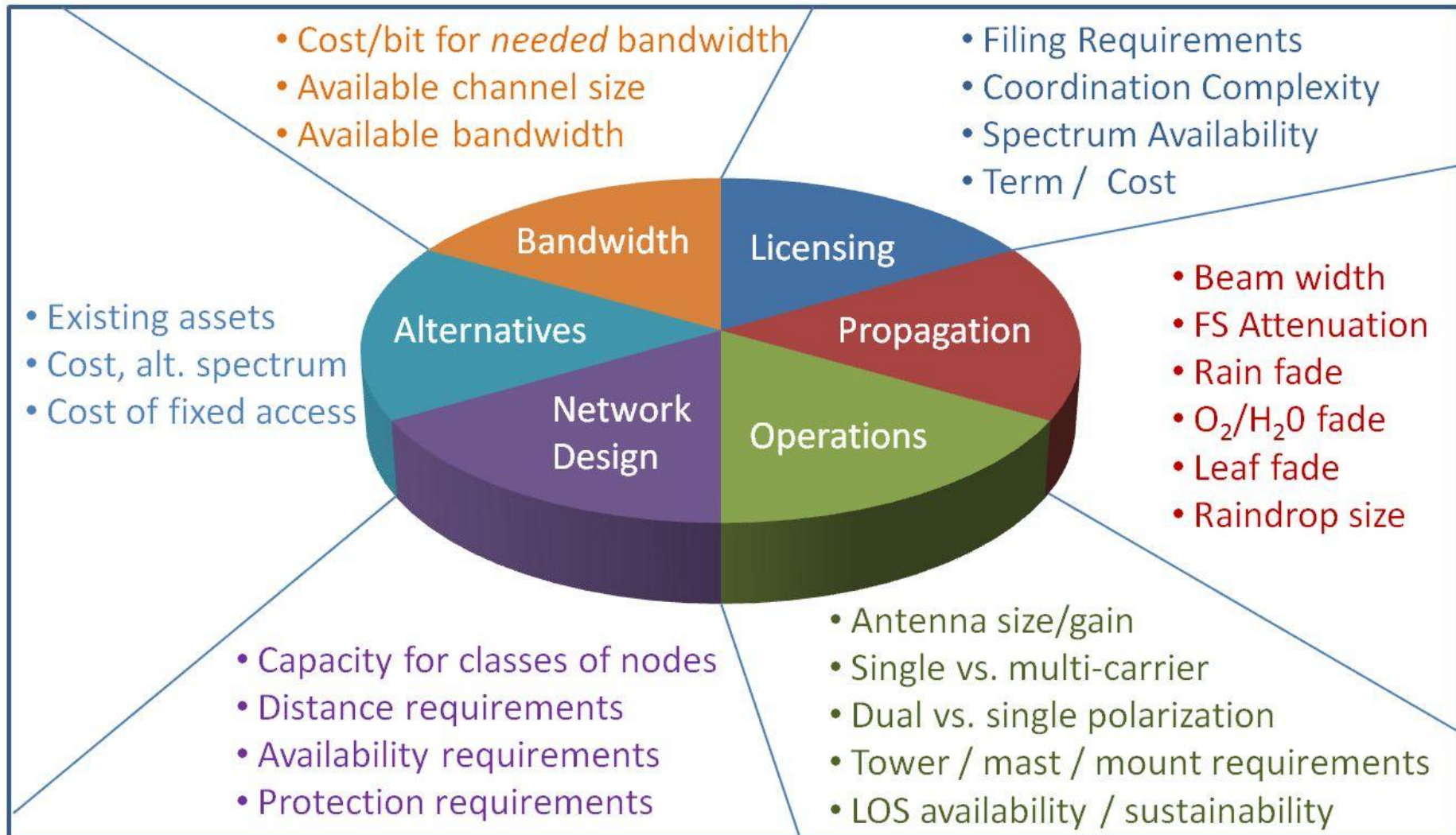

Spectrum Analysis – Case Study

Active Survey (con't)

Active Survey – Case Study

Requirements

- Cost/bit for *needed* bandwidth
- Available channel size
- Available bandwidth

- Filing Requirements
- Coordination Complexity
- Spectrum Availability
- Term / Cost

Bandwidth

Licensing

- Existing assets
- Cost, alt. spectrum
- Cost of fixed access

Alternatives

Propagation

- Beam width
- FS Attenuation
- Rain fade
- O_2/H_2O fade
- Leaf fade
- Raindrop size

Network Design

Operations

- Capacity for classes of nodes
- Distance requirements
- Availability requirements
- Protection requirements

- Antenna size/gain
- Single vs. multi-carrier
- Dual vs. single polarization
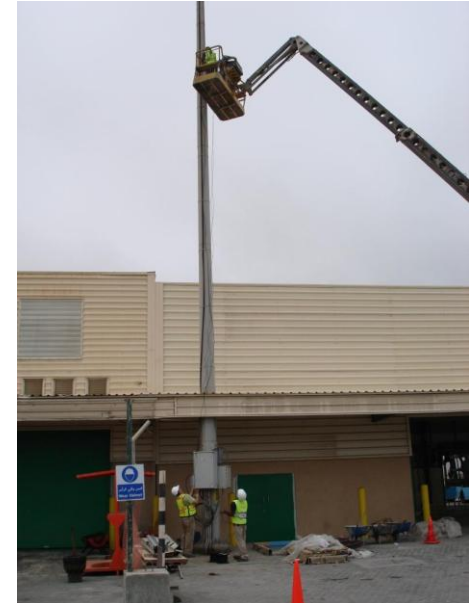- Tower / mast / mount requirements
- LOS availability / sustainability

Procurement and Deployment

- Frequency Identification
  - Open or licensed frequencies

- Documentation
  - Wireless Technical Solution documentation
  - Deployment timeline
  - Schematics and design documentation

Constraints

- Environmental Constraints
  - Weather conditions can pose a problem for wireless communication and reliability.
- Site Constraints
  - Existing wireless networks
    - Noise
    - Available spectrum
  - Radar
  - Mounting locations
- Bandwidth Requirement Identification
  - Number of units to be deployed
  - Distance required to cover intended area
  - Time required to display data at the CAS
- Link Redundancy
- Link Failure
  - Data buffering for fixed locations

Technology Examples

Type	Release Date	Op. Freq	Throughput	Net Bit Rate
802.11a	1999	5 GHz	23 Mbps	54 Mbps
802.11b	1999	2.4 GHz	4.5 Mbps	11 Mbps
802.11g	2003	2.4 GHz	19 Mbps	54 Mbps
802.11n	2009 (draft)	5 or 2.4 GHz	N/A	600 Mbps
802.16	2007 (e) 2008 (m)	2 to 24 GHz	N/A	1.6 Gbps

- Technologies chosen should be based on the bandwidth required for each site

Technology Examples (cont)

- Wireless fiber (laser) Communications
  - Considered Point-to-point
  - Open architecture communication standards
  - Frequencies: 70 to 90 GHz
- Cellular Broadband
- Satellite Communications
- 4G or Beyond 3G
  - Long Term Evolution (3GPP)
    - 300 Mbps download / 170 Mbps Upload

A few Myths about Wireless

- The only interference problems are from other 802.11 networks
- My network seems to be working, so interference must not be a problem
- I can overcome interference by having a high density of access points
- I can analyze interference problems with my packet sniffer
- There is no interference at 5 GHz
- Wi-Fi interference does not happen very often
- Interference is a performance problem, but not a security risk
- 802.11n and antenna systems will work around any interference issues

Issues identified

- Radar systems
  - 3 cm (10 GHz), 5 cm (6 GHz), and 10 cm (3 GHz) wavelength radar
    - Radars will effect wireless communication if ships keep units on at port.
    - Requirements for many WiFi and WiMax systems require hopping channels when radar is detected.
    - Site needs to identify regulations on radar systems at port and if there are methods to identify radar frequencies.

- Commercial appliances
  - Cordless phones, Microwaves, CPUs