

*Understanding Dynamic
Spectrum Sharing through
Spectrum Observatories, Test
Cities, Cows and Service
Provider Testing*

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Spectrum
Observatory,
@ IIT, Chicago

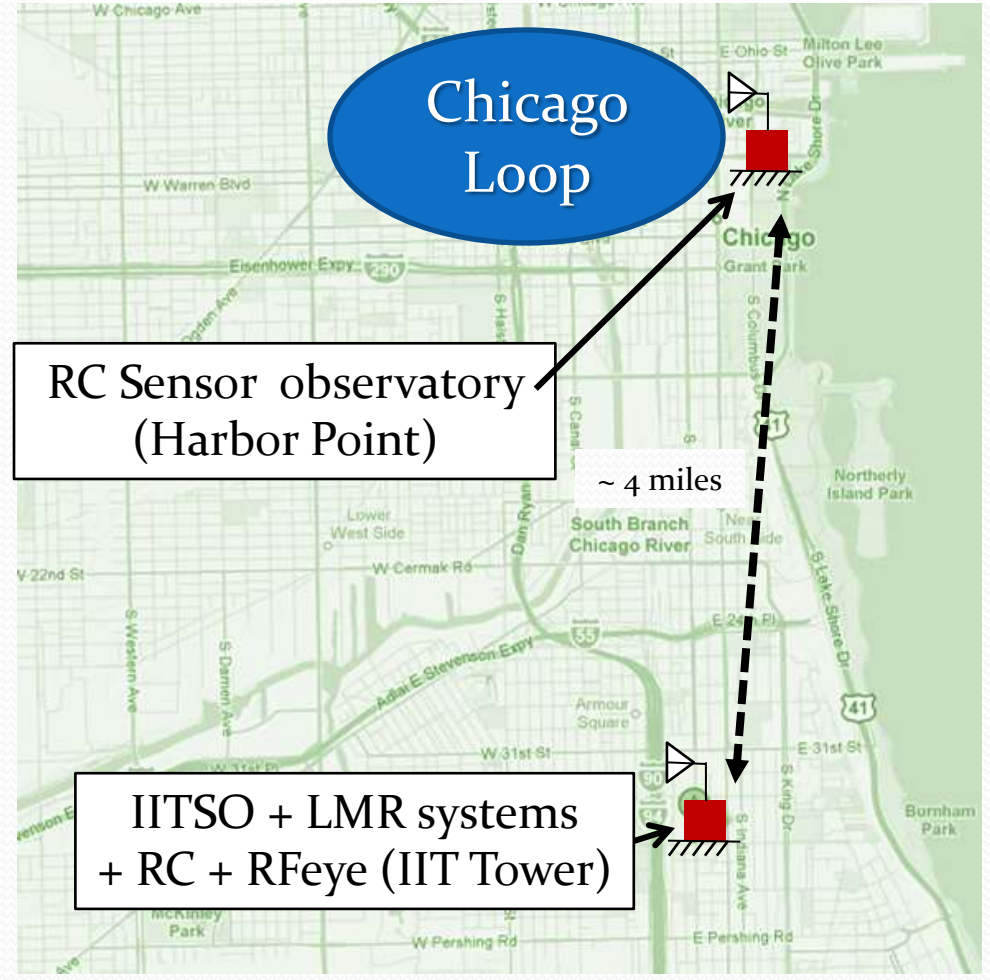


• Motivation

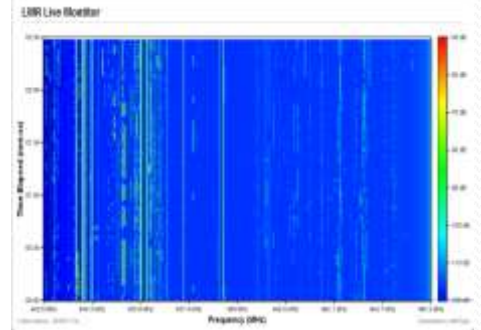
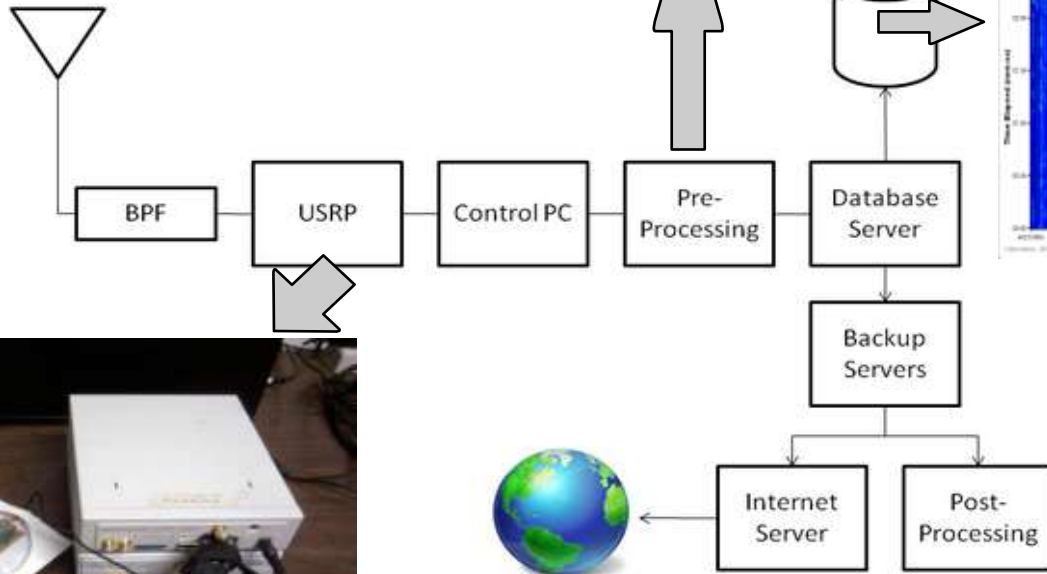
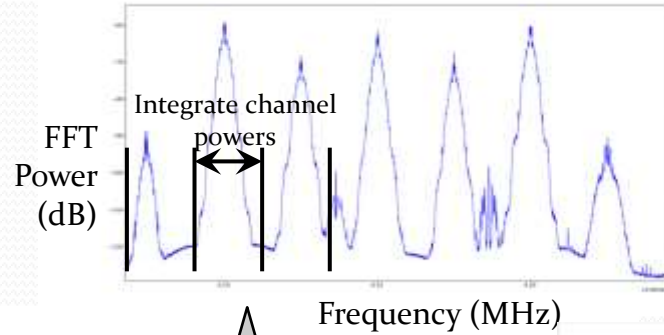
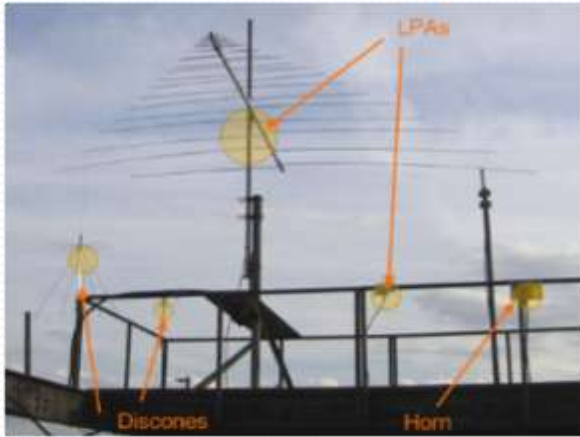
- Ongoing, Increasing Spectrum Need
 - FCC National Broadband Plan (2010) → 500 MHz spectrum
 - PCAST Recommendations (2012) → 1000 MHz shared spectrum
 - Dynamic Spectrum Sharing (DSS) direction
- Technologies for efficient use of RF spectrum (e.g. DSA / CRS)
- Long Term RF Environment Characterization (June 2007 to present)
 - Deep understanding of *actual* RF spectrum utilization
 - Interference Identification / Mitigation
 - Trend Assessments
- Understand RF Sharing Opportunities (e.g. temporal for Chicago)

WiNCom's 7 Spectrum Measurement Systems

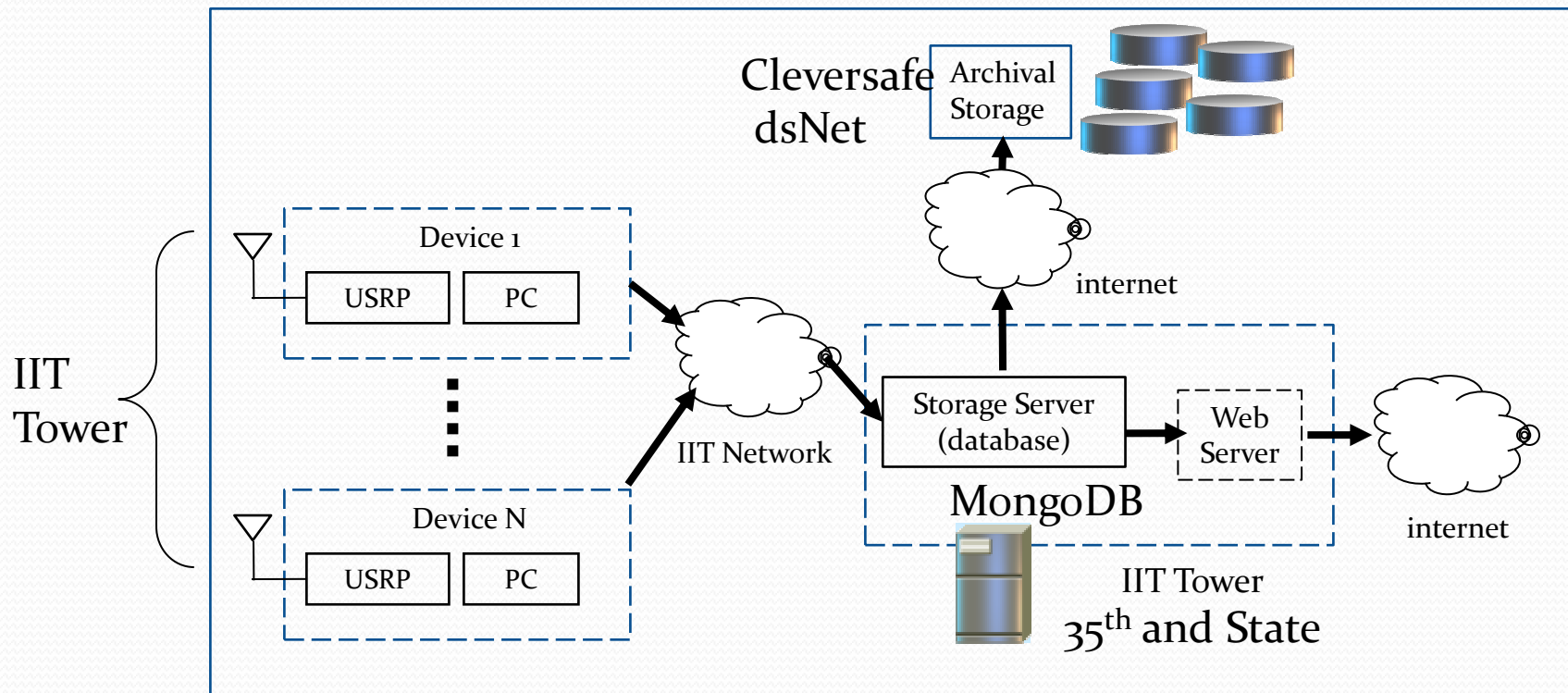
- **Three observatory classes including seven measurement systems**
- **Main Observatory (IITSO)**
 - Spectrum analyzer based
 - 30 – 6000 MHz
- **Land Mobile Radio (LMR)**
 - 3x Universal Software Radio Peripheral (USRP2) units
 - Specific bands (e.g. 460-470 MHz)
- **Special Observatories**
 - 2x RC sensors
 - 1 RFeye sensor
 - Special Studies
 - Harbor point + IIT Tower



Land Mobile Radio (LMR) System

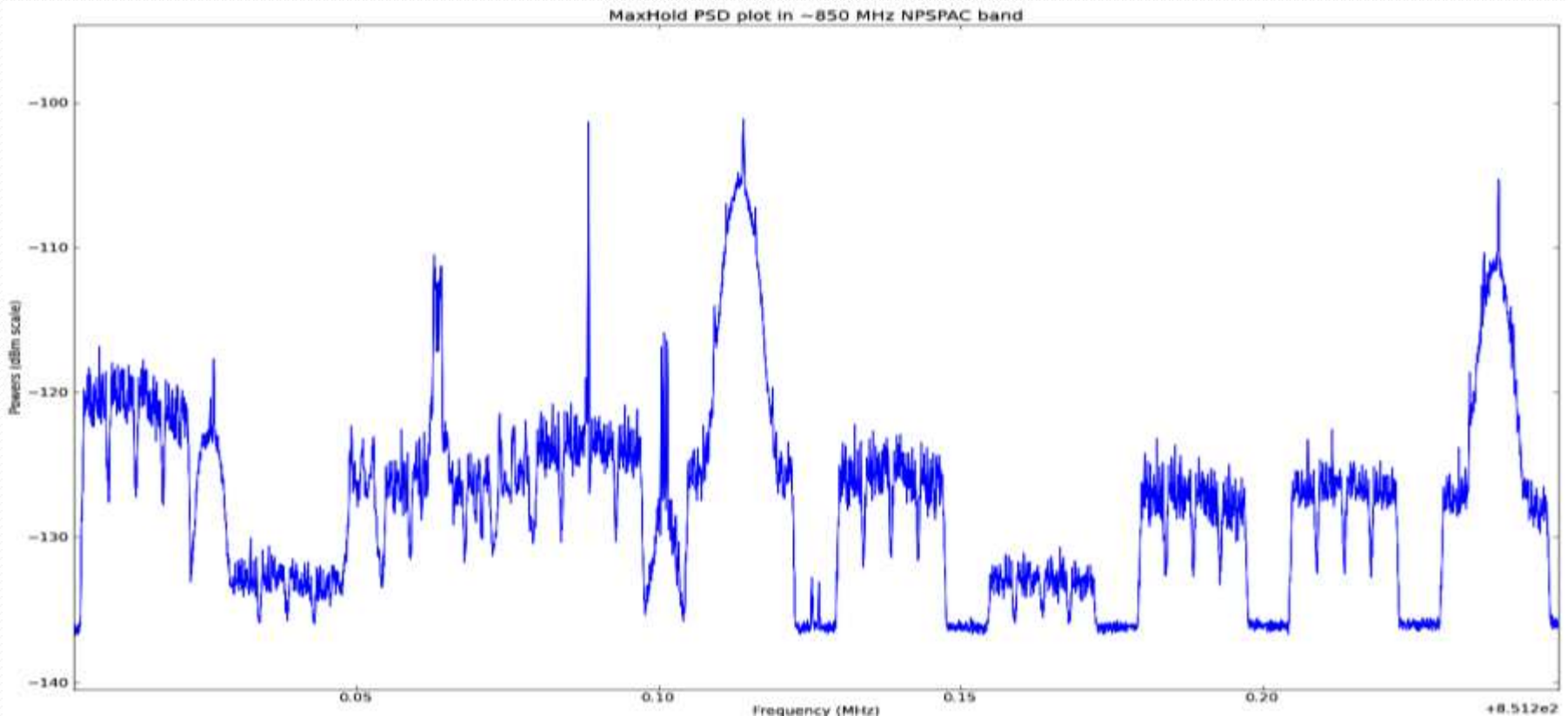


LMR System: Data Storage



LMR System: Sample Data

- 850 MHz NPSPAC band
 - 47 Hz max-hold power spectrum
 - iDEN (Nextel Service) + FM visible



What happens during an Emergency?

Record Chicago Snowfall: ~ 0.75 m.



1-Feb-2011 (tues) PM

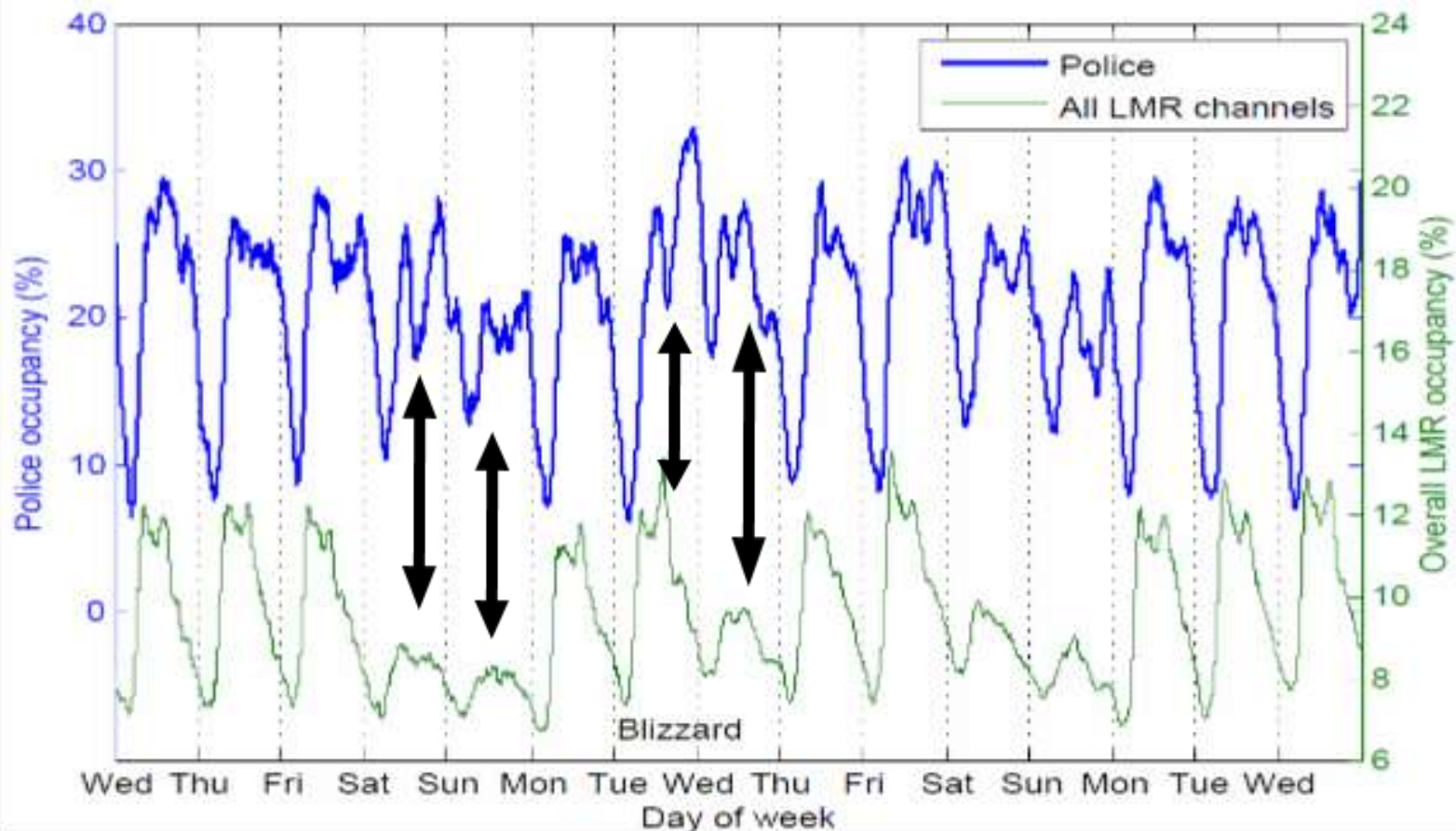
(still snowing)



2-Feb-2011 (wed)

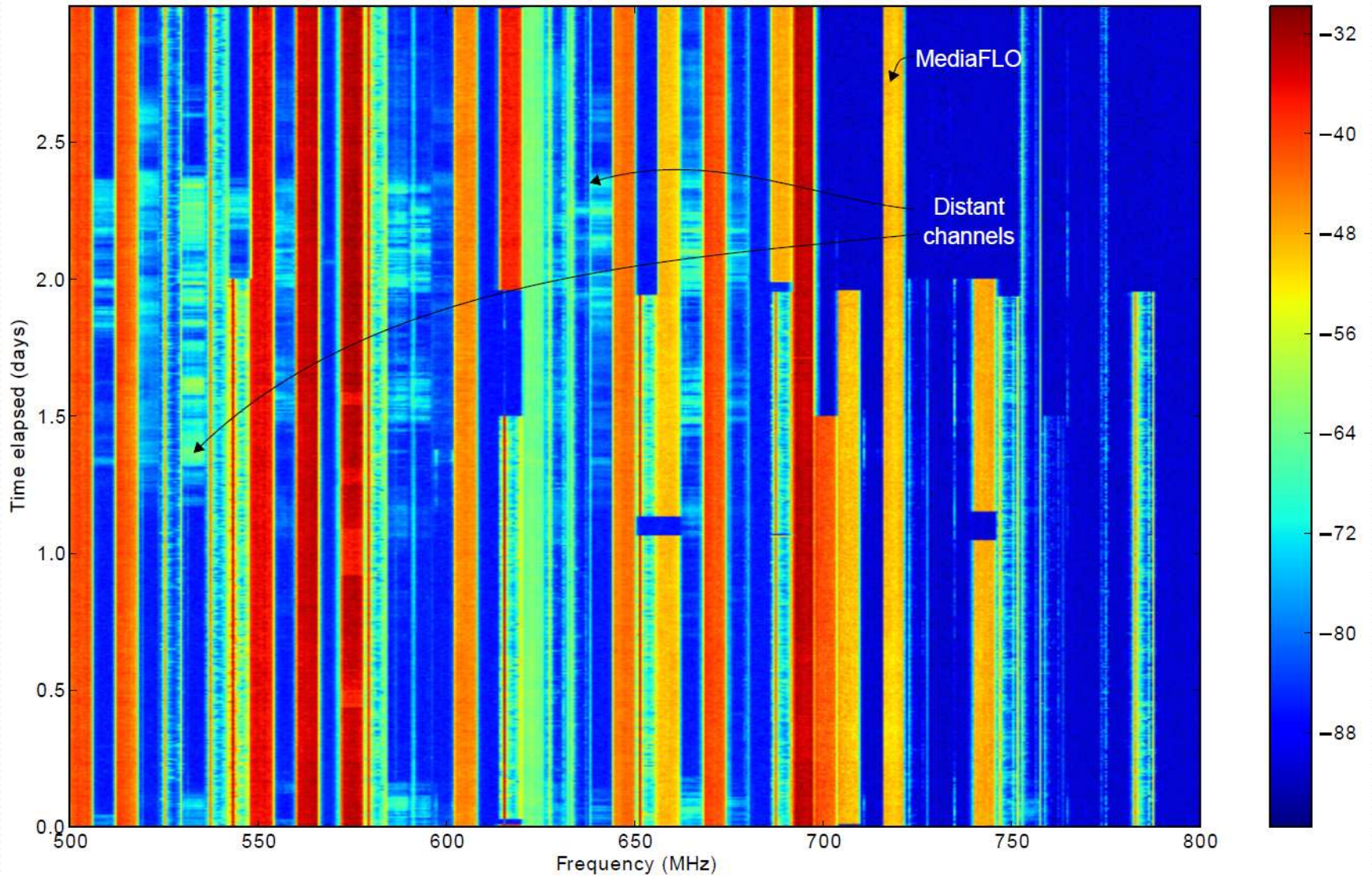
(snowed in)

During an Emergency: Police vs other LMR user

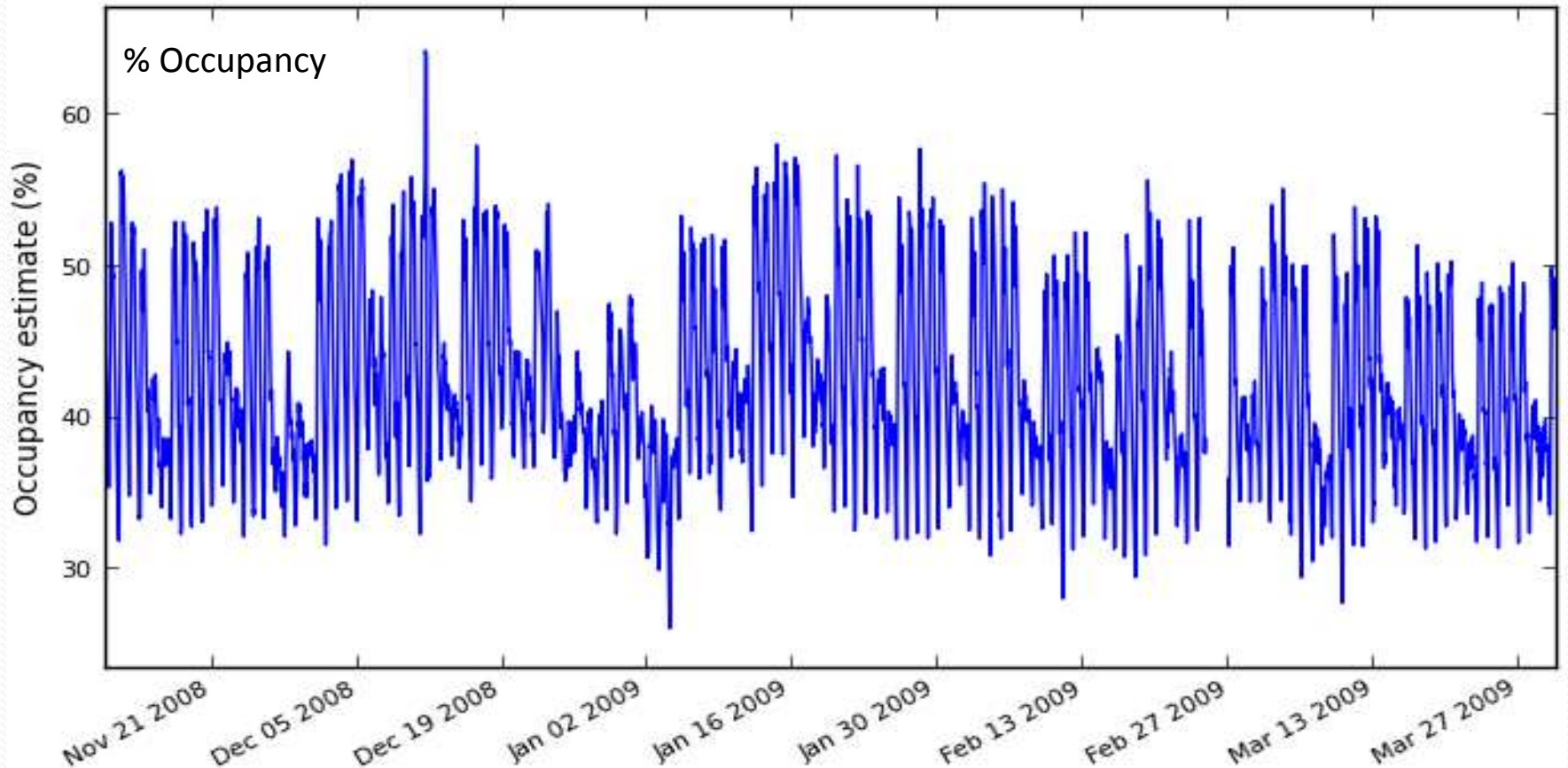


- High public safety occupancy and low commercial occupancy
 - Week-day nights and Weekends
 - During record snow-storm (Feb. 1-2, 2011)

Digital TV Switch-over

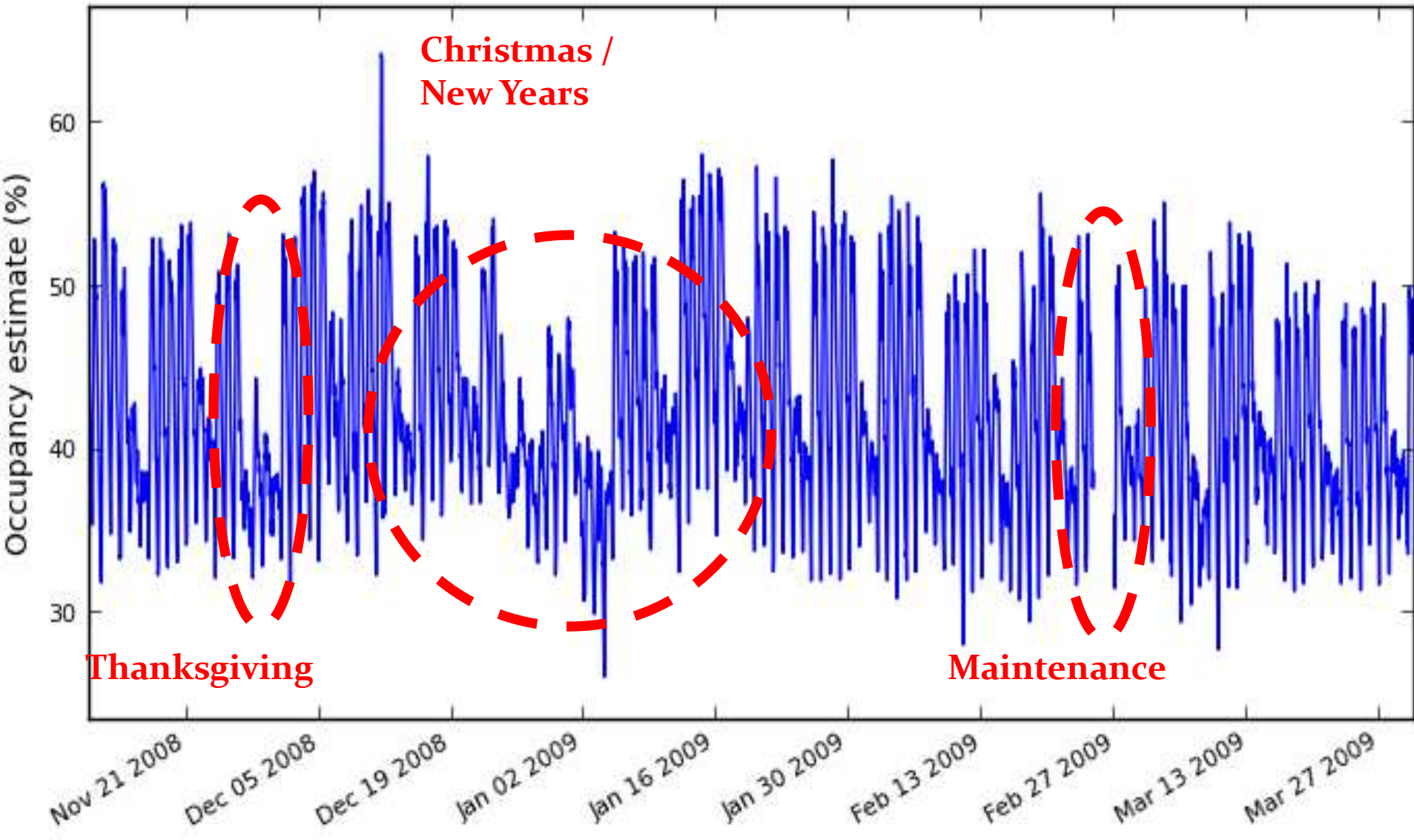


Long-Term Spectrum Occupancy (450-465 MHz) Nov 2008 – March 2009



Average Spectral Occupancy vs. Time (days)
Average over frequency and time
(Includes Commercial and Public Safety Radios)

Long-term occupancy (450-465 MHz LMR band)





To see the recent history of the
700 MHz band:

<https://www.youtube.com/watch?v=h-Ffq1kCvas>

Fueling the Wireless Engine: Preparing the 1755-80 MHz Band for Commercial Operations

“Today, the wireless industry took a critical next step toward preparing the 1755-1780 MHz band for commercial operations and delivering a key building block in the nation’s efforts to retain its global mobile broadband leadership. **T-Mobile, on behalf of CTIA and the wireless industry, took a leadership role in this effort by filing a request for special temporary authority with the Federal Communications** Commission to test the deployment of commercial mobile broadband service in this critical band of spectrum, which has been identified for reallocation on a bipartisan basis by the Administration, Congress and the FCC. T-Mobile’s request recognizes that fully clearing spectrum should remain the end goal, but this band cannot be cleared from top to bottom with the wave of a wand. That’s why the wireless industry has “rolled up its sleeves.” This testing can provide valuable insight into the opportunities and challenges of operating commercial mobile broadband services in the 1755-1780 MHz and 2155-2180 MHz bands, even if a limited number of incumbent federal operations, in a defined number of geographic locations, remain in the band on a transitional basis.”

T-Mobile - Special Temporary Authority

– 1755-1780 & 2155-2180 MHz*

- T-Mobile USA, has sought a special temporary authority from the FCC to test “the ability of federal and commercial users to share spectrum” in the 1755-1780 MHz and 2155-2180 MHz bands during “an interval where federal use for certain systems may continue...”
- As part of the test, T-Mobile, together with CTIA member companies, will be **collecting data on the effects to commercial operations from existing federal licensees** such as the DOD.
- Ultimately, the **focus will be on whether geographic- and temporal-based sharing--not technological-based sharing--can be achieved in these federally controlled spectrum bands.**

PCAST Report:

Dynamic Spectrum Sharing for Public Safety

The recent payroll tax bill, HR 3630, reallocates the 700 MHz D block to public safety providing \$7 billion to build a nationwide public-safety broadband network. **\$7 billion is not enough to build a complete nationwide network therefore the bill allows for leasing of the spectrum**

The Spectrum Access System (SAS) provides a means to implement this secondary access, generate revenue, and enable public safety to retain usage of the spectrum in times of need as the primary user.

Public safety would be the primary user of the spectrum. Secondary access, as administered through the SAS, would be granted via certificates with a finite time-to-live. The secondary user devices would have to constantly renew their certificates, allowing public safety to quickly reclaim exclusive use of the spectrum in times of emergency. This would be the most cost-effective way for public safety to generate revenue from secondary use of their spectrum, since it would leverage the spectrum access infrastructure built for sharing of other federal bands. **This approach could generate revenue for public safety prior to construction of the FirstNet network, as the secondary access could be provided before the network is built providing funds for the construction of the network.**

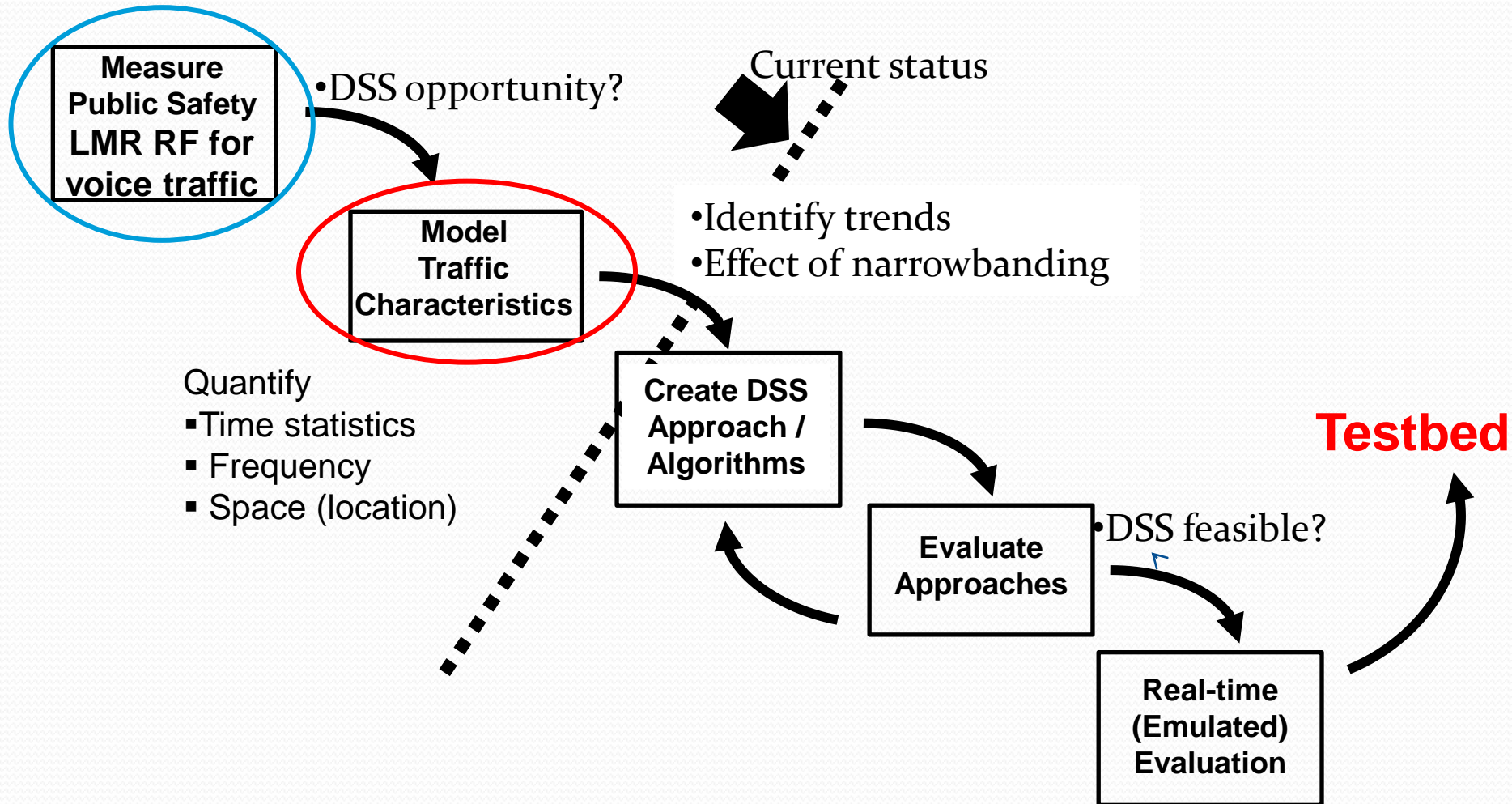
Dynamic Spectrum Sharing for Public Safety

HR3650 calls for public safety to return the T-Band (470–512 MHz). This spectrum is primarily used by public safety in large cities, where significant recently T-Band investments have been made. DSS provides an alternative to T-band reallocation. Spectrum could be shared with incumbent public safety systems as primary users. The T-band also includes business/industry and Specialized Mobile Radio (SMR) operators in 13 of the largest cities. **Spectrum sharing across this band provides a way to harmonize usage of the T-Band rather than have public safety relinquish the spectrum while commercial users stay in place.**

DSS provides benefits to public safety far beyond the 700 MHz D-Block. 1 GHz of spectrum to be made available for DSS. **Through the SAS, public safety can gain access to spectrum they are unable to access today.** The device eco-system driven by spectrum being made available for commercial sharing should result in affordable devices for public safety, and the gigahertz of spectrum would provide additional communications capacity for public safety in both emergency and non-emergency situations.

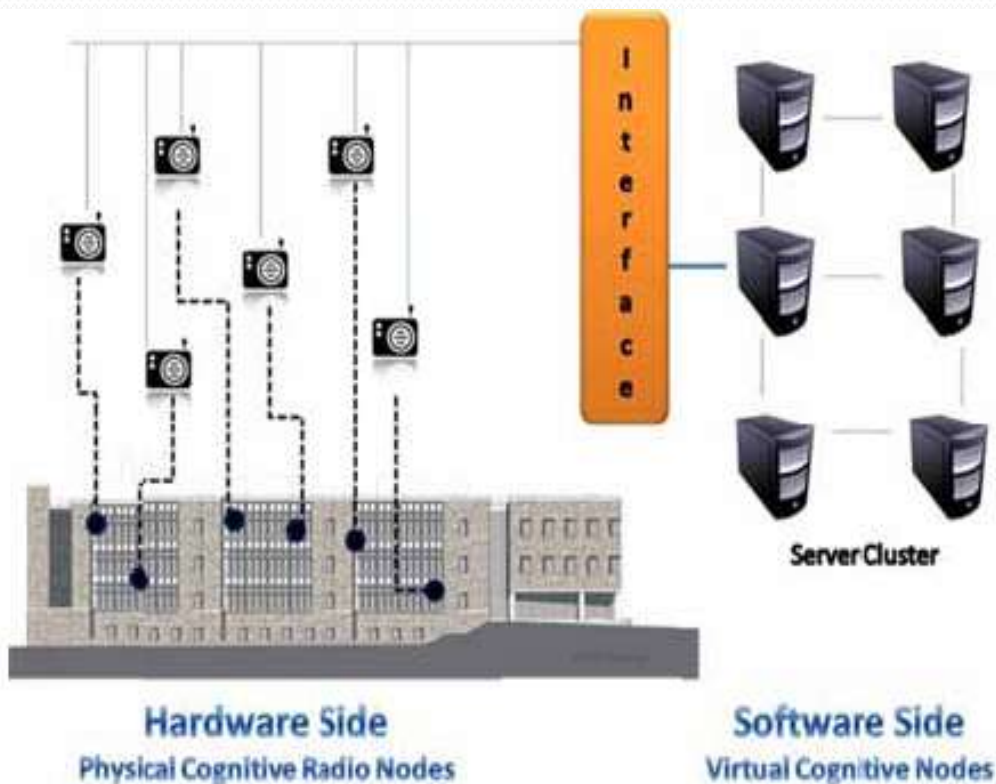
Example: DSS for Public Safety: Approach

Approach: User traffic characteristics key element in devising Dynamic Spectrum Sharing Approach



Recommended: Immediate Pilot Actions

Specify and fund the ongoing Scalable Real-World Test Services needed (a **Test City and Mobile Test Service**) test sharing of Federal Bands and Public Safety with industry



The Test City and Mobile Test Service

- **Finding 6-1:** Insufficient opportunities are available to test new architectures, policies, and the new systems proposed in this report for the large scale dynamic sharing of innovative commercial products in the presence of existing real world Public Safety and Federal incumbent applications.
- **Recommendation 6-1:** **PCAST recommends that the Secretary of Commerce, working through the NTIA and NIST, provide test services (a Test City and a related Mobile Test Service) to support the development of the policies, underlying technologies and system capabilities required to support dynamic spectrum sharing.** Services would include large-scale sustainable facilities for systems level testing across multiple frequency bands, including public safety and selected Federal bands. The Secretary should support these services by establishing a Public-Private Partnership that would pool the resources of Federal, state, and local governments with industry and academia. **The Federal contribution to the partnership could be funded, depending on timing and other factors, by NIST's "Wireless Innovation Fund," by the Public Safety Trust Fund, and potentially by the Office of the Secretary of Defense, and the National Science Foundation.**

Questions?

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THANK YOU!

IITSO + LMR Demo

Demo of real-time streaming & long-term data

