



Monroe County 700/800 MHz P25 Network Performance

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Outline

- **Purpose of the Study**
- **Description of the Network**
- **How Performance is Measured**
 - What is typical performance for Public Safety?
 - How is building loss handled?
- **How the Study was Done**
- **Study Results**
 - Bit-error rate
 - County-wide and individual Fire District performance
- **How do 3 Additional Sites Improve Performance?**
 - Performance improvements from Shoremont, Gates, Mumford

Purpose of the Study

- **Goal**
 - Get an objective third-party measure of the network performance
 - Pericle Communications was hired in 2015 to perform the study
- **Pericle Communications Company**
 - Consulting engineering firm specializing in public safety radio
 - Founded in 1992, 8 employees, primarily electrical engineers & radio technicians
- **Objectives of the Study**
 - Measure County-wide and fire district performance of network
 - Evaluate up to three new sites and model improvements
 - Quantify results as % covered by County and by fire district

Network Description

- **700/800 MHz P25 Trunked Radio Network**
- **Consists of Three Simulcast Cells Totaling 18 Sites**
 - East Cell, 700 MHz, 8 Sites
 - South Cell, 700 MHz, 4 Sites
 - West Cell, 800 MHz, 6 Sites
- **Service Area = 1,367 Square Miles**
- **36 Fire Districts in Monroe County***

*As supported by the County radio shop

How is Performance Measured?

- **Two Performance Parameters:**
 - Received signal strength (RSSI)
 - Bit-error rate (BER)
- **Poor Performance Can Have Multiple Causes**
 - Weak signal
 - Simulcast time delay interference (TDI)
 - External interference
- **BER is Best Because it Captures TDI/Interference**
- **Minimum Performance Required for DAQ 3.4:**
 - RSSI > -110 dBm
 - BER < 2.4%

What is the Minimum Covg.?

- **Coverage is the Percent of the Service Area that Provides a Minimum Signal Quality**
- **There is no Federal or State Mandate for Minimum Coverage or for Building Loss Assumption**
- **The County and Fire Service can Specify Whatever they Want, but There are Guidelines and Precedents:**
 - Typical specified mobile (vehicle) coverage = 95%
 - Typical specified portable coverage outdoors = 90%
 - Building loss specified at 700/800 MHz is highly variable if it is specified at all. 10 dB is typical, 15 dB is also used.
 - Sometimes a set of loss values is used, e.g., 15 dB urban, 10 dB suburban, 5 dB rural

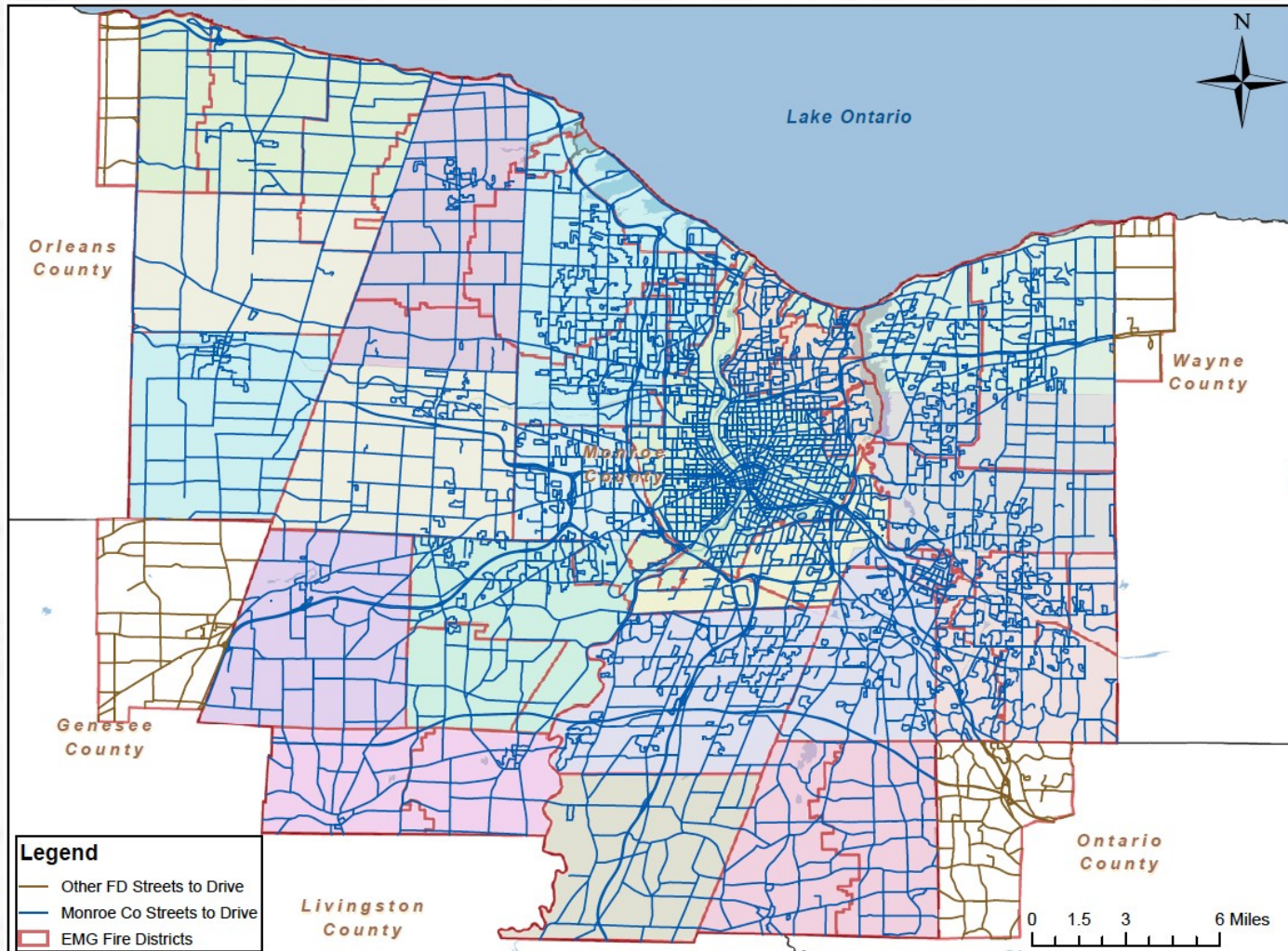
How Is Building Loss Treated?

- **If the Buildings of Interest are Known, One can Measure Signals Inside the Building**
- **This is Rarely Done for Cost and Schedule Reasons**
 - Typically there are too many buildings for this to be practical
- **Alternatively, Outdoor Coverage Measurements Can be Scaled using a Building Loss Assumption**
 - This is what Pericle did for the Monroe County Study

Coverage Survey Approach

- **Establish a Grid Over the County**
 - Roughly ¼ mile in Rochester, ½ mile suburban, 1 mile rural
 - Map the route
- **Drive The Route, Collecting RSSI & BER**
 - 2,792 miles
- **Grid the Data to Uniform Tiles**
 - Results in 14,263 tiles (samples)
- **Data Processing**
 - Scale measurements for antenna gain body loss (-8.5 dBd)
 - Scale measurements for building loss (5, 10, 15 dB)
 - Compute service area reliability (SAR)* by County and by District

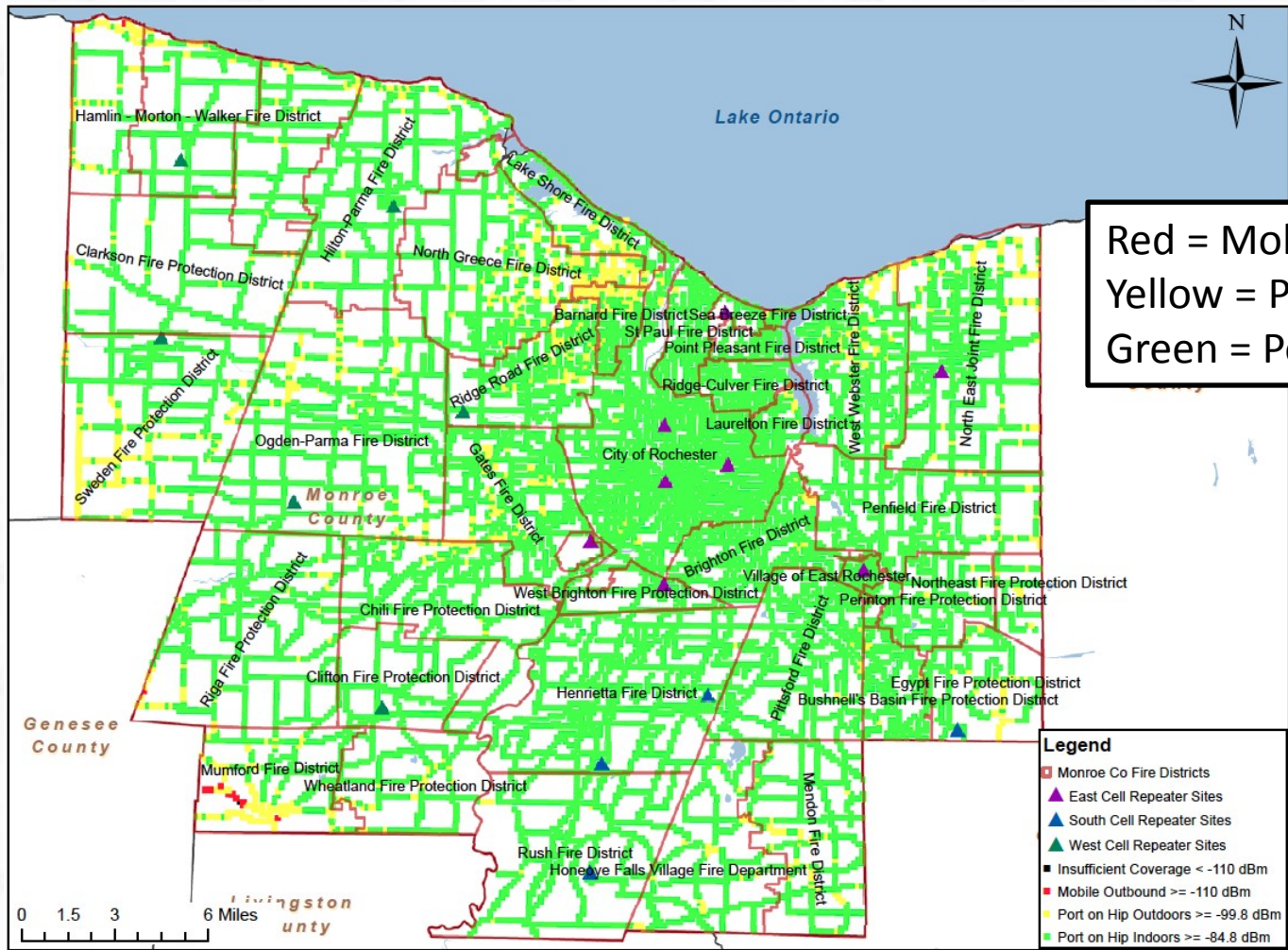
Drive Test Route



Coverage Survey Results

- **County-Wide Coverage:**
 - Mobile coverage = 100%
 - Portable outdoor coverage (on hip) = 99.9%
 - Portable indoor coverage (15 dB building loss) = 91.8%
 - Portable indoor coverage in Rochester (15 dB) = 99.2%
- **Fire District Coverage**
 - 36 of 36 districts have mobile coverage > 95%
 - 36 of 36 districts have portable outdoor coverage > 95%
 - 23 of 36 districts have portable indoor coverage > 95%
- **Note: Fire Service Goal is County-Wide Coverage > 95%**

Signal Level Measurements



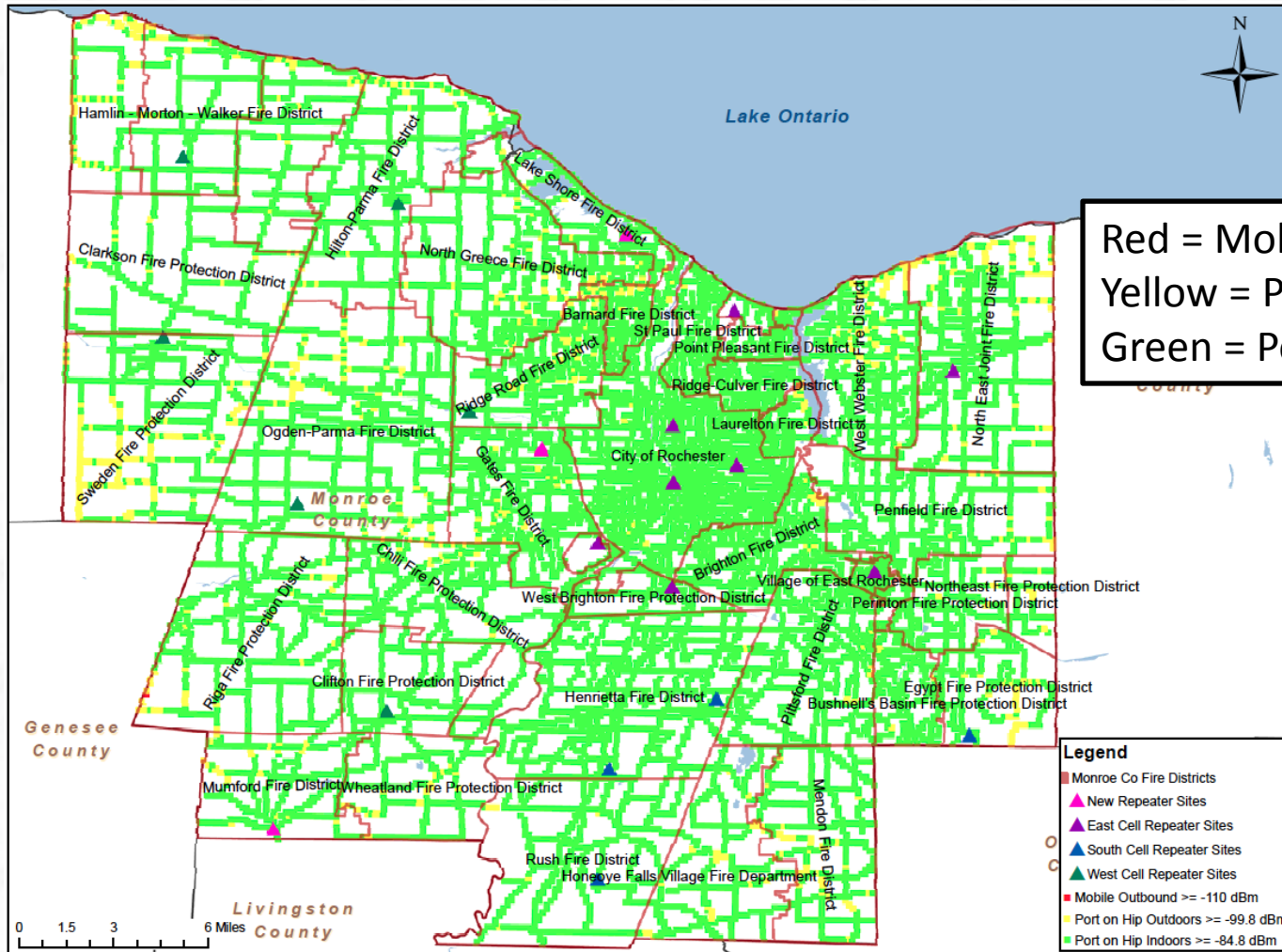
Red = Mobile Only
 Yellow = Portable Outdoors
 Green = Portable Indoors

- Legend**
- Monroe Co Fire Districts
 - ▲ East Cell Repeater Sites
 - ▲ South Cell Repeater Sites
 - ▲ West Cell Repeater Sites
 - Insufficient Coverage < -110 dBm
 - Mobile Outbound >= -110 dBm
 - Port on Hip Outdoors >= -99.8 dBm
 - Port on Hip Indoors >= -84.8 dBm

New Sites

- **County Asked Pericle to Consider 3 New Sites:**
 - Need improved coverage in Shoremont, Gates and Mumford
 - Try to improve County-wide coverage to 95%
- **Approach**
 - Computer modeling not as accurate as measurements
 - For best accuracy, we modeled existing and future and used the difference (in dB) to model an increase in the measured tiles
- **Results**
 - County-wide improves from 91.8% to 94.0%
 - 26 of 36 districts have portable indoor coverage > 95%
 - Mumford indoor coverage (15 dB) increases from 60.4% to 91.7%

21 Site Coverage (3 New Sites)



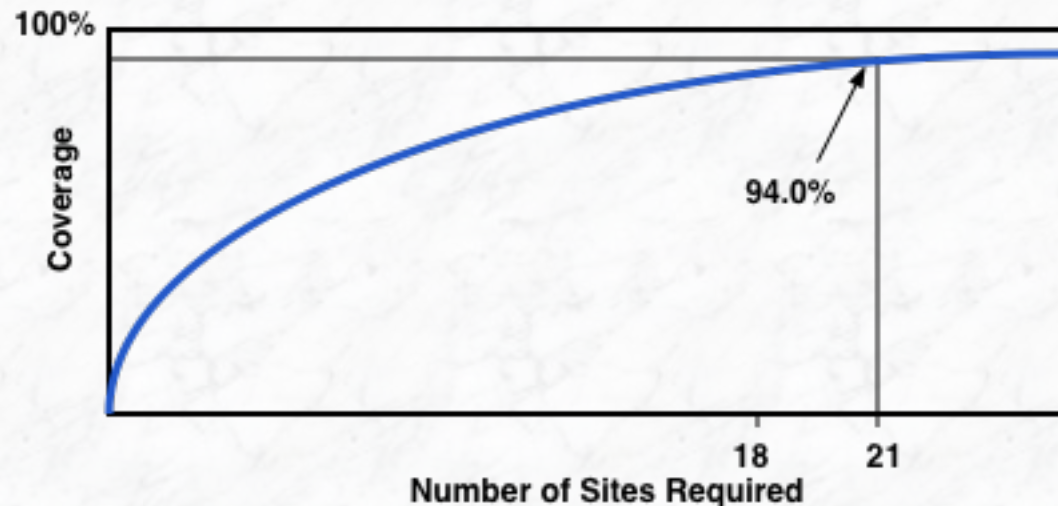
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Legend

- Monroe Co Fire Districts
- New Repeater Sites
- East Cell Repeater Sites
- South Cell Repeater Sites
- West Cell Repeater Sites
- Mobile Outbound ≥ -110 dBm
- Port on Hip Outdoors ≥ -99.8 dBm
- Port on Hip Indoors ≥ -84.8 dBm

Additional Modeling

- **Pericle is Modeling Several Combinations of 4, 5 or 6 Sites in Attempt to Achieve 95% County-Wide**
- **Why is this Hard?**
 - Diminishing returns
 - When coverage is already close to 95%, much greater cost and effort is required to get the last 1% of coverage



Conclusions

- **Existing Coverage is Excellent by Industry Stds.**
 - Mobile coverage = 100%
 - Portable outdoor coverage (on hip) = 99.9%
 - Portable indoor coverage (15 dB building loss) = 91.8%
 - Portable indoor coverage in Rochester (15 dB) = 99.2%
- **Best Indoor Coverage Exists Where Needed Most**
- **Three Planned Sites Boost County Covg. To 94.0%**
- **Study Underway to Find Additional Sites to Improve from 94.0% to 95.0%**