Radio and Trunking 101

- Public Safety Radio Technology Presentation
- Brian Zastoupil
- Red River Regional Dispatch Center
- 2/10/2016

Presentation Agenda

- Radio 101
- Analog and Digital
- Conventional Description
- Trunked Description
- Dispatch
- SIRN

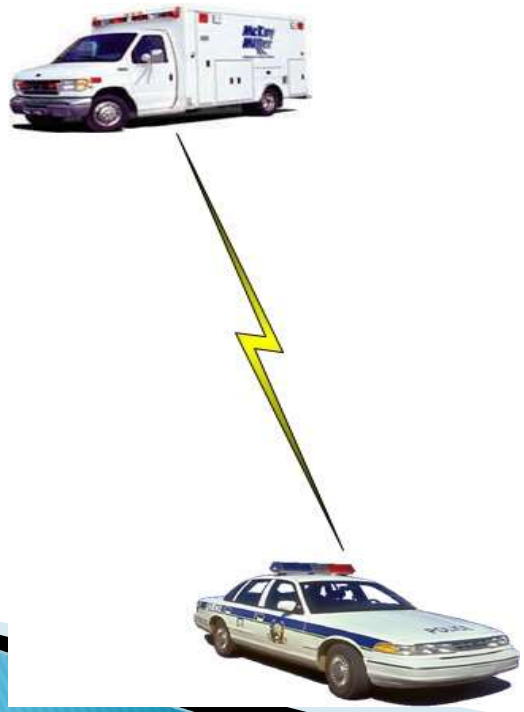
- High Level Presentation!
  - I will do my best to stay out of acronym hell!
- Disclaimer
  - Depictions noted are for demonstration purposes only and do not reflect any final system design.
  - Presenter is not responsible for errors or omissions in training materials

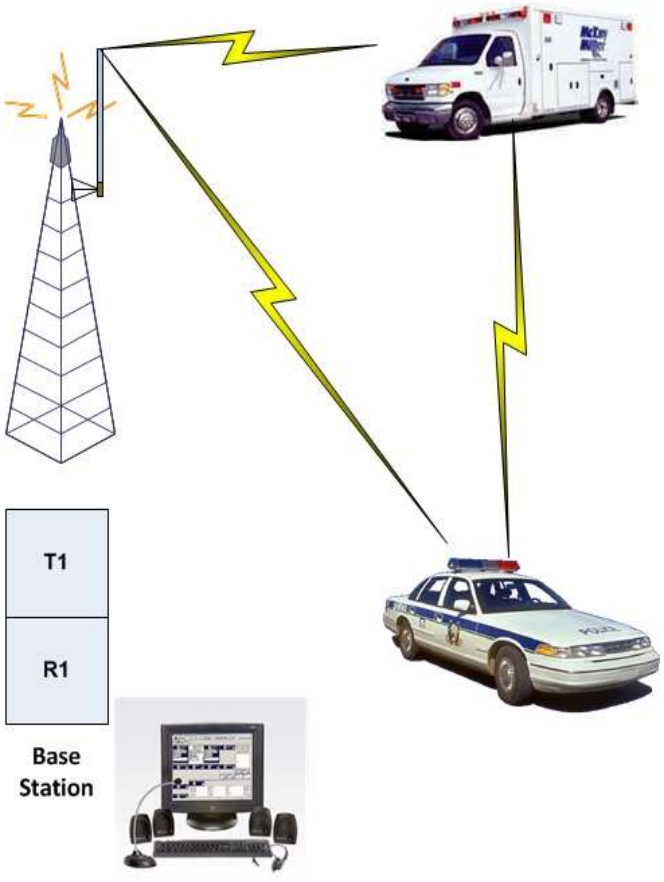
- There will NOT be a test!

- Questions
- No silly or bad questions!
  - Exception- The question not asked!

Radio 101-Simplex

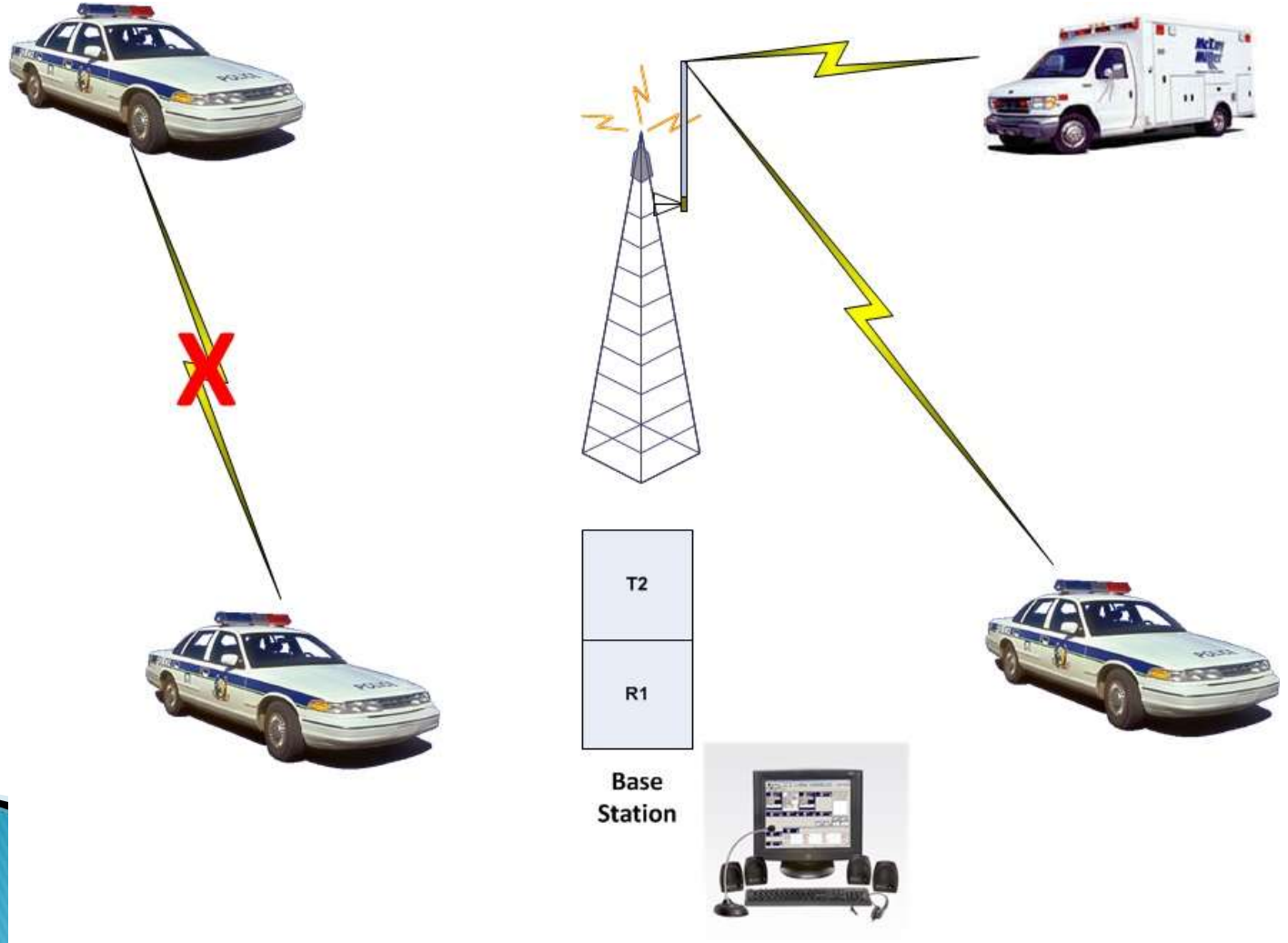
- EX-VLAW31or Majority of Bank 5 channels
- Base to Field Unit or Field Unit to Field Unit
  - Mobile/Portable range is limited
- Not dependent upon infrastructure
- Typically a stand alone resource





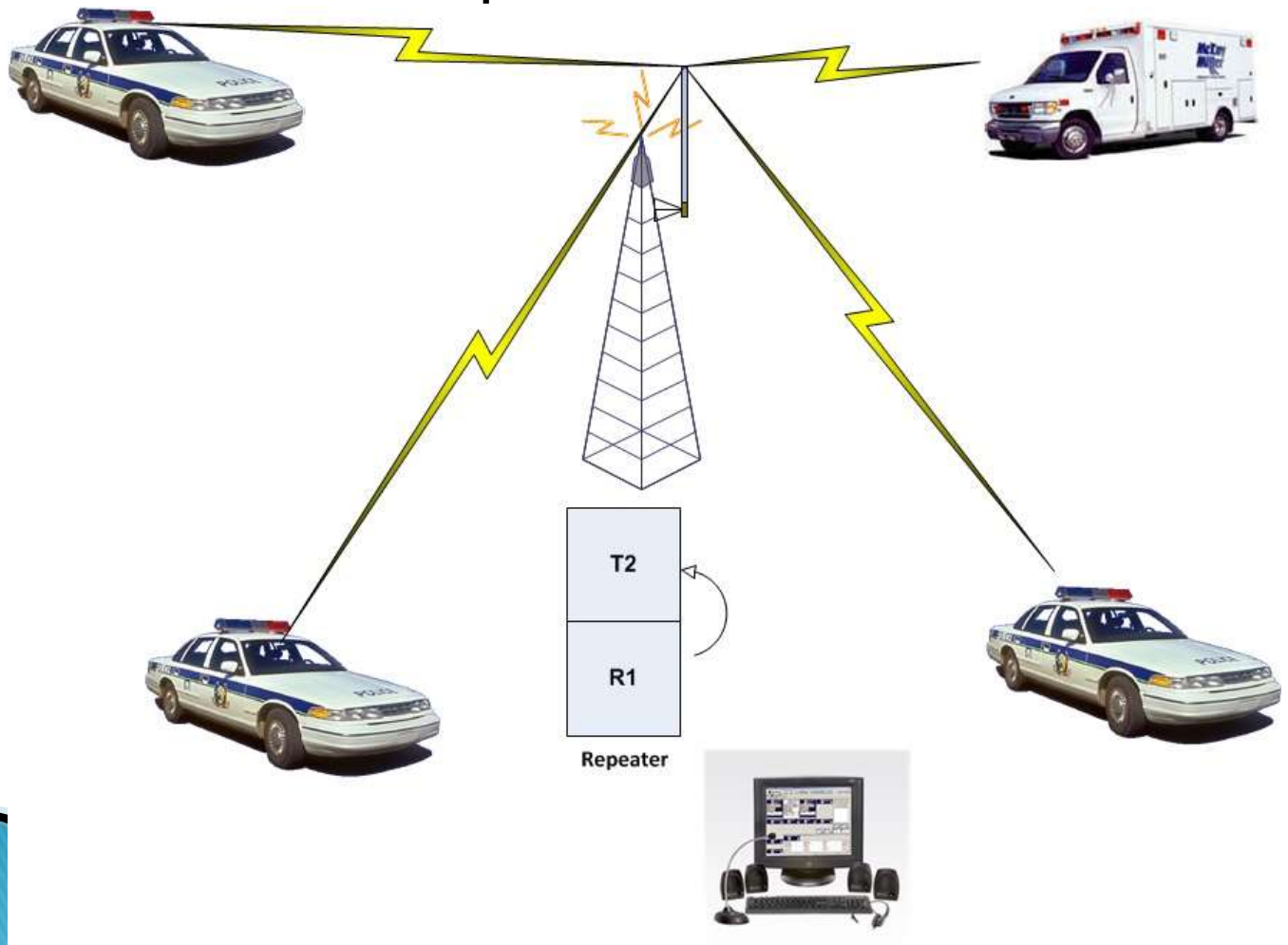
Radio 101–State Radio

- Car to Tower (SR1CT or SR2CT)
- Same frequencies pairs at all towers in state
- No enhanced coverage for field units



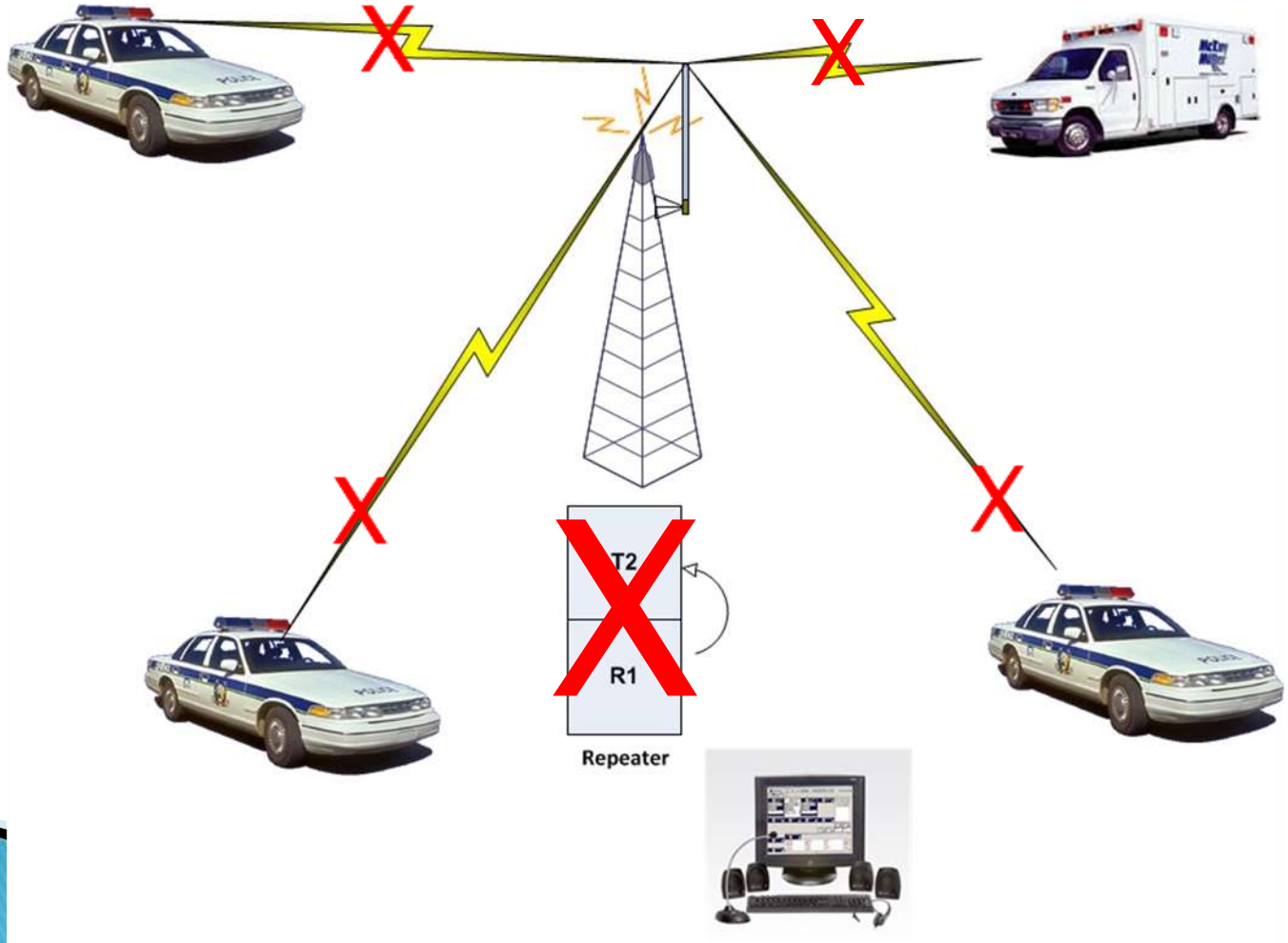
Radio 101-Repeater

- Field Transmission is rebroadcast
- Greater Field unit to unit radio coverage
- Infrastructure Required



Radio 101-Repeater

- Voice is rebroadcast
- Greater Field unit to unit radio coverage
- Infrastructure Required

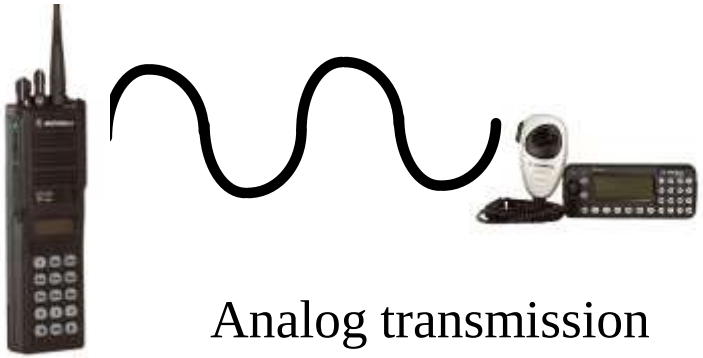


We are building a foundation of knowledge, so be patient!

Questions…so far?

Analog and Digital

- Which is “better”?
  - No easy answer. Depends!
- Voice/Speech is analog as it enters a microphone!



Analog transmission

Digital transmission

Information is sent by changing the frequency, amplitude or phase of the radio signal (EX-FM & AM broadcast)

Information is converted to true data bits, and applied directly to the radio transmitter

Analog and Digital Cont.-LMR (Land Mobile Radio)

- Analog Attributes
  - Simple and Basic (Technology)
  - Users experienced some loss of range during FCC narrowbanding (Analog Wide vs Analog Narrow)
- Digital Attributes
  - Clearer audio throughout system coverage area
  - Improved radio frequency efficiency
  - Improved system coverage (vs NB Analog)
  - Encryption with no range loss
  - Received audio sounds “different”
    - Closely reproduces voice
    - Minimizes non voice components (Noise)

Analog and Digital–Conventional and Trunked Radio Systems

- Separate terms and technologies that overlap
- Conventional Radio Systems can be either Analog or Digital Operation
- Trunked Radio Systems can be either Analog or Digital Operation
  - For our discussion today, when a trunked system is referenced it is assumed to operate in the digital mode of operation (Modern)

Analog and Digital Cont.

Who still uses one of these???

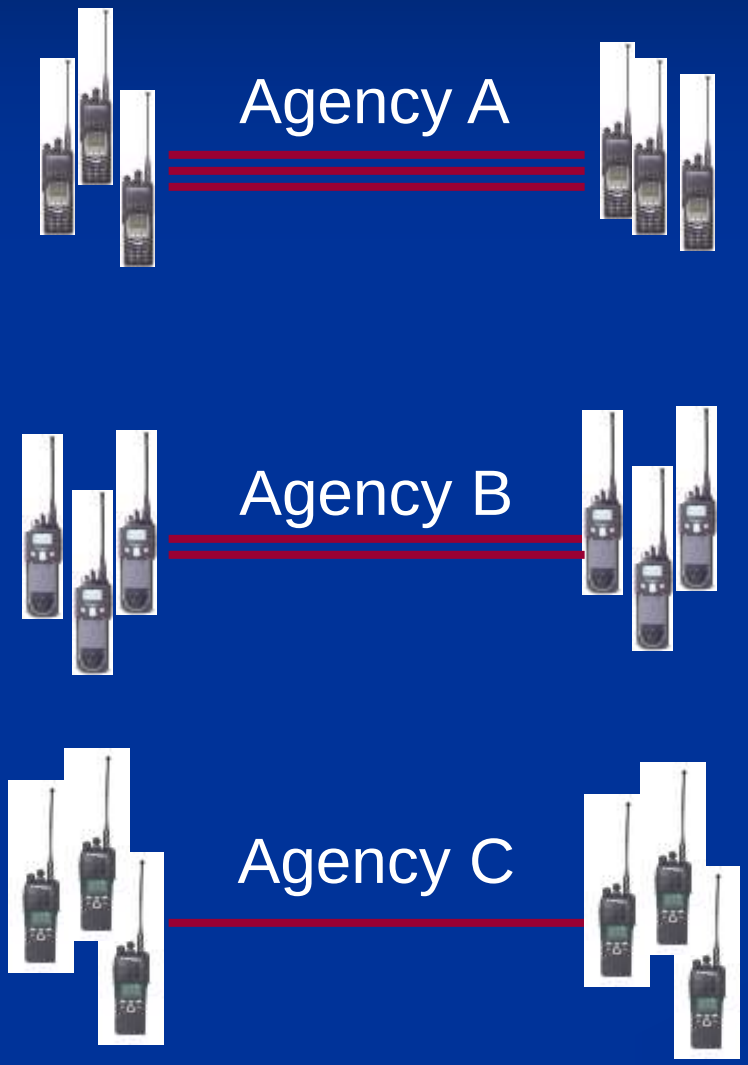
Conventional and Trunked Communications

How Does It Work?

Conventional Systems as Compared to Trunked Systems

- A Conventional Radio System uses a dedicated Base or a Repeater
- Conventional Systems use a dedicated radio frequency for each radio channel in a system unless they share a channel
- A Channel is a Frequency i.e. 155.475 EX-VLAW31 channel
- If a channel is in use the radio user must wait for it to clear before being able to transmit

Conventional Radio System



- Conventional radio systems users talk on their own channels
- This is an inefficient use of frequencies
- For example, if more than two groups of people in Agency C want to talk at the same time they must wait
- This is the case even if there is no traffic on any of the Agency A or B frequencies

Conventional Radio–Cont.

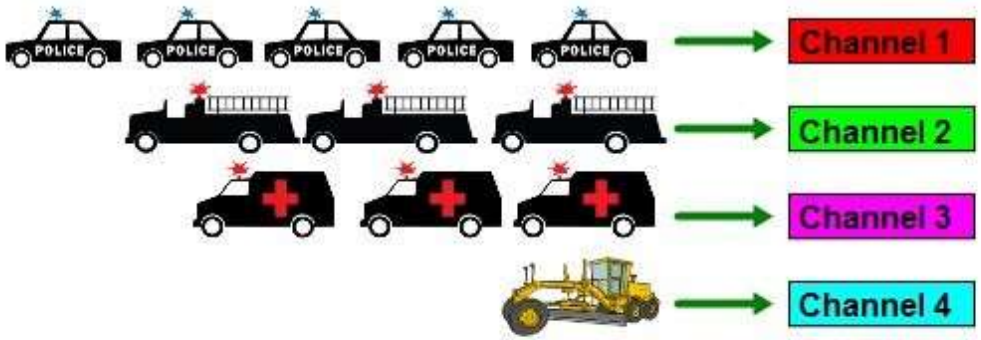
- The system is limited by the number of frequencies in the system
- If an agency wants an additional channel/talk path, a FCC modification/addition is required.
  - Additional infrastructure costs would also be incurred unless communications were limited to a radio to radio basis.

Conventional Radio System

The Grocery Store Analogy

Another way to visualize the conventional radio system is to think of grocery store lines.

At the grocery store, a fixed number of lines may be open at any time. Customers queue up to these lines and move in a strictly linear fashion through their individual lines. Some lines may move faster or slower than other lines.



What is “Trunking”

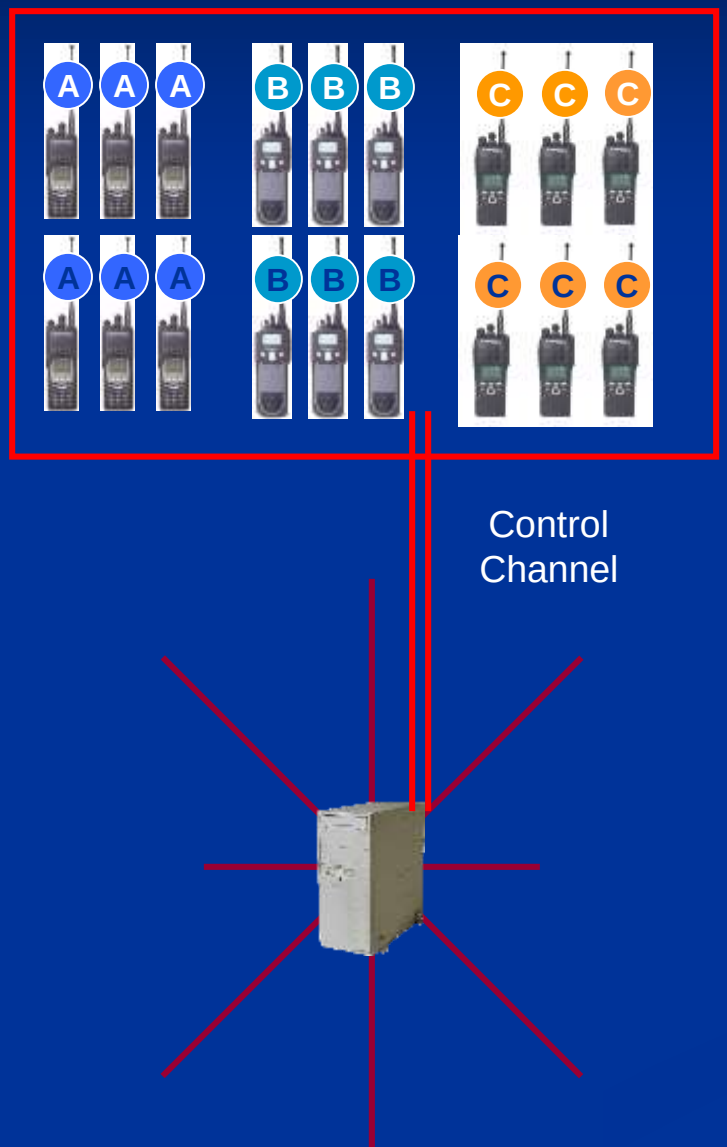
- It is NOT a term that belongs to any company or manufacturer
- It is NOT a term exclusively for radio systems
- It is a generic technology term to describe:

“The sharing of a limited number of communications paths (Trunks) among many users.”

What is “Trunking”

- “The sharing of a limited number of communication paths (Trunks) among many users”
  - Think of a law enforcement facility phone system and how it works. A lot of calls on just a few phone lines.
- Several similar radio frequencies are used to create a “pool” (Communications Site) for radio system users to access
- Trunked systems are not frequency band dependent
- Can be built using VHF, UHF,800 MHz or a mix of frequency bands
- Think of it as a cell phone system for LMR (Land Mobile Radio)

Trunked System



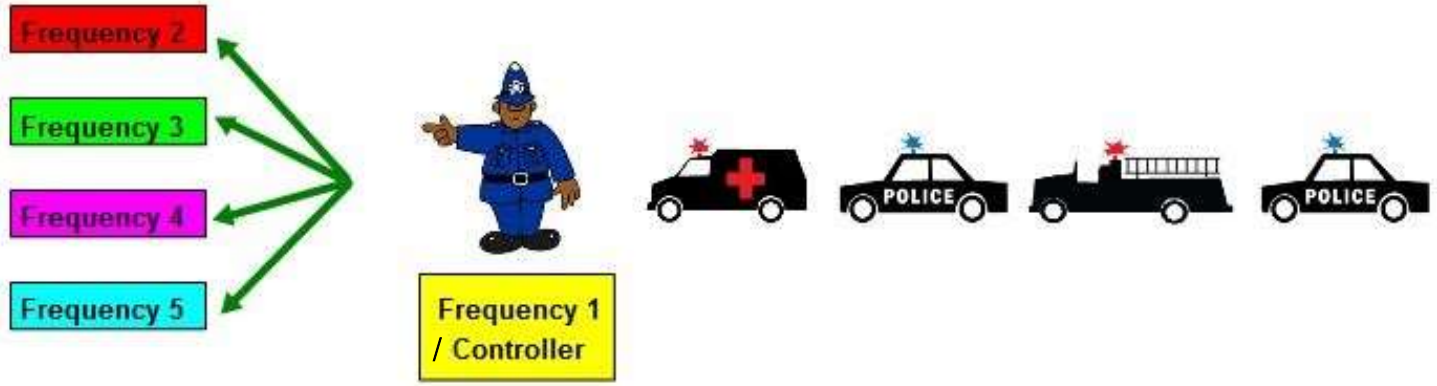
- A computer controlled repeater system assigns available frequencies to users as they are needed
- The terms “channel” or “frequency” do not apply in a trunked radio system
- The term “talkgroup” is used to identify groups of users who communicate together

Trunking 101

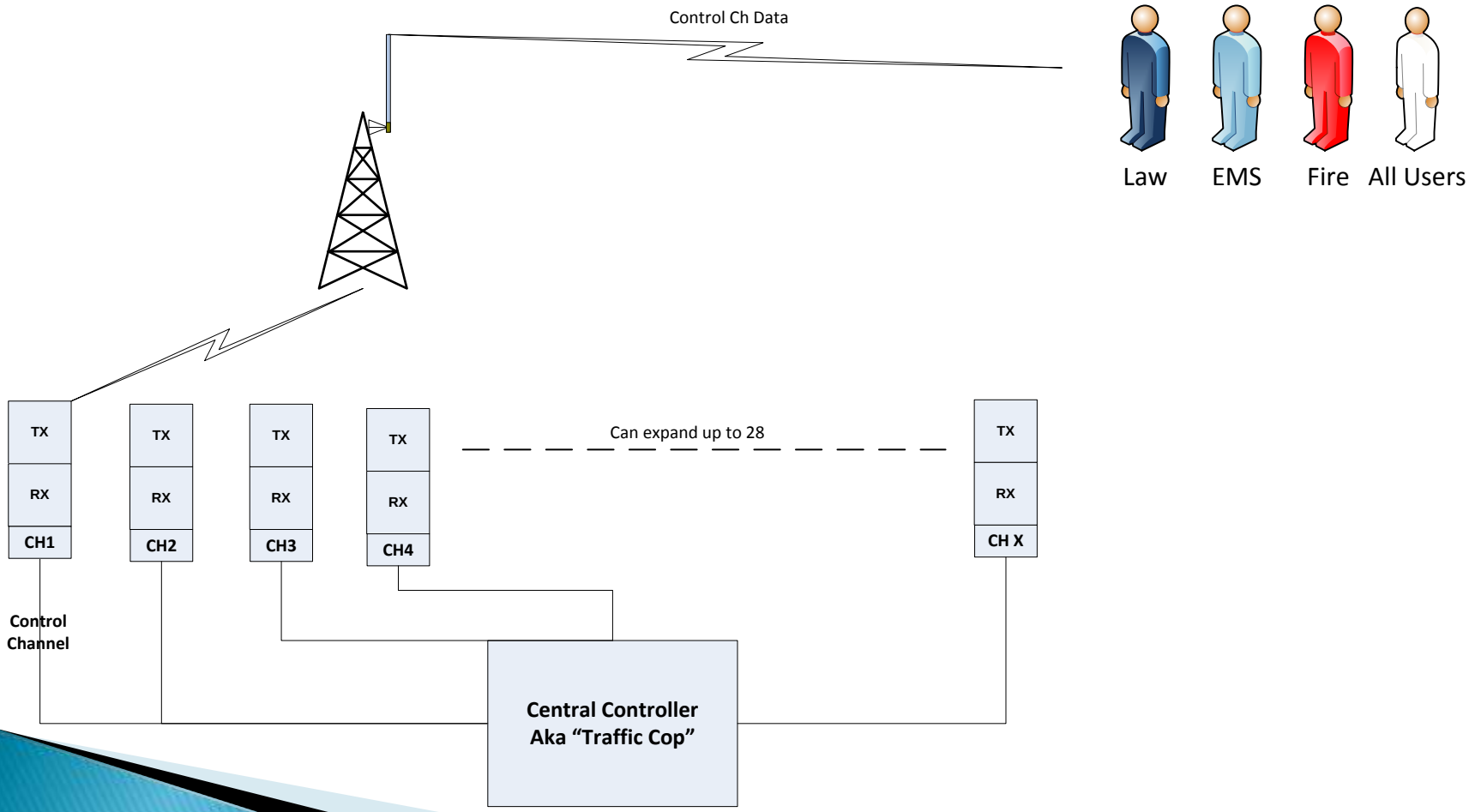
The Banker Teller Analogy

Now, to visualize the trunked system compared to the conventional system, think of a bank teller line.

All customers queue up in a single line, and as the bank teller becomes available, customers move to that individual.



Trunking–Cont.– Single Site



Trunked System Benefits

- Improved usage of radio frequencies
- Consistent Radio Coverage
  - Reduction in duplicated systems
    - EX Sheriff system doesn't have better coverage the highway system
- Radio users on a common radio system
  - Dedicated talkpaths eliminate duplicate or overlapping conversations (IE Irrelevant comms)
- Greater system flexibility and redundancy
  - EX Site Trunking and Failsoft
- Data Features (Optional)
  - GPS
  - OTAP (Over the Air Programming)
- Out of Range indication-Trunked
- Site roaming-Wide Area Trunked
  - A user doesn't need to select a tower

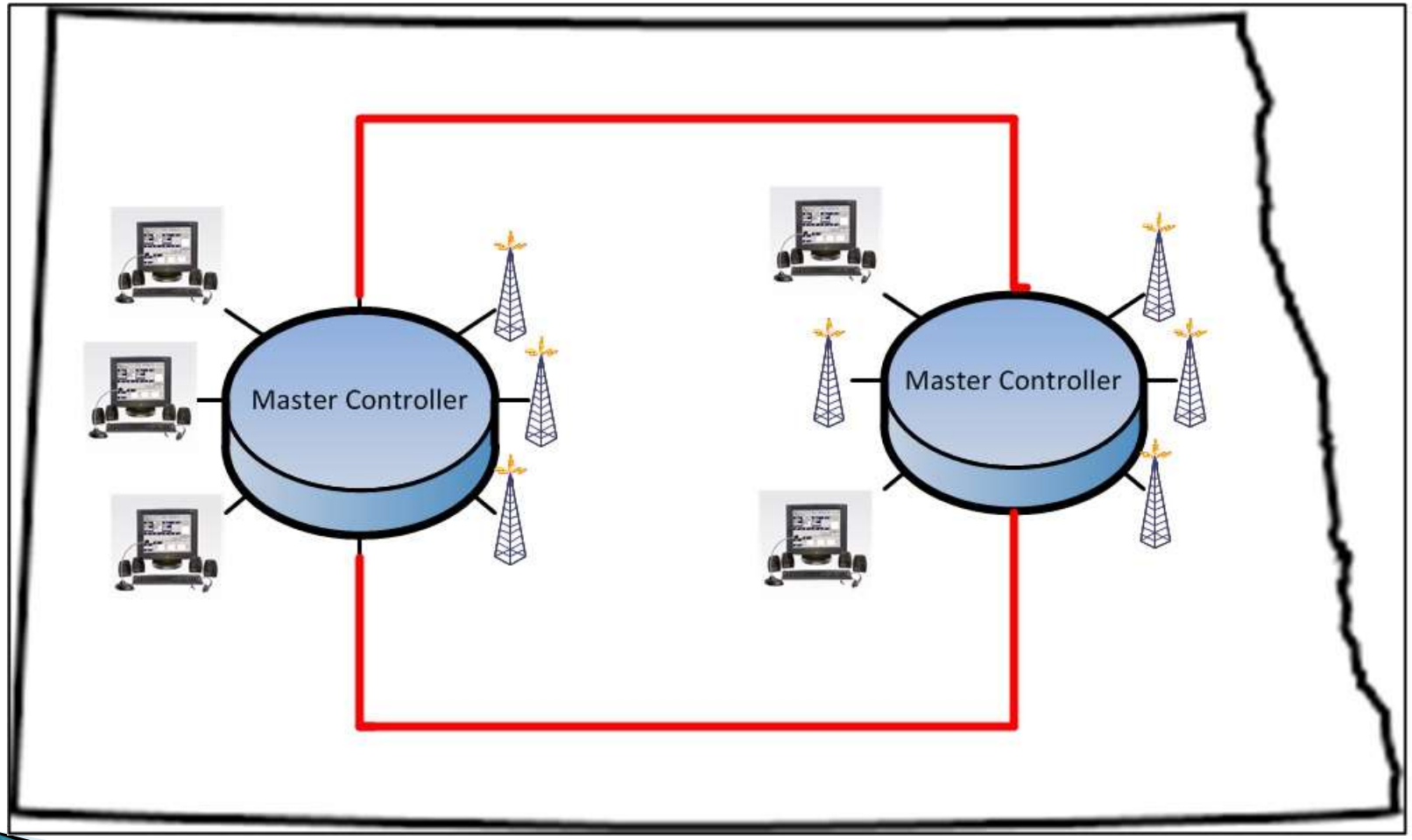
Conventional vs Trunked- Operational Differences

- Additional features on subscriber units
  - Push to talk ID
  - Talkgroup/Dynamic regrouping
  - Call Alert
  - Radio Inhibit
  - Talk Group Capabilities
    - EX Multi Group
- Talk permit tone-Trunked
  - Slightly longer channel grant time
  - .1sec Conv vs ~.25 secs Trunked
- Unable to do tone and voice page on a trunked system
  - The Conventional paging layer can be analog tone and voice or “digital paging” IE Alphanumeric paging

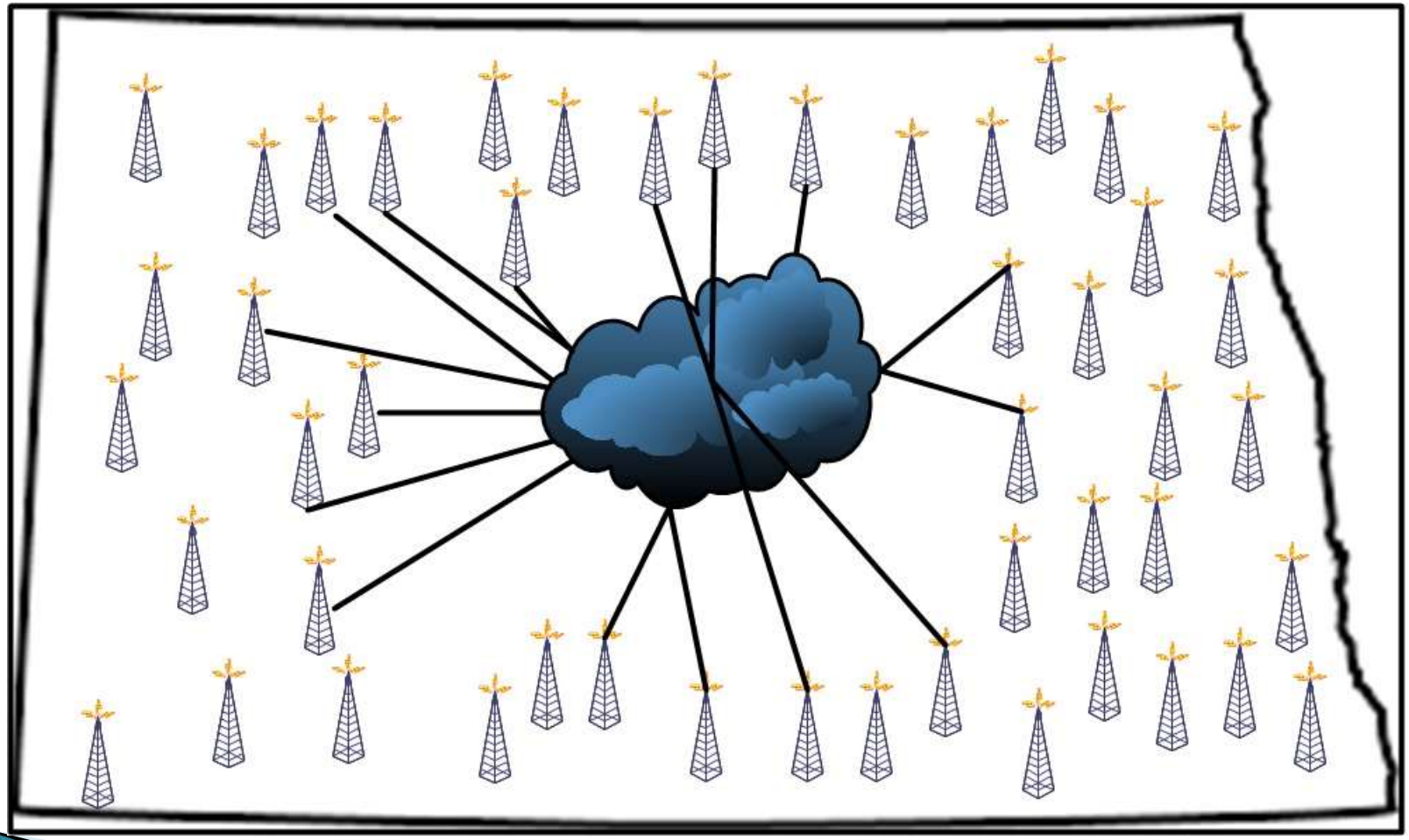
Questions?

NOW TO TIE IT ALL TOGETHER!

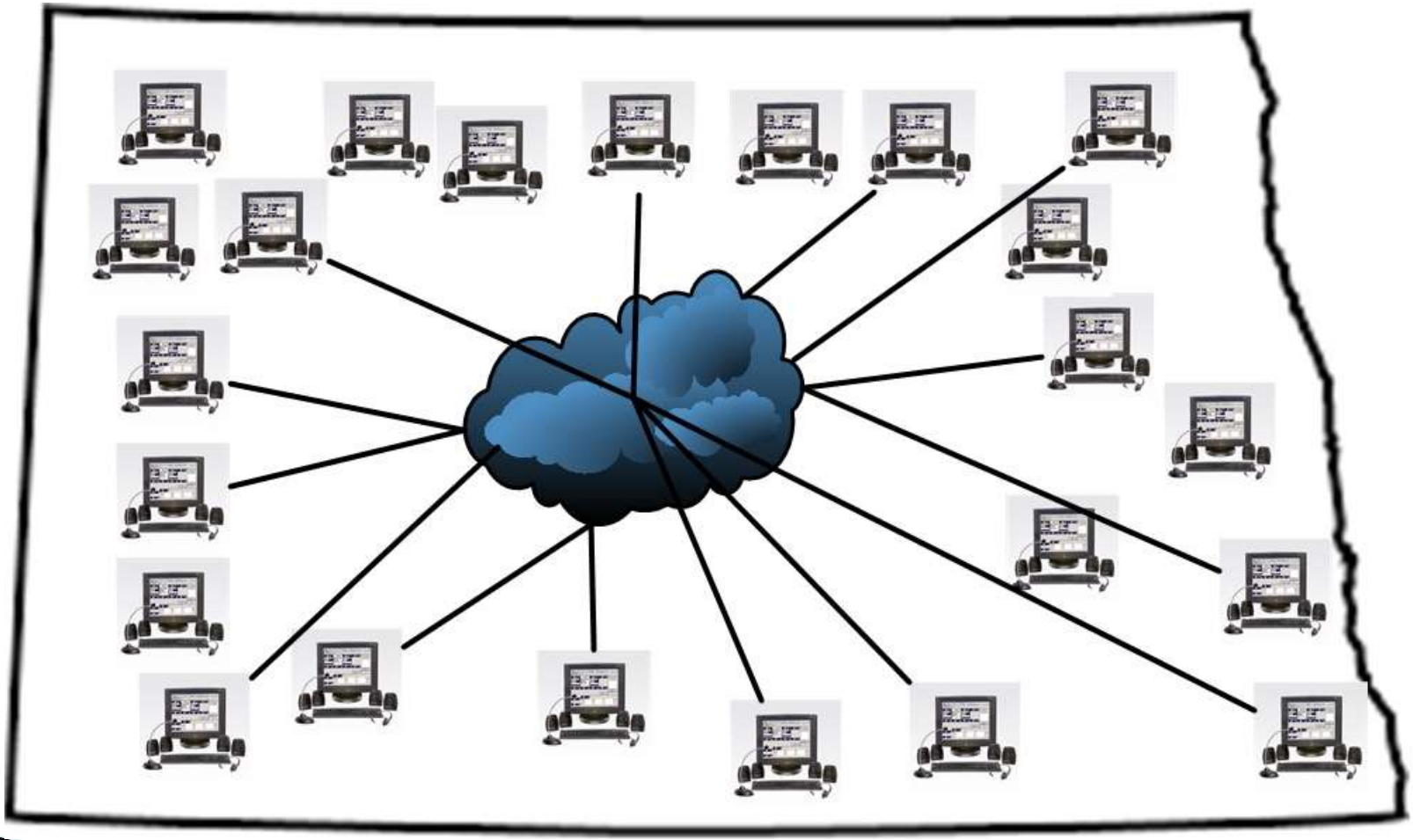
Wide Area Trunking- Is a Communications Network!



Wide Area Trunking–Cont.



Wide Area Trunking–Cont.



Wide Area Trunking–Cont.

- But I don't need to talk across the state!
  - Might be because you never had the capability?
- My current radio channels aren't busy!
  - You are also leveraging the capabilities of network
  - The system allows for scalability of talkgroups
    - Talkgroup operational footprint is configurable
    - Agency, Local/County, Regional, and State/Federal
    - Talkgroup capabilities are established, based upon needs. Guidelines are established by best practices and governance
    - Function of system management and trunked system administration

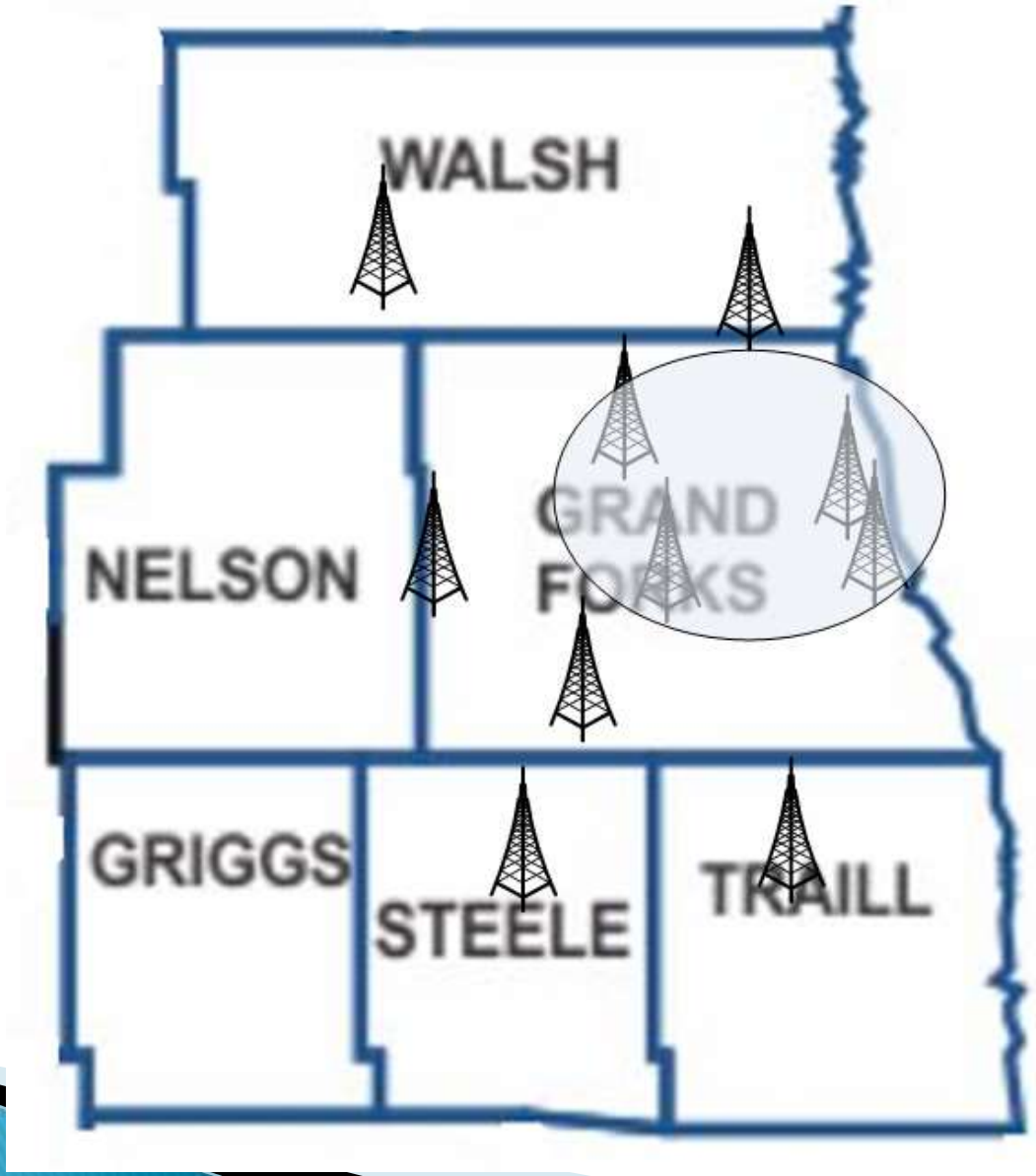
Interoperability

- Talkgroup Planning

Agency-level talkgroups are for your exclusive use unless…you give other agencies permission to use them. For example:

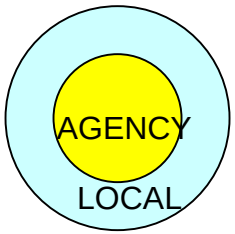
- Police car-to-car talkgroups
- Investigations talkgroups
- Fire fireground talkgroups
- EMS talkgroups
- Public Works talkgroups

EX-Agency Talkgroup



Interoperability

- Talkgroup Planning

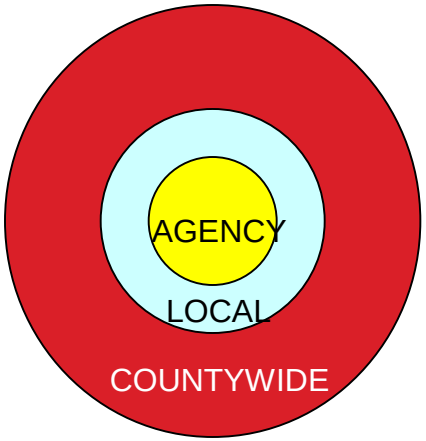


Local-level interoperability talkgroups are those that agencies within your local unit of government create and agree to share. For example:

- County or City-wide Operations talkgroups
- Police / Fire only common talkgroups

Interoperability

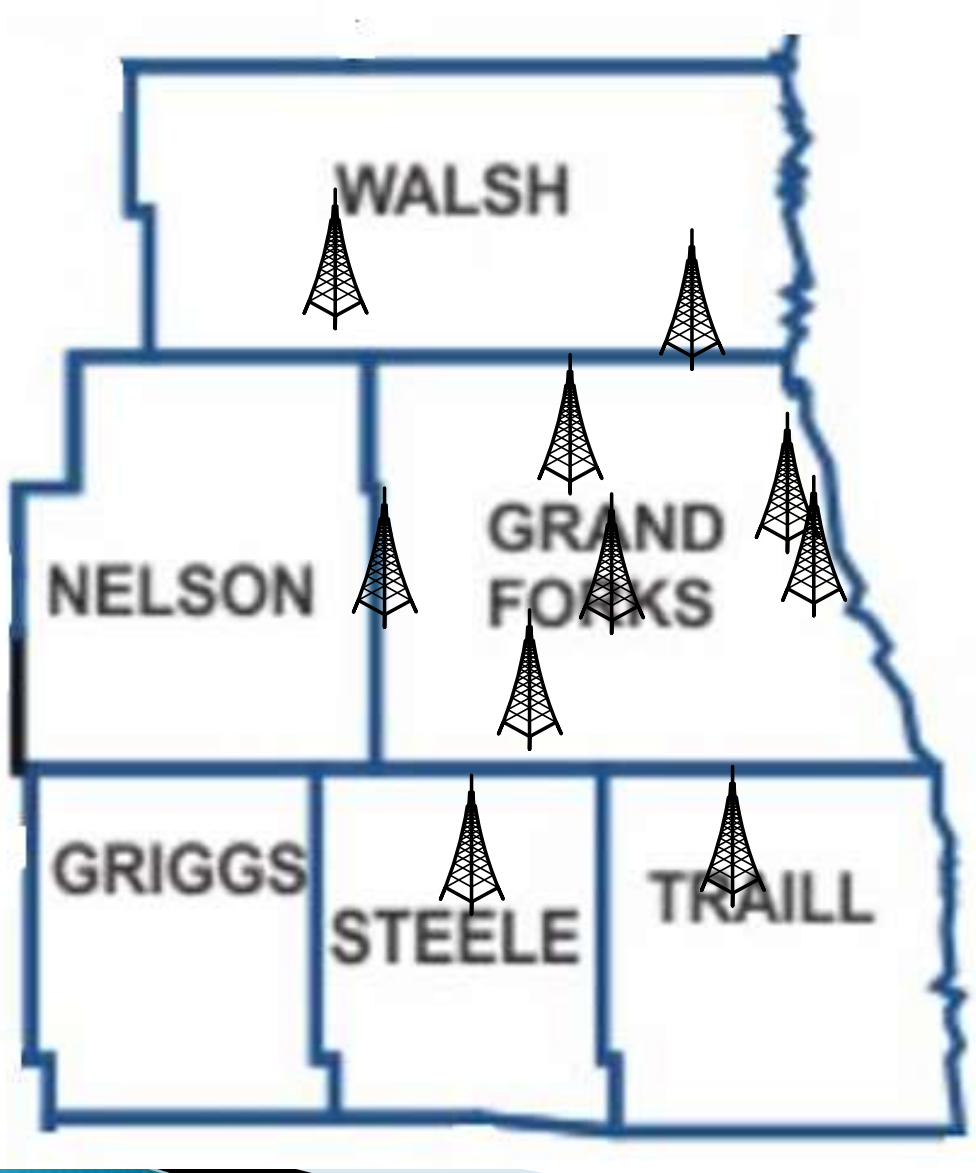
- Talkgroup Planning



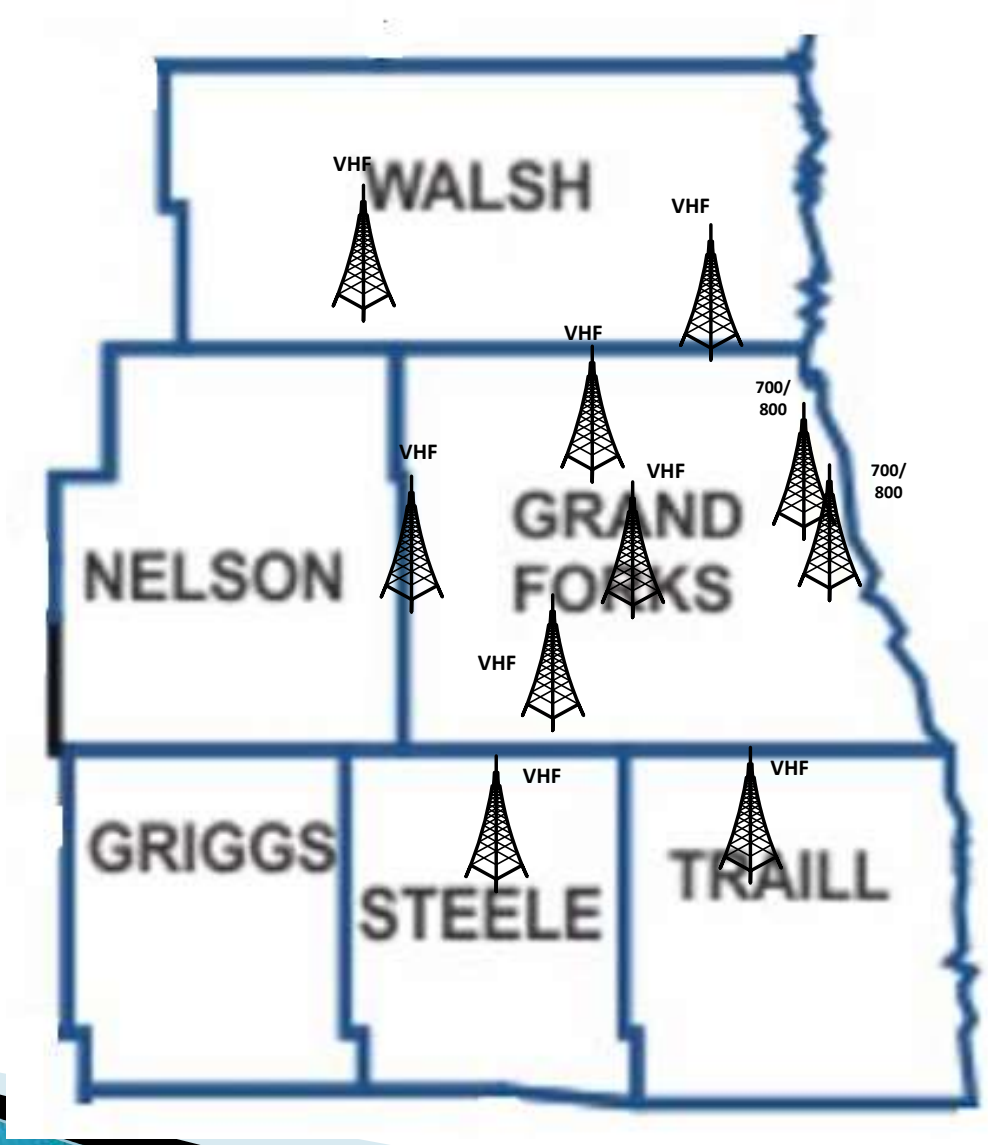
- County-level interoperability talkgroups are those that local agencies within a county use and agree to share. For example:

- County-wide Sheriff / Law enforcement mutual aid tactical talkgroups
- Countywide fire mutual aid tactical talkgroups
- Countywide all user common talkgroups

EX-Local/County Talkgroup

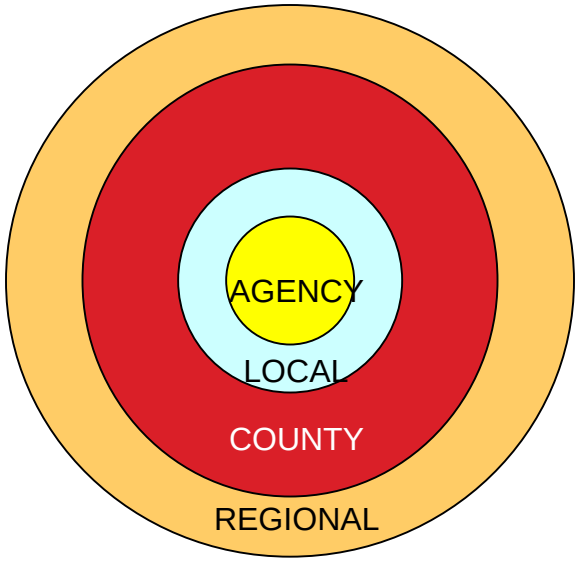


EX-Local/County TG-Dual Freq Band



Interoperability

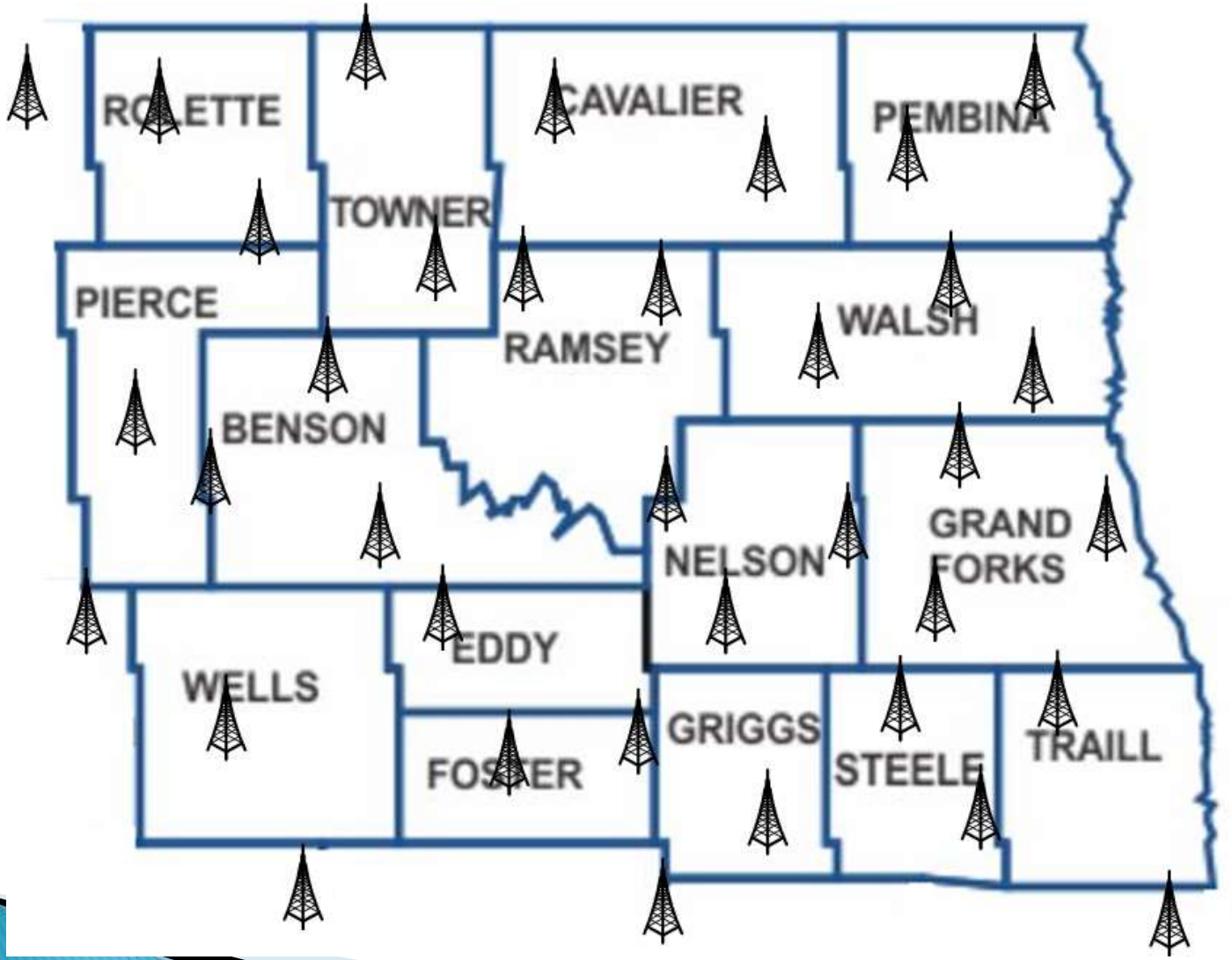
- Talkgroup Planning



Regional-level interoperability talkgroups could be established for wider area operations or agencies. EX ND Highway Patrol District, HAZMAT, SWAT, Regional Ambulance, Multi County Dispatch

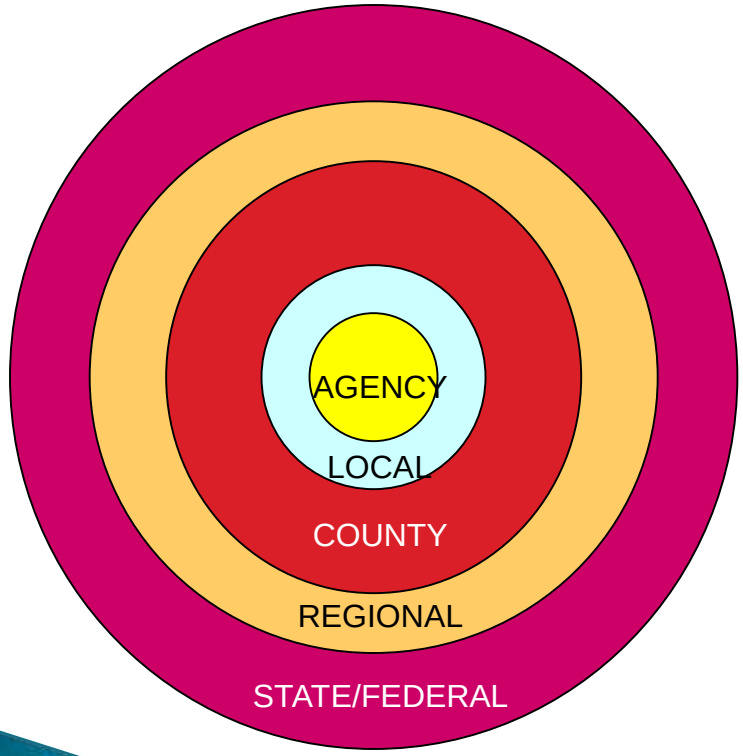
Other example- A regional law talkgroup could be established for State Radio dispatch where a dispatcher could give out a single BOLO to all 22 counties they serve, with one single PTT (Multigroup)

Regional Talkgroup



Interoperability

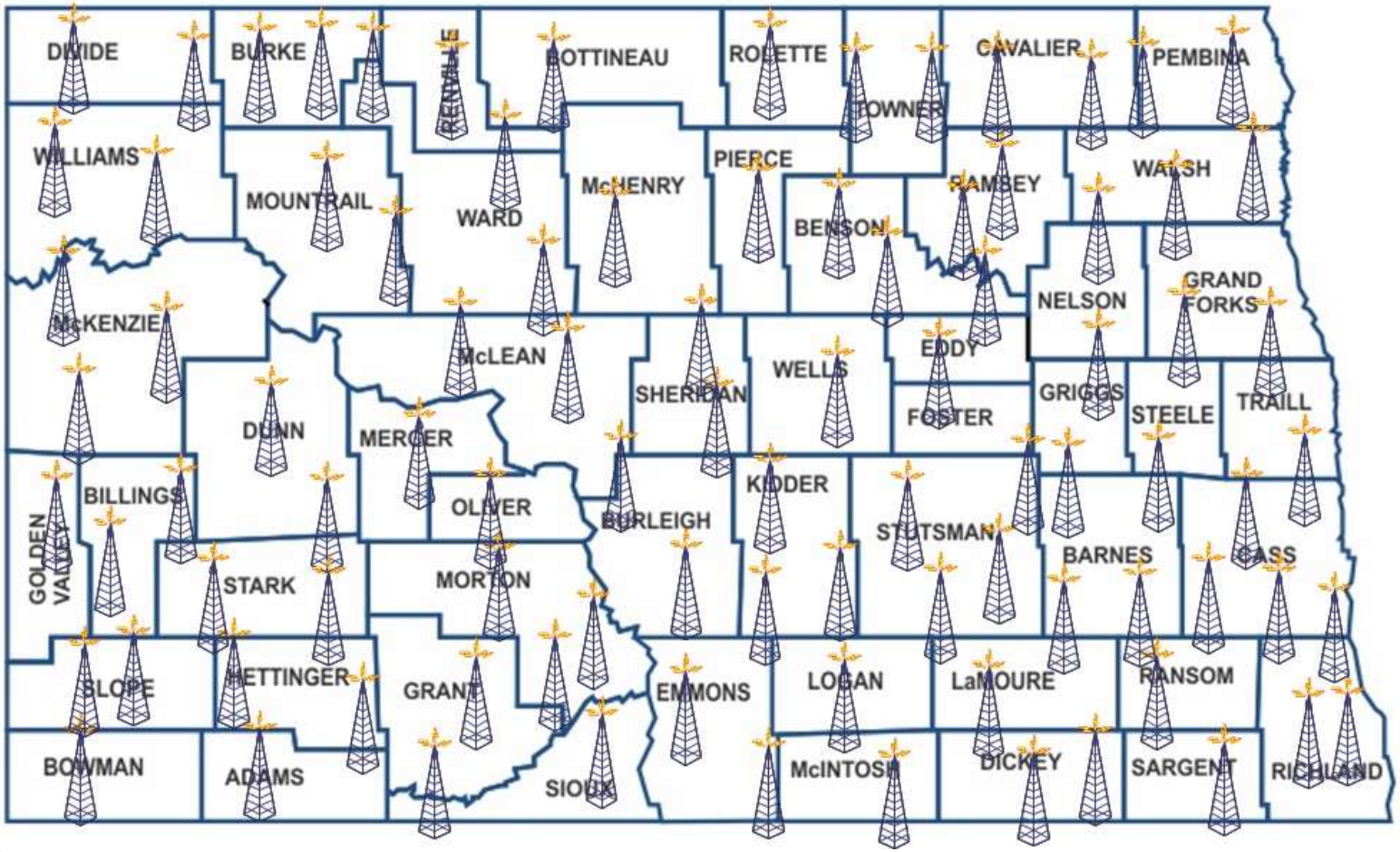
- Talkgroup Planning



Statewide Communications will involve a mix of wide area trunking talkgroups and National Interoperability Conventional channels- VHF and 800 MHZ

Why statewide talkgroup?
- Interoperability
- Functionality- (Pursuit)
- User Needs (EX BCI, HAZMAT, Emergency Manager,Incident Command, etc)

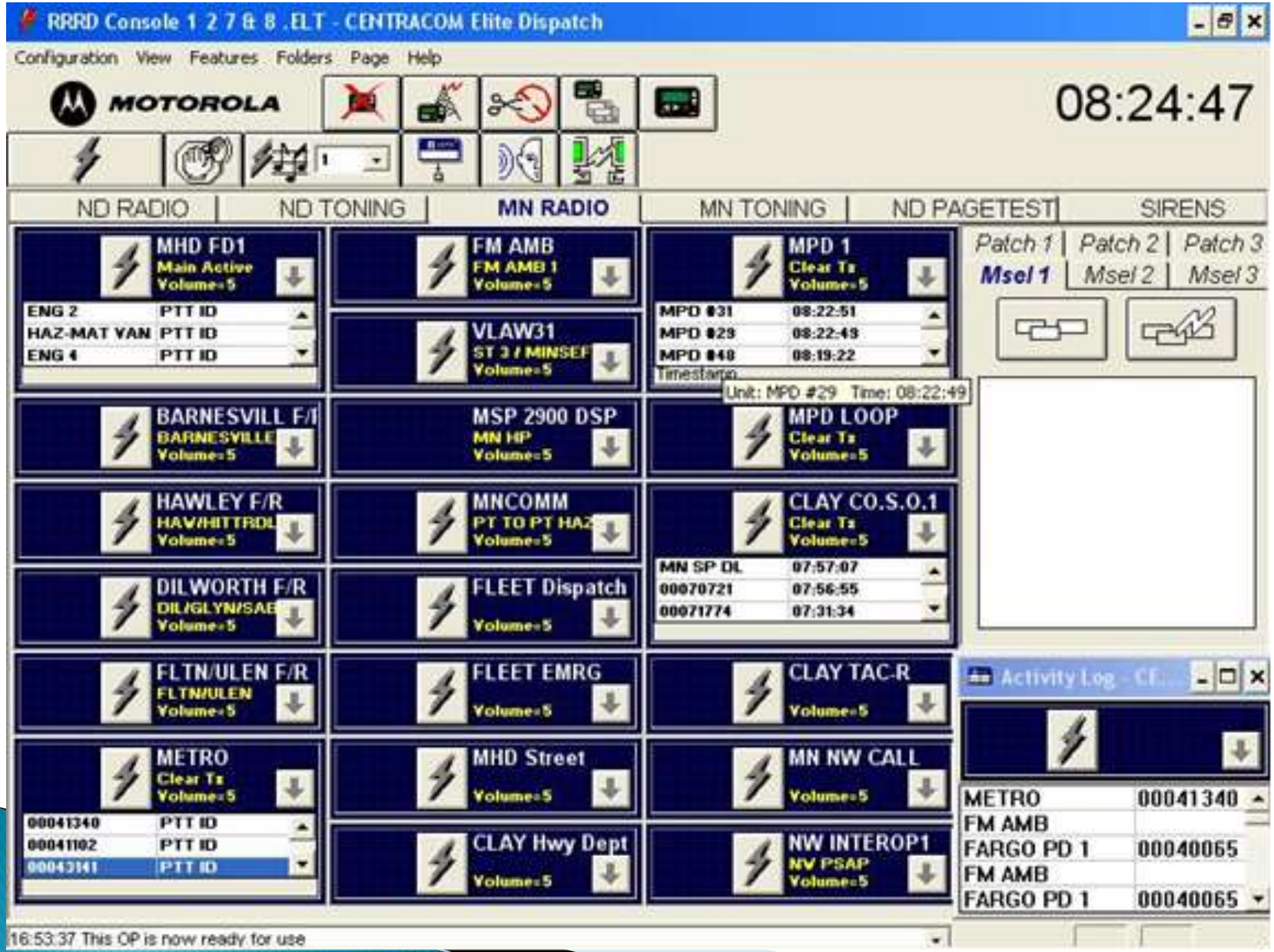
Statewide Talkgroup



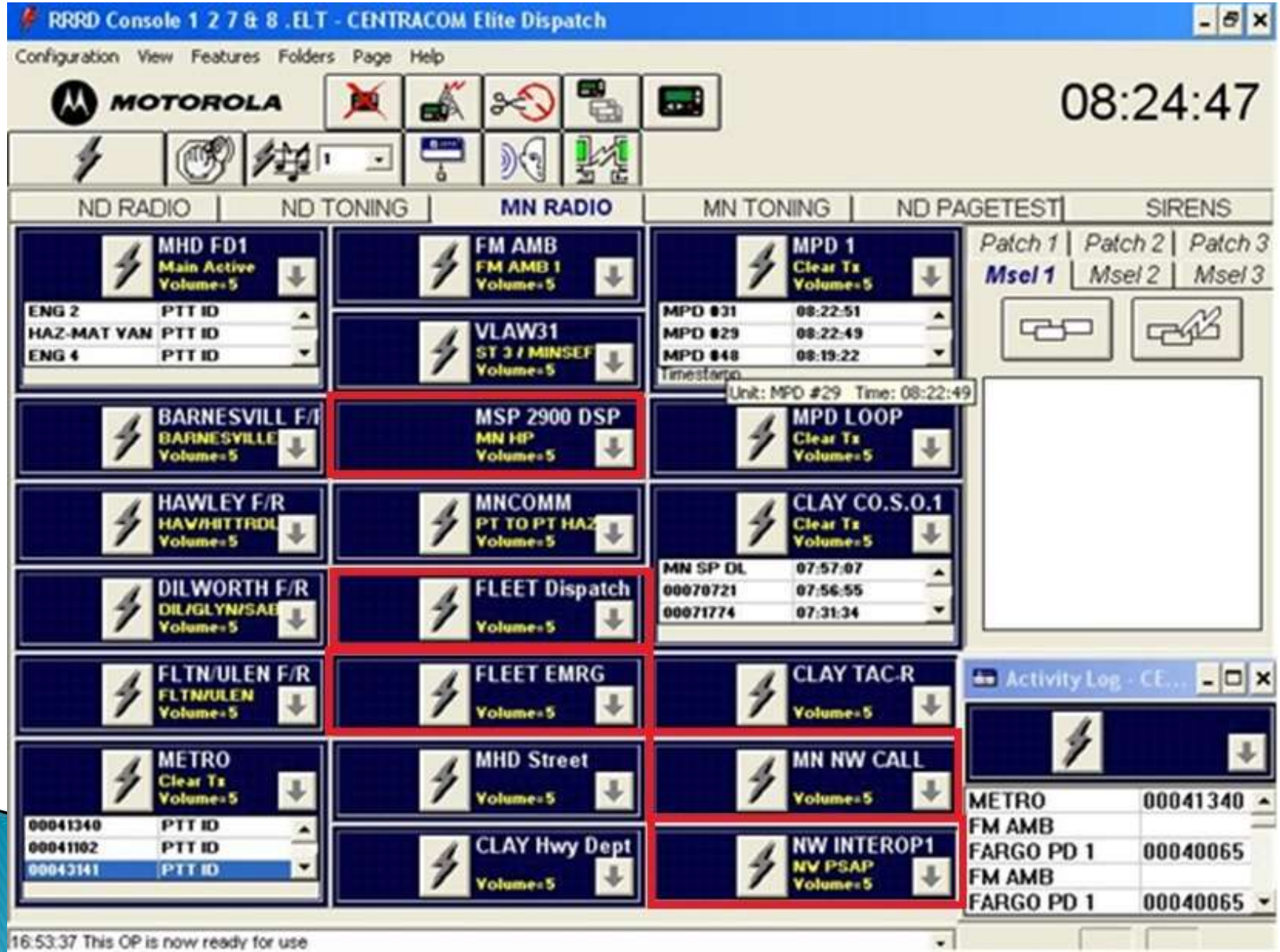
Trunking in a PSAP

- What is different?
  - Talk permit tone
  - Any features/options previously mentioned
    - Examples (Conventional systems has some capability)
      - Patching
      - Radio ID
      - Radio Inhibit
      - Call Alert
      - Emergency
      - Encryption
        - End to End
      - Multigroup

Trunking- Dispatch



Trunking Dispatch



Why are we here talking about trunking?

Why now?

- Issues are Varied, depending upon system
- Equipment End of life Issues (End of factory support)
  - December 31, 2018
  - Many mobiles, portables, base/repeaters, comparators
  - Dispatch consoles (13 out of 22 ND PSAP's)
- Deficiencies in day to day communications
  - Silo Systems (System Duplication)
  - Coverage issues
  - Lack of wide area communications capabilities
    - Lack of scalability
- Interoperability
  - Lack of wide area capabilities

SIRN 20/20

- SIRN- Statewide Interoperability Radio Network
- SIRN 20/20 Oversight by SIEC
- SIEC-Statewide Interoperability Executive Committee- Membership
  - •North Dakota 911 Association
  - •North Dakota Adjutant General
  - •North Dakota Department of Emergency Services, State Radio Director's Office
  - •North Dakota Department of Emergency Services, Division of Homeland Security
  - •North Dakota Department of Transportation
  - •North Dakota Emergency Managers Association
  - •North Dakota Emergency Medical Services Association
  - •North Dakota Fire Chiefs Association (Current Vice Chair)
  - •North Dakota Highway Patrol
  - •North Dakota Chief Information Officer/Information Technology Department (Current Chair)
  - •North Dakota Police Chiefs Association
  - •North Dakota Peace Officers Association
  - North Dakota Sheriff's and Deputies Association

SIRN 20/20
What is it?

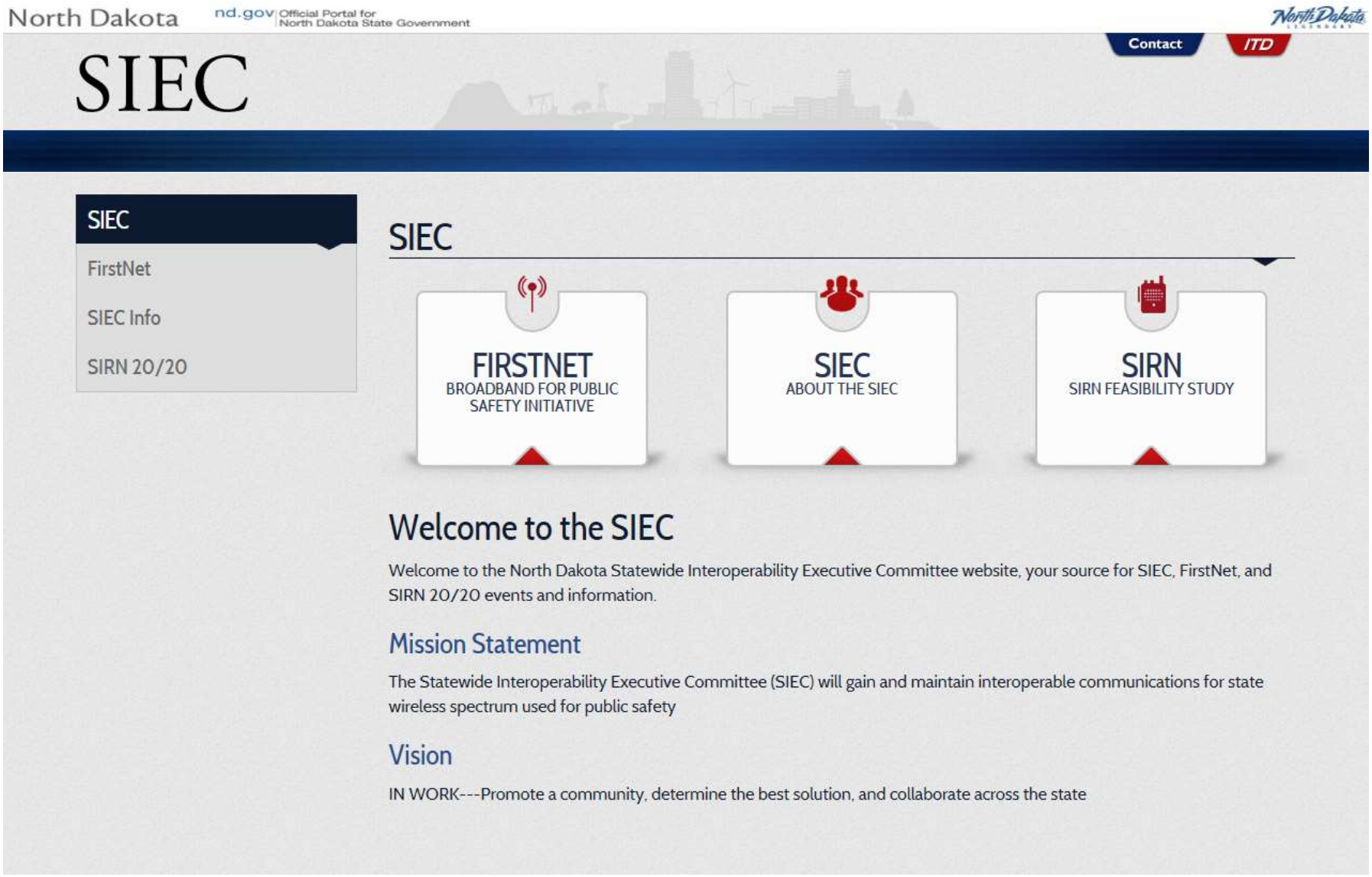
- Background
  - 2014- Exploratory study to identify/clarify issues with public safety communications
    - Study results in late 2014 recommended a statewide trunked network
  - Early 2015 study results presented to 64th Legislature for funding
    - Project was not funded but legislature directs ITD to conduct a feasibility study
  - Present- SIEC/ITD currently conducting study to assess feasibility and desirability of interoperable communications across ND

SIRN 20/20
Cont.

- Study-
- Hiring professionals to get the work done
- Initiating work with SIEC-representative organizations
- Initiating effort to work with other public safety offices
- Establishing a team of subject matter experts to assist in facilitating outreach into public safety communities
- Define the mission

SIRN 20/20

- What is necessary?
- How do we do this?
- How do we govern solution effectively?
- How do we pay for it?



https://www.nd.gov/itd/statewide-alliances/siec/sirn-2020

SIRN 20/20

UPDATED! January 2016 Newsletter and Study Overview is now available on the Resource Page

What is the Statewide Interoperable Radio Network (SIRN- pronounced siren) 20/20 Study?

SIRN 20/20 is a statewide initiative to study and recommend a consensus solution for delivering, integrating, and supporting mission critical interoperable radios systems, and training for first responders and the public safety community. Based on the results of an initial 2014 study sponsored by first responder associations in the state, the North Dakota Legislature approved funds to determine the best solution. Led by the SIEC and managed by the North Dakota Information Technology Department, the public safety community is conducting research to assess, measure, and determine what we need. As part of the study, we will measure how best to acquire and integrate this new, and vital tool in the public safety community across local, tribal, and state public safety offices.

Why now?

North Dakota first responders have outstandingly continued to provide a safe environment for the State. Unfortunately, the initial study has indicated that the current approach to how we utilize land mobile radios has its limits. In order to continually improve service to the public and effectively work together in delivering fire, rescue, law enforcement and aid across the State, we need to determine when and how to transition to an interoperable solution that ensures responders have the means to assist each other and the people of North Dakota regardless of their state, local, or tribal affiliation.

No matter what the outcome of the study is, available radio technology and options on how to train and prepare the public safety community on how to use them has never been better in North Dakota. Finally, responders have an integrated advocacy group in the SIEC to assist with organizing and implementing a statewide and inclusive approach benefiting everyone.

"The Initiative to capture radio and dispatch challenges across North Dakota in 2014 clarified our understanding so that we can benefit from a statewide interoperable radio network. The SIEC is working to find a solution we can all support."
-Mike Ressler, SIEC Chair

Mission:

Work collaboratively to build consensus and determine feasibility of a public safety radio solution including a strategic plan for procurement, implementation, and operation of an interoperable current generation statewide radio and dispatch system.

Vision:

A statewide integrated and interoperable mission critical land mobile radio (LMR) network solution assisting public safety personnel in their ability to communicate effectively and reliably while carrying out their duties

Goals:

- Frame a fiscally responsible solution for implementing statewide, interoperable, radio communications
- Define and establish a representative governing organization that considers and incorporates the views of all stakeholders as appropriate
- Provide a model that enables all stakeholders to gain and maintain access to resources, training, and systems based on their need
- Define the basis for the continued and collaborative resourced support of an operational, statewide solution

ND SIRN 20/20

A statewide integrated radio and dispatch network vision for North Dakota...

"The Initiative to capture radio and dispatch challenges across North Dakota in 2014 clarified our understanding that we can benefit from a statewide interoperable radio network. The SIEC is working to find a solution we can all support."

Mike Ressler, SIEC Chair

"...130 law enforcement agencies, 175 public and private EMS departments, 22 dispatch centers, and nearly 400 fire departments, operational across 53 counties, Tribal nations, and the State..."

ND Statewide Radio Systems Assessment and Evolution Study, 2014

Public safety professionals and leaders throughout the state are important to framing the answer

We need your help to...

...capture options State, County, Municipal, and Tribal public safety stakeholders have to implement public safety communications systems statewide, compliant with the P25 standard

...build support at the State, County, Municipal, and Tribal level

....define an approach to management of an integrated public safety communications solution

...develop a funding strategy for implementation

...determine value...

...lead a solution...

SIRN 20/20 SUPPORTERS

- North Dakota Statewide Interoperability Executive Committee
- North Dakota 911 Association: STEPS Subcommittee
- North Dakota Fire Chief's Association
- North Dakota Association of Public Safety Communications Officials
- North Dakota Highway Patrol
- North Dakota Department of Emergency Services
- North Dakota Information Technology Department
- North Dakota Department of Transportation
- North Dakota Peace Officers Association
- North Dakota Emergency Management Association
- North Dakota Sheriff's and Deputies Association
- North Dakota EMS Association
- Emergency Services Communications Coordinating Committee

...Promote a community for the next level of interoperability...

...by determining the best solution and collaborating across state agencies, counties, municipalities, and tribal entities for the North Dakota way forward

Produced by the Statewide Interoperability Executive Committee

DONE!

Discussion
&
Questions