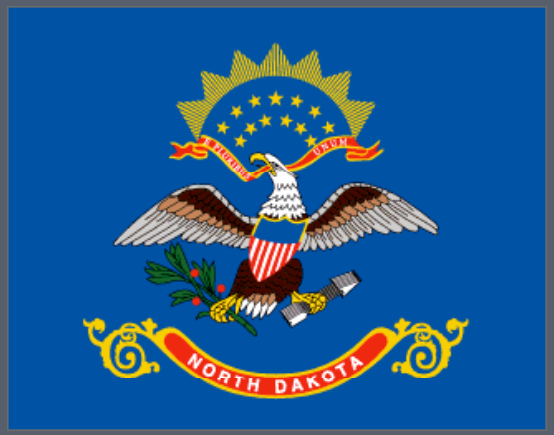
NORTH DAKOTA RURAL TELECOM COALITION



700 MHz
PSBL
SPECTRUM
WAIVERS

PS Docket
No. 06-229

FCC *ex parte* meetings, January 6-7, 2010

Overview

- Public safety community objects to ND/Flow
- Flow Mobile's technology will not be interoperable with 700 MHz PSBN constructed with LTE
- Flow Mobile's technology will cause harmful interference to public safety broadband and narrowband operations
- North Dakota not ready to deploy PSBN until long after D-Block proceeding complete, and VZW LTE deployment underway. <u>No interim waiver needed</u>. Flow is not eligible for waiver per Sec. 337

Overview, cont'd.

- Wi-Fi is not suitable for a fully-mobile 700 MHz public safety network, regardless of proprietary "beam forming" or implementation of 802.11r. Wi-Fi has no recognized upgrade path to 4G.
- In contrast, LTE is a purpose-built mobile technology with an established path to 4G, chosen by public safety and world's largest wireless carriers.
- Flow's cost arguments are erroneous and unsupported by available information

Public Safety Community Objects to the Flow Mobile Proposal

- PSST believes North Dakota and Flow Mobile proposals "are vague and appear inconsistent with the Commission's nationwide interoperability goals." *PSST Comments* at p. 22.
- APCO says "[u]nder no circumstances should North Dakota be allowed to "pave over" the 700 MHz interoperability channels to facilitate broadband communications." *APCO Comments* at p. 14.
- FCC should respect Public Safety consensus, akin to APCO P-25 standard for 700 MHz narrowband.

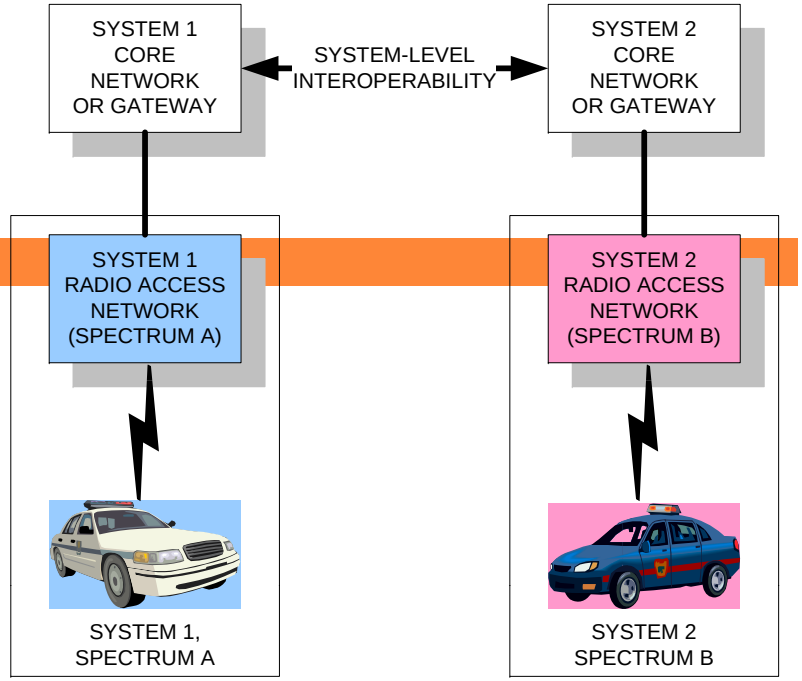
Public Safety Community Objects to the Flow Mobile Proposal

- Recommendations of the NPSTC Broadband Task Force are predicated on the use of LTE technology from the outset
- IACP takes exception to idea of "reallocating" 700 MHz narrowband channels for broadband use. Seeks to dispel "misconception … that wireless broadband will be an alternative to LMR mission critical voice systems." *IACP Comments* at p. 1

Interoperability with LTE?

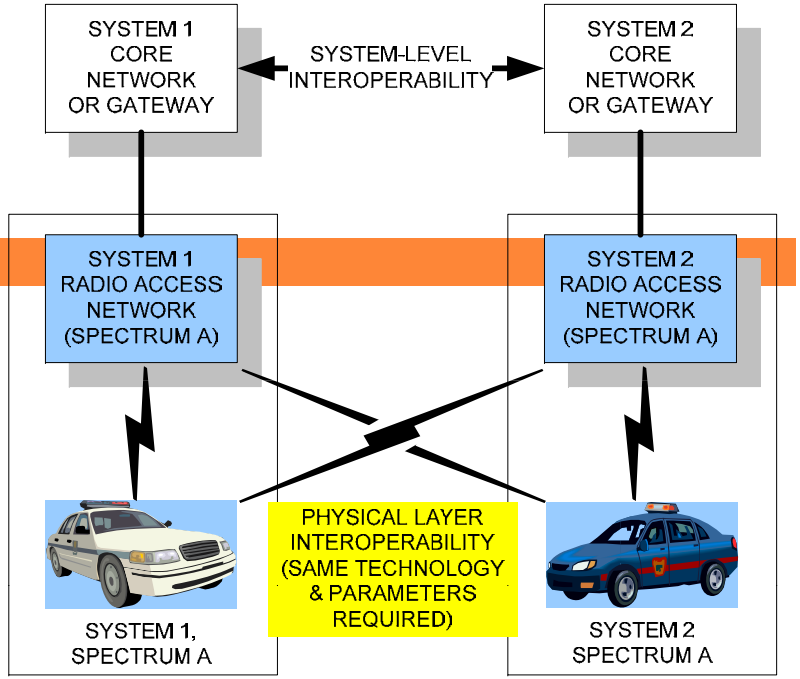
- Flow's network is <u>not capable of physical layer interoperability</u> with LTE
- Dr. Bill Lane, FCC, recognizes that entities operating in same spectrum [*i.e.* public safety in 700 MHz] <u>require</u> physical layer interoperability.

Interoperability with LTE?



- Flow Mobile uses the wrong definition of Interoperability which is expedient to Flow Mobile, but is irrelevant to the practical application
- Flow's claims of eventual LTE interoperability all assume <u>system</u>-level Interoperability
- As Flow's cited example of GSM and Wi-Fi -
  - Each has its own spectrum and access network;
  - Core networks interface at the system level through gateways

Interoperability with LTE?



- However there is <u>only one</u> PSBL 700MHz spectrum block contended for
- Observations of Bill Lane, FCC Public Safety and Homeland Security Bureau Chief Engineer and author of the FCC website page, "Tech Topic 1 – Interoperability", from which Flow's system-level Interoperability "proof-text" was extracted, contradict Flow's approach

Interoperability with LTE?

- Dr. Lane describes the need for physical layer interoperability for entities using the same spectrum:

How It Is Achieved

1. Using compatible communications equipment operating on the same frequencies, with the same signaling characteristics, and the same operating procedures
2. Ensuring adequate signal coverage …, and
3. Scaling the size of the radio network … by sharing the mutually agreed upon procedures.

Same operating parameters. "The first principle of interoperability is for all entities to use the same operating parameters."

Interoperability with LTE?

- Flow cannot possibly comply at this level.
- Even Flow has stated this in its own conclusion, "We don't believe that LTE and Wi-Fi can be deployed in the same frequency block."
- "The thought of deploying two networks in the same frequency block is not a possibility and is absurd", according to Flow Mobile.
- RTC agrees (as it refers to Wi-Fi and LTE).
  - cdma EV-DO, for example, does not pose these same issues – other 700 MHz waiver requests could proceed without delay

Interference with LTE, P-25?

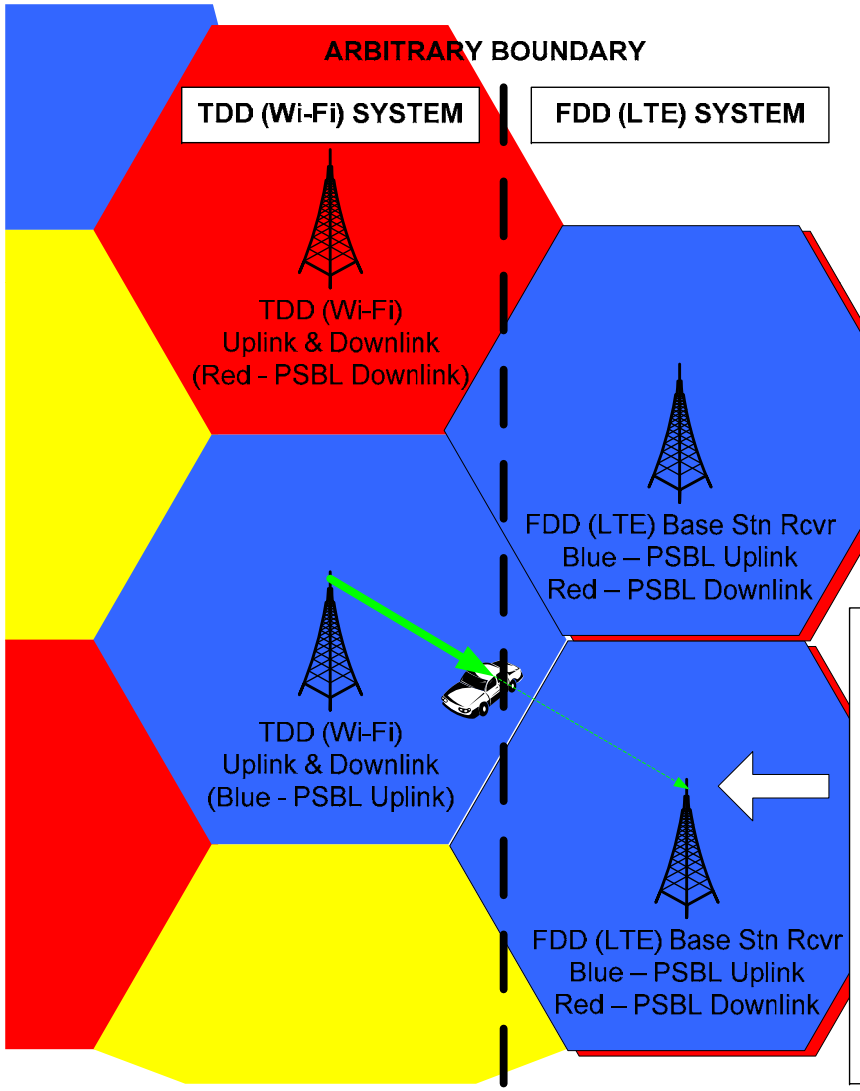
- Flow's proposed mitigation is to use guard bands.
- Guard bands simply are not applicable when the interference is co-channel.
- Flow admits and confirms that, "Interference is caused, in those cases [bordering systems], if two different companies have license to use the [same] spectrum."
- Minnesota (Region 22) has objected due to threat of interference to 700 MHz P25 operations.
- Interference scenarios are many and varied.

Co-channel Interference with LTE, P-25?

- Neighboring co-channel FDD LTE systems would be able to interleave use of subcarriers, which is inherent to LTE's OFDMA design.
- A neighboring TDD (Wi-Fi) system, however, will have a serious propensity to interfere:
  - Powerful TDD (Wi-Fi) base stations will transmit across the neighboring FDD (LTE) system's entire <u>uplink</u> channel, disrupting FDD (LTE) base stations trying to hear their low-power mobiles. *(Example on next slide)*
  - TDD mobiles near the border will transmit across the FDD system's entire <u>downlink</u> channel, disrupting nearby FDD mobiles trying to hear their base stations.

Co-channel Interference with LTE, P-25?

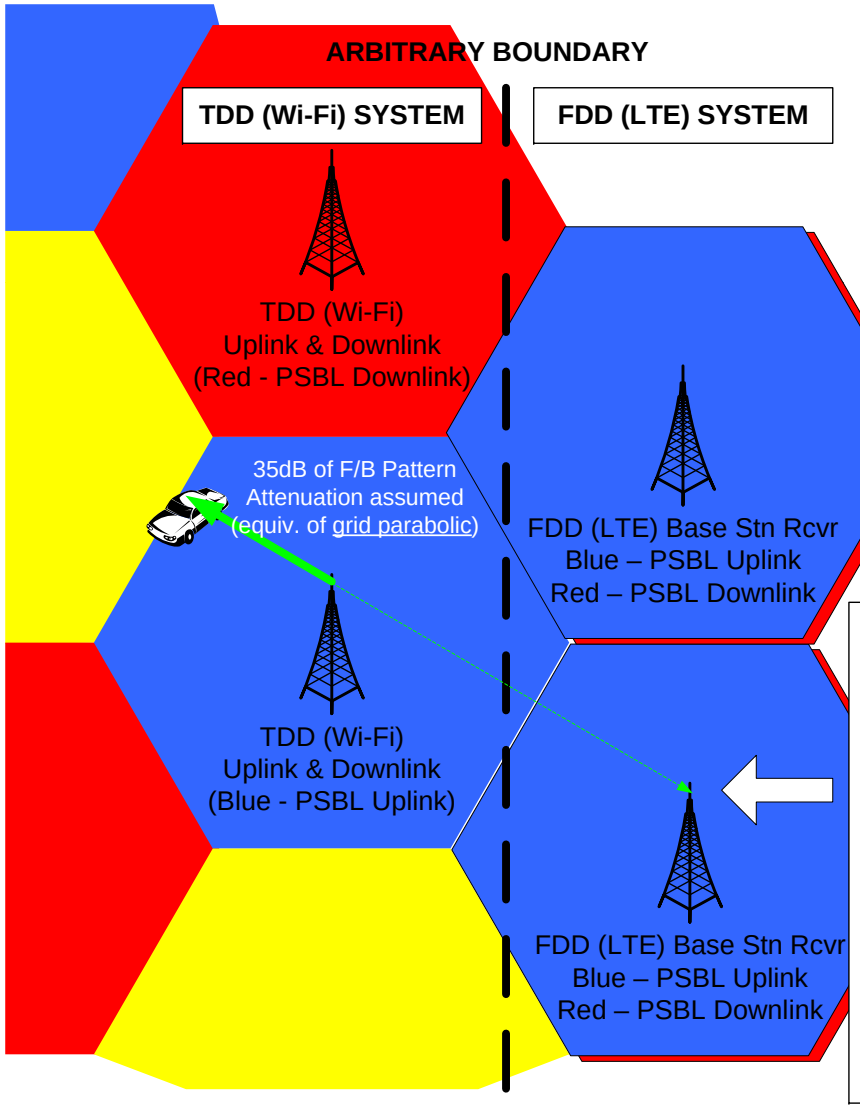
- Example – TDD (Wi-Fi) Base station transmitting on FDD Uplink Channel
  - >46dB of Interference to FDD Base Rcvr



Ch BW	5000 kHz
Noise Floor (at 72°F)	-101 dBm
Rcvr Noise Figure	2 dB
Noise Floor + Noise Figure	-99 dBm
Max Undesired Signal (1dB Rise in Noise Fl.)	-105 dBm
Net Ant Gains & Losses	10 dB
Max Undesired Signal at Victim Rcvr Ant	-115 dBm
Undesired EIRP	48 dBm
Freq	763 MHz
Distance to Victim Rcvr	13.2 Mi
Free Space Loss	116.7 dB
Undesired Signal at Victim Rcvr Ant	-68.7 dBm
Interference Margin	-46.3 dB

Co-channel Interference with LTE, P-25?

- Example – TDD (Wi-Fi) Base station w/ Beam-Forming on FDD Uplink Channel
  - <u>Even when Tx away from border</u>
  - Still Interference to neighboring FDD Base Rcvrs



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Free Space Loss	116.7 dB
Undesired Signal at Victim Rcvr Ant	-103.7 dBm
Interference Margin	-11.3 dB

Co-channel Interference with LTE, P-25?

- Neighboring co-channel FDD LTE systems are able to interleave use of their subcarriers, which is inherent to LTE's OFDMA design.
- Similarly, neighboring P-25 narrowband systems are able to coordinate and interleave narrowband channel usage within the narrowband block, like meshing two fine-toothed combs.

Co-channel Interference with LTE, P-25?

- However a neighboring Flow TDD Wi-Fi system 5MHz channel would appear as a "brick" within the 6 MHz Narrowband block assignment, unable to mesh with the neighboring P-25 "fine-toothed comb."

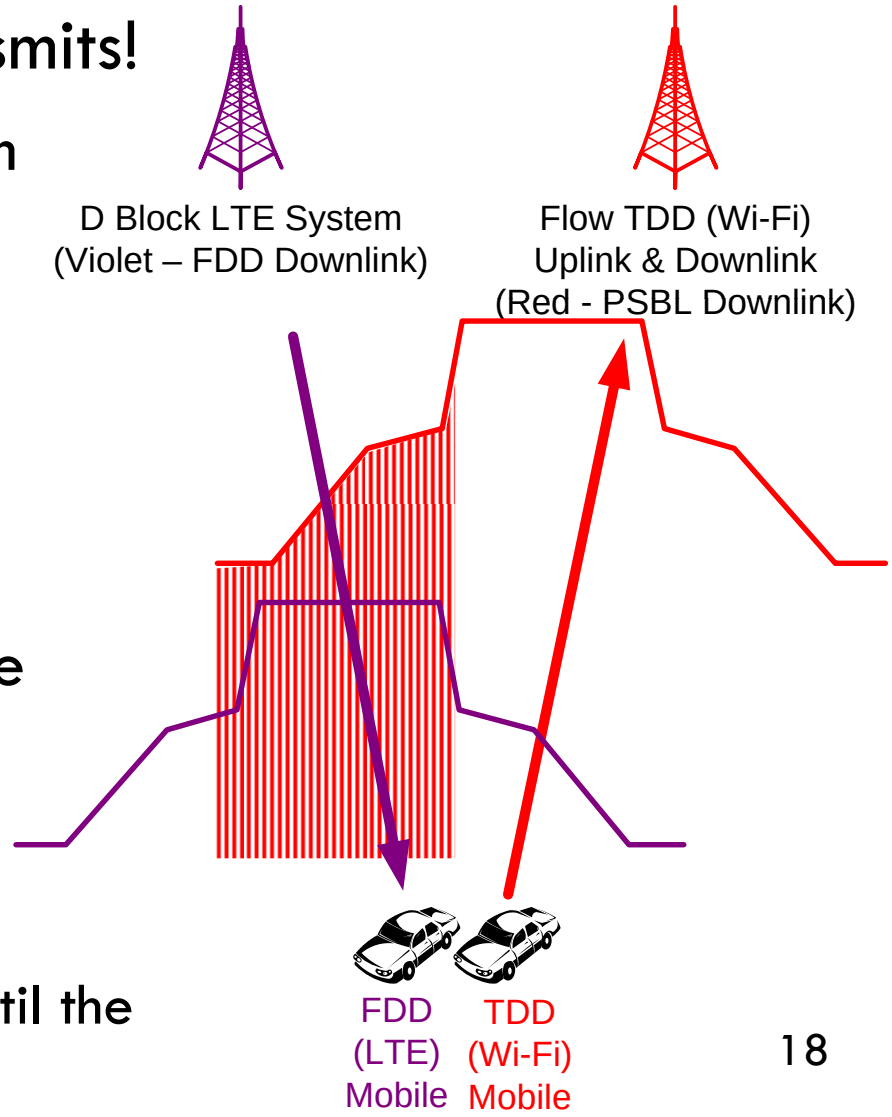
- Even in an N=3 re-use pattern with Flow base station located farther from border, serious interference potential to the neighboring P-25 downlink remains

Adjacent Channel Interference with LTE, P-25?

- Adjacent Channel interference issues are also created for FDD (LTE) operations (e.g. Upper D block in ND)
  - Mobiles, having omni-directional antenna patterns, cannot benefit from "beam-forming"
  - Flow's recommended 5MHz guard band is not possible between 5MHz carriers in the PSBL Broadband and Upper D block channels, which are immediately adjacent.
  - First responder LTE Upper D block communications will be disrupted everywhere and every time a Flow TDD mobile using the adjacent downlink channel, (a one in two chance), shows up at a scene

Adjacent Channel Interference with LTE, P-25?

- The TDD (Wi-Fi) mobile transmits!
  - Adjacent channel energy from the TDD mobile will be many powers of ten higher than the signal arriving from the FDD Upper D block base station
  - The opposite will also occur where the TDD system uses the PSBL Uplink channel and the adjacent channel FDD mobile transmits *(not shown)*
    - The problem will not resolve until the mobiles are many miles apart.



Timing Issues

- "Delay and Uncertainty" in D-Block Licensing does Not Provide a Basis for Granting the Flow Mobile / North Dakota Waiver Request
- FCC expected to announce plan for D-Block in a matter of weeks

North Dakota Is Not Prepared to Implement a 700 MHz PS Network

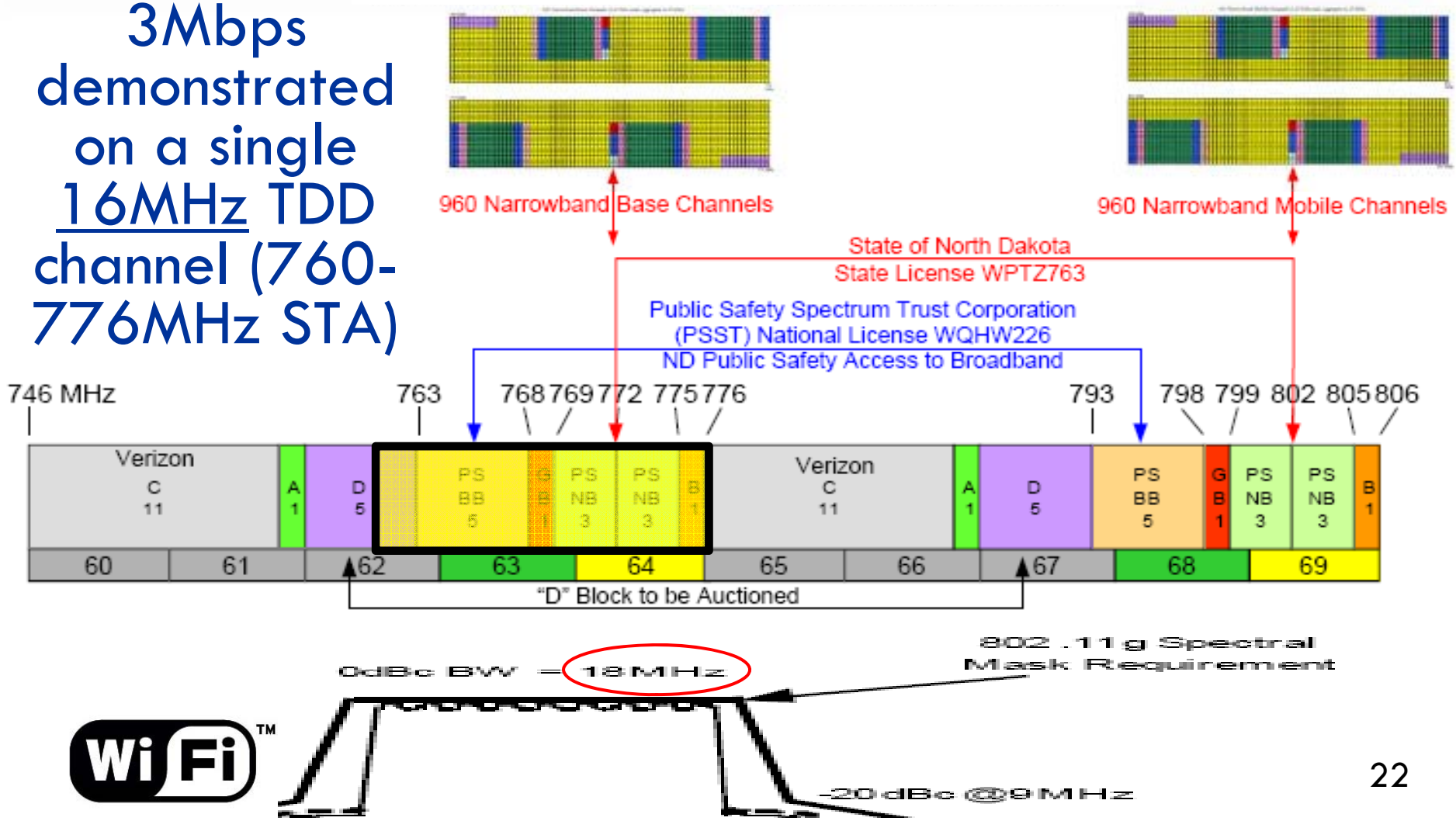
- North Dakota is required to conduct an RFP
- North Dakota follows a two-year budget cycle (biennial legislature - sits in odd-numbered years)
- North Dakota has not completed 700 MHz public safety regional planning
- North Dakota has made no effort to coordinate with neighboring jurisdictions
- Flow will need two years to deploy per *Elert Report*

Wi-Fi is Unsuitable for 700 MHz Mobile Public Safety Network

- Wi-Fi is a fixed/nomadic WLAN technology that is <u>not suited</u> for high-speed mobility
- Wi-Fi can suffer from <u>subscriber overload</u> with no way to control which users may connect to which access points (per *Elert Report*)
- Flow's proprietary "beam forming" technology <u>isn't comparable</u> to LTE's MIMO
- 802.11r <u>doesn't fix things</u> – it doesn't magically turn Wi-Fi into suitable mobile technology
- Flow's demonstration network proves this…

Flow's Technology Demonstration is Invalid for PSBL Spectrum

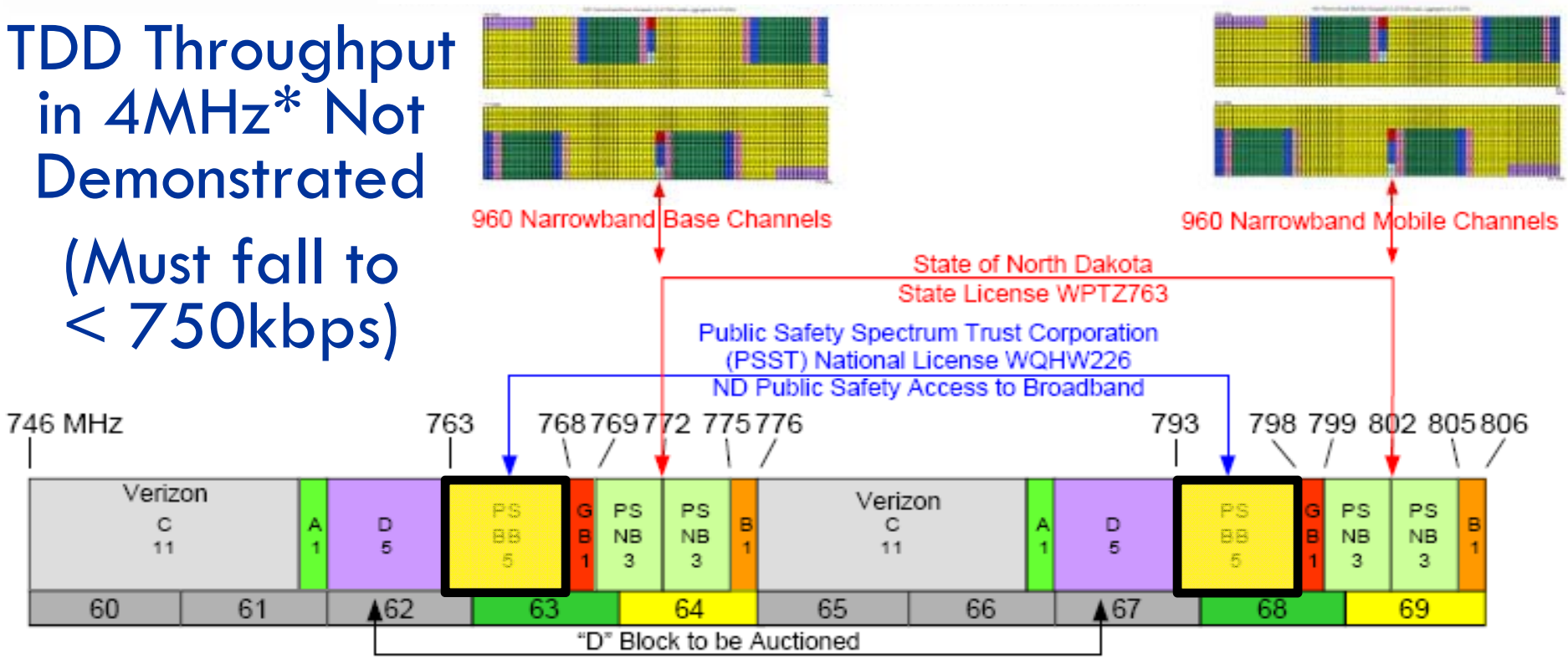
3Mbps demonstrated on a single 16MHz TDD channel (760-776MHz STA)

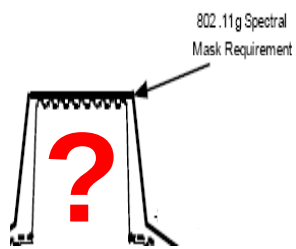


Flow's Technology Demonstration is Invalid for PSBL Spectrum

TDD Throughput in 4MHz* Not Demonstrated

(Must fall to < 750kbps)





* Flow Mobile proposed occupied bandwidth in PSBL 700MHz spectrum

Flow's Technology Demonstration is Invalid for PSBL Spectrum

- Handoffs…
  - Failed miserably, 20-25% of the time
  - Compared to 3% typical industry experience for <u>all</u> abnormal call terminations, not just handoffs
  - Even in a 2.4GHz Wi-Fi system with 20MHz-wide channels, not 5MHz-wide as would be in practice
  - Even <u>with all of</u> Flow's claimed solutions to full-mobility:
    - Even <u>with</u> Flow's beam-forming
    - Even <u>with</u> 802.11r "Fast Basic Service Set Transition"
- No 700MHz Handoffs have been demonstrated
  - Only <u>one</u> 700MHz AP even in demo, on a <u>16MHz</u> ch.

Costs 1/10th that of 3G/4G?

- Flow's costs are based on grossly irrelevant methodology, and are inflated by10x
- CostQuest est. is to cover state with BOTH 3G technologies
- Study assumes small (6-mi.) coverage radius/site, grossly inflating # of sites needed
- Cost/site is 2x typical cost for rural system

SUMMARY

- Public safety objections to Flow? YES.
- Interoperability with LTE? NO.
- Interference to LTE, P-25? YES.
- Timetable requiring interim waiver? NO.
- Wi-Fi suitable for mobility? NO.