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Public Safety Broadband Summit & Expo

Building the Nationwide Public Safety Broadband Network in Rural America

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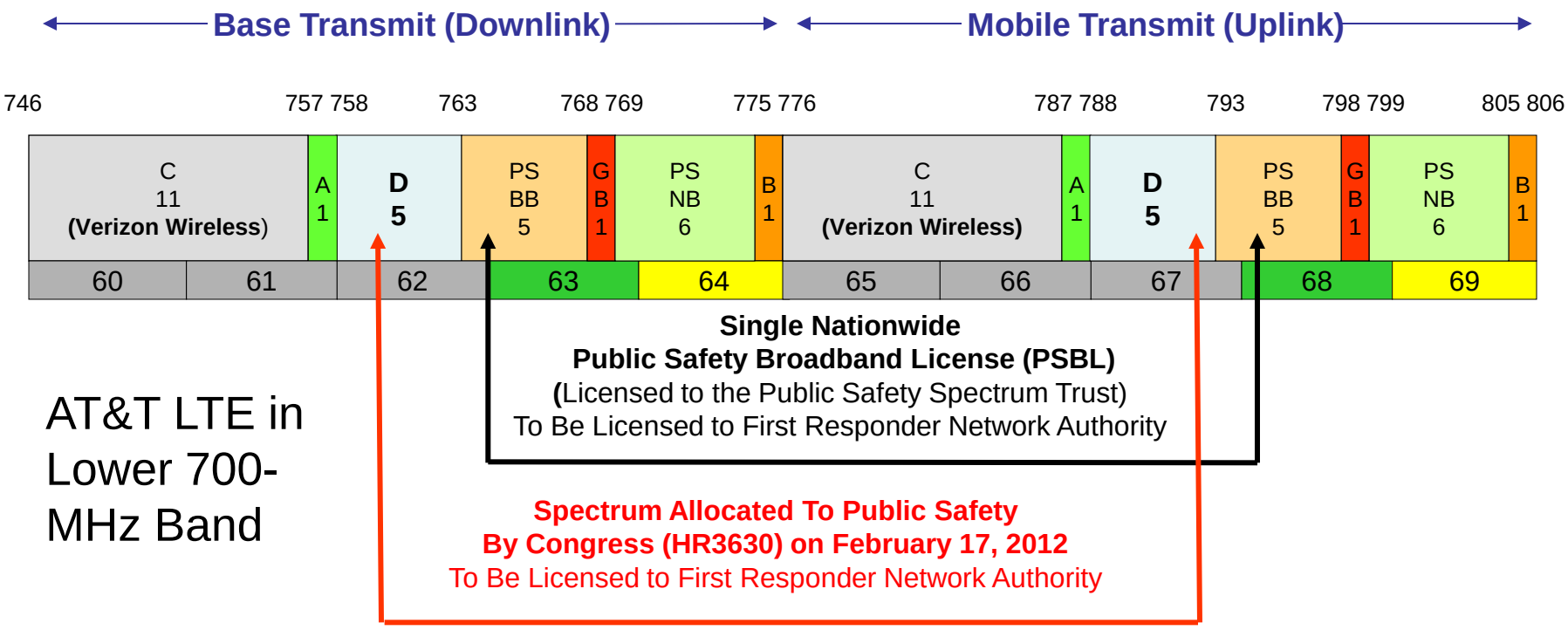
PSBN: 20 MHz of Broadband Spectrum

Public Safety 700 MHz:

20 MHz of Broadband Spectrum and 12 MHz of Narrowband Spectrum



AT&T LTE in Lower 700-MHz Band

Where the Money Will Come From

- $7 billion from incentive auctions
  - If and when the auctions take place
  - If the auctions raise sufficient funds
- $2 billon of the $7 billion is available today
  - Loaned to FirstNet, interest-free by Treasury
- Network will cost many $billions more
- Where will this money come from?

Law Permits Leasing Excess Spectrum

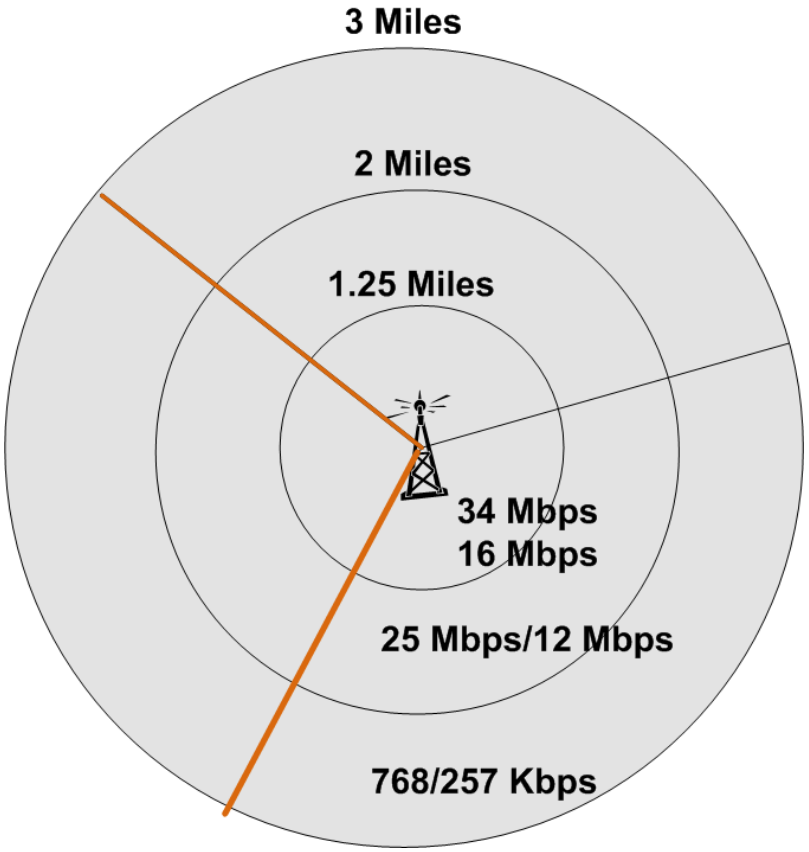
- Can be leased by other companies, organizations
  - Cannot be leased to individual users
  - However, those leasing spectrum from FirstNet CAN provide it to anyone and make money
- How much spectrum is available, who will want to lease it?

How Much Excess Spectrum?

- In Metro Areas: Unknown at this point
- Suburban: Most of the time except for major incidents covering large areas
- Rural: Most of the time
  - Only caveat, during major incidents
    - Local incidents will only cause problems within the confines of the incident area
    - Major storms or disasters could impact large areas

Spectrum Sharing During an Incident

Localized Incident:
Only one or several cell sectors will be affected. Secondary services in and around the incident area may not be available. **However**, away from the incident sharing will continue.



Major Incident Sharing

During a major incident:
Secondary use in a wider area may be reduced or not available.
The Springs fire disrupted cellular communications in a wide area.

Sharing Spectrum and Resources in Rural America

HOW SPECTRUM CAN BE SHARED AND BY WHOM

Covering Rural America Is Tough

- Lots of terrain to be covered
- Not enough people to support commercial cellular systems or broadband services
- Original electric and telco was subsidized by Federal Government
- Some rural broadband has been funded but not nearly enough; perfect time for partnerships in rural areas

Let's Utilize Public Safety Resources

- Existing LMR towers and locations
  - Coverage will be different but it is a start
  - Sites are generally hardened
- Forestry radio sites
- Tribal sites that provide additional coverage
- Existing Sheriff, Police, Fire, EMS buildings

FirstNet Potential Partners

- Existing commercial operators
  - Can build out in areas they don't cover
- Rural wireless operators
  - Add 700-MHz broadband to their services
- Rural power companies
  - Use for smartgrid, meter reading, resale
- Medical, schools, towns, others

How It Would Work

- Example below: Rural power co-ops
- These examples were used during D Block reallocation campaign with Senators and Representatives
  - Rural telcos not included because Rural Carriers Association (RCA now CCA) wanted D Block auctioned
  - Today they are a viable asset to Public Safety

Example One: State of Utah

- Land Area: 82,143 square miles
- Persons per square mile: 27.2
- Most residents and businesses outside major metro area have only dial-up or no access to Internet
- Rural electric co-ops covering Utah include
  - Dixie Escalante Rural Electric Association (REA), Beryl
  - Garkane Energy Coop, Loa
  - Moon Lake Electric Association (EA), Roosevelt
  - Utah REA, South Jordan
- Rural telcos
  - Beehive Telephone, St. George
  - Central Utah Telephone, Fairview
  - Emery Telephone, Orangeville
  - South Central Utah Telephone, Escalante
  - Utah Basin Telecommunications Association, Roosevelt

Example Two: Kentucky

- Total population: 4,334,113
- Total with Internet access: 54.86%
- Total with dial-up: 14.44%
- Total with no Internet access: 33.34%
- 253,000 homes with dial-up-only access
- 1,049,000 homes with no Internet access
- Number of rural co-op power companies: 38
- Co-op power companies cover more than 46% of state population

Example Three: Ohio's 8th District

- Total population: 667,061
- Total with any Internet access: 62%
- Total with dial-up access: 14.4%
- Total with no access: 23.6 %
- Area served by 4 rural power co-ops
- Power co-ops cover 39% of district
- With co-op partners: 100% Internet access

Spectrum Business Model

- Co-op power and telecoms help build out systems
  - Existing high-tension towers for cell sites
  - Existing fiber/microwave for backhaul
  - Money for construction costs
- What they get in return
  - Secondary access to spectrum
    - Smartgrid
    - Meter reading
    - Resale to their existing power and telco users
    - Fixed and mobile broadband for rural customers, school, towns, etc.
  - Income from all of the above

Other Examples

- Competitive Carriers Association (CCA)
  - Members include many rural cellular carriers
    - Some already own lower A and B block spectrum
    - Some don't own any 700-MHz spectrum
    - T-Mobile and Sprint are both members
  - Already serving rural America with 2G and 3G services and roaming agreements
  - Many moving ahead with LTE today
- Issue: competitive devices that fit their needs

CCA as Partners

- Cover large areas of rural, semi-rural U.S.
- Most have nationwide roaming agreements
- Some have 700-MHz lower band A and B
  - This will present a challenge: Building devices with both lower block and Public Safety will further limit number of devices
  - CCA has asked FCC to require ALL 700-MHz devices to cover entire band (pending)

Verizon/Rural Partners

- Verizon leasing spectrum to small network operators in rural areas
  - Network operator builds out LTE, has access to nationwide services, Verizon devices
  - Verizon has many such partners in the U.S.
- Verizon's spectrum is adjacent to NPSBN
  - Easy fit for additional spectrum access
- Downside: Operators may not believe they need the additional spectrum

AT&T, Sprint, T-Mobile

- AT&T's spectrum in lower 700-MHz block
  - Same issue as CCA with dual 700-MHz radios required
  - AT&T might be interested in extending footprint
- Sprint and T-Mobile have no 700-MHz spectrum
  - Might be interested in sharing Public Safety spectrum
  - Might be incented to work in rural areas in exchange for better metro and suburban lease rates
  - Gaining access to Public Safety spectrum might enable them to gain roaming agreements with other networks

More Rural Partners

- State, county, city, rural school districts, colleges, universities
- State, county, city, private medical facilities including hospitals
- Farmers associations and other rural groups
- Federal Government for U.S. lands?

Partnerships Don't Have To Be Limited

- To a single partner in each area
- Co-operation between a number of partners should be considered
  - Power company, telco, schools, medical, even towns or entire communities
- Many rural areas include tribal land so adding them to the mix is also possible

New and Different Partners

- Google
  - Owns lots of dark fiber across U.S.
  - Wants to capture more eyeballs
  - Could afford to build out rural areas
    - Users would pay less for broadband
    - Google would capture more eyeballs
  - Google LOON project: Hot air balloons do not make sense, sharing with Public Safety would

New and Different Partners (2)

- Rural farm co-ops, major crop buyers
- Microsoft
- Railroads (most rural towns have or have had a railroad running through them)
- Federal partners
  - Forestry
  - Bureau of Land Management
  - Other

Rural Build-Outs

- Require fewer sites
- Use of high-level sites
- Vehicle devices with higher power
  - Handheld devices, user vehicle repeaters
- Satellites can be used for backhaul
  - In areas where backhaul is not available
    - Vehicles can have satellite antennas
    - Sites can be remote LTE/LMR with satellite access

Rural Broadband via

SATELLITE

Special User Devices for

RURAL PUBLIC SAFETY

Rural Devices Will Be Different

- Higher-powered mobile modems
- Vehicles with smart LTE cells
- Handheld LTE devices that will also make use of 4.9 GHz or LTE to the vehicle
- Solar and battery-only sites
- Satellite systems
  - Full-time deployments
  - Vehicle-mounted satellite unit
  - Temporary “drop-in” systems

High-Powered Mobile Modems

- Normal LTE devices have a power output of ¼ watt (250 milliwatts)
  - Output power controlled by network
- Rural devices will run up to 1 watt
  - Vehicle-mounted with external antennas
  - Will require some modifications to LTE network
  - Devices will have to “fall back” to normal LTE modes when in better coverage areas

Vehicles with Smart Cells

- Each vehicle would contain
  - Smart LTE cell
  - Satellite uplink and downlink
  - LMR radio
- Operation would be from LTE or Wi-Fi handhelds back to vehicle, then back to network
- Not necessary for every vehicle in the fleet

Handheld Devices

- Rural LTE devices (handhelds/tablets)
  - LTE, Wi-Fi, 4.9-GHz PS Wi-Fi, Bluetooth, GPS
  - Automatic sensing of best signal routing
  - Public Safety and one or two commercial networks for back-up
- Devices do NOT replace LMR, augment it
- LMR can be extended via satellite

Solar and Battery Sites

- Sites without AC will be more difficult to power
  - LMR systems don't transmit all of the time
  - Usually on an 80-10-10 duty cycle
  - LTE cell sites that transmit 24/7 require more current
  - Will be a challenge for remote sites with no AC
  - More solar, bigger batteries, more expensive

Satellite Systems

- Multiple types of systems
  - Fixed permanent sites with satellite backhaul
  - Vehicular-mounted systems
  - Temporary, deployable
- Satellite backhaul will need sufficient bandwidth for LTE requirements
- Can also be used to extend LMR coverage

Satellite Industry Role in PSBN

- Create operability where none exists – TODAY!
- Enhance interoperability between disparate systems while PSBN is built out nationally
- Provide an essential connectivity element of the PSBN national infrastructure for remote locales
- Add new functionality to existing LMR networks
- A practical approach to economical deployment of the PSBN for Rural America

Satellite-Based Infrastructure

- Economic alternative to traditional terrestrial-based network build-outs – both CAPEX and OPEX
- Establish LMR, data and AVL network services where they otherwise could not be placed either practically or economically
- Exponentially reduce time to engineer, deploy and commence operation of new networks
- Seamlessly utilize traditional LMR and data terminal devices for personnel
- Technology is available today!

Satellite-Based Infrastructure

Three basic operational modes –

- Provide primary LMR and data backhaul for new fixed infrastructure PSBN sites
- Adding mobile data services to existing LMR repeater infrastructure
- Provide direct-to-car satellite repeater for LMR, mobile data and vehicle location where no terrestrial infrastructure exists

Satellite-Based Backhaul Infrastructure

- Allows agile placement of repeater sites at any location
- Immediate re-siting and expansion without expense of new build or changes to terrestrial infrastructure
- System agnostic – works with any voice or data network regardless of frequency band

Satellite-Based In Vehicle Repeaters

- Enables all vehicle-based communication processes
- Functions like any terrestrial-based system for the user
- Economical to acquire, install and operate
- Operates across vast distances without terrestrial connectivity
- Enables new services in concert with existing networks

UAV Platforms as a Resource

- Patrol vast areas unreachable by personnel
- Extend agency reach with an ability to remain “on-station” for extended periods of time
- Provide communication links – voice and video
- Eliminate risk to personnel in dangerous situations

Rural Public Safety Broadband

A FIRSTNET PRIORITY

FirstNet Board of Directors

- Has stated that building out metro and rural portions of the system is a dual priority
- Realizes it needs to provide coverage as good and better than today's LMR coverage
- Using a combination of LTE cell sites and satellite LTE for coverage everywhere

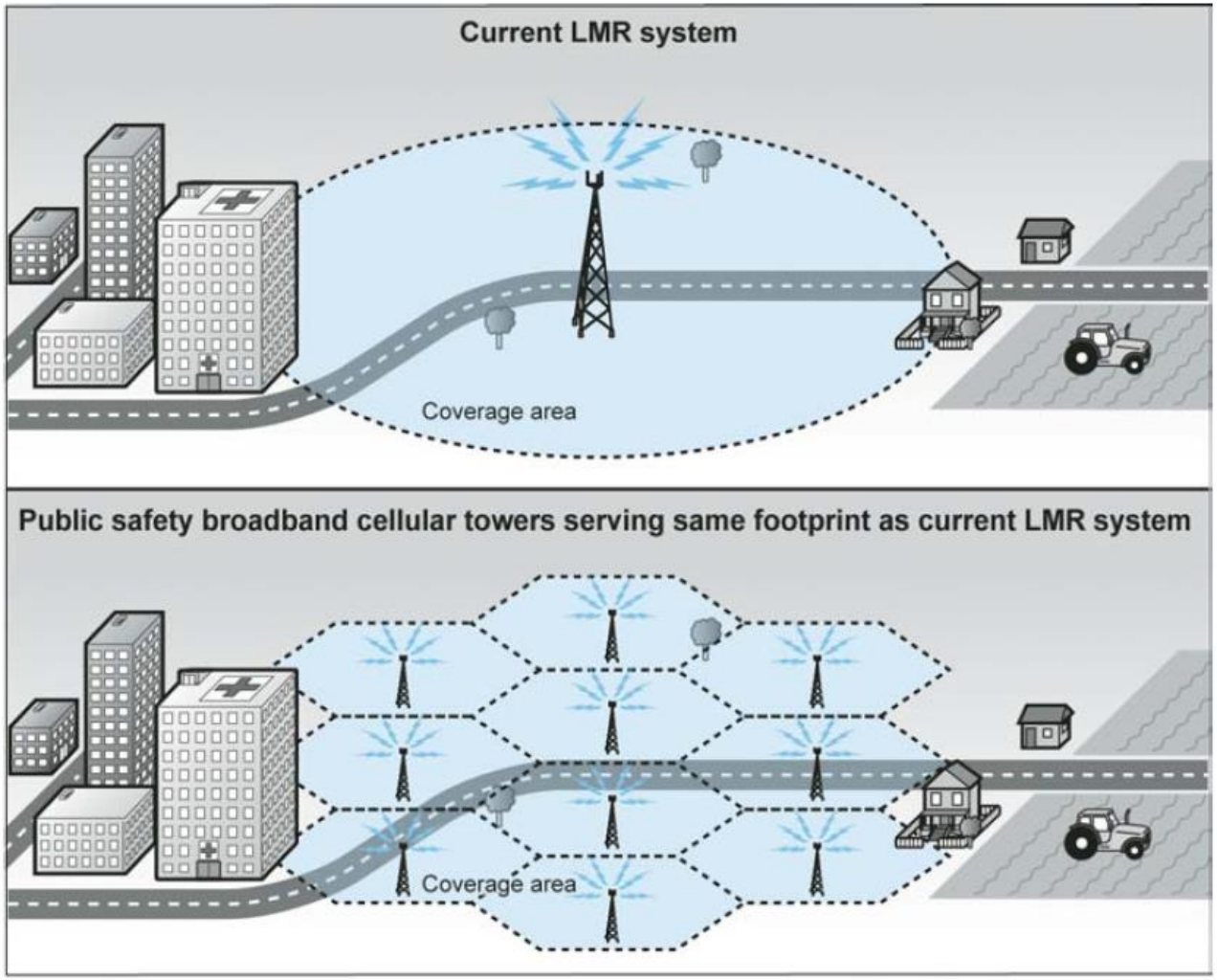
Building Out Rural America

- In some ways funding may be easier
  - Many potential partners
  - Number of them already expressed interest
  - Combining several partners in rural areas makes sense
  - Co-ops/non-profit power and telcos interested, have resources and funding
  - A plan of action is required

Rural America's Needs Are Different

- Different areas need
  - Different approach to partners
  - Inclusion of tribal lands, Federal lands
  - Some partners cover more than a single state
- Covering rural America cannot be a cookie-cutter approach
  - Each area is different, with different challenges
  - But there are plenty of options

LMR and LTE System Differences



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Q & A

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