### An overview covering

Olmsted County and the Minnesota ARMER project

Robert Andrews robert@robertandrews.com

January 2010

Rochester Amateur Radio Club http://www.rarchams.org





# AGENDA

- Conventional Radio Systems
- Trunked Radio Systems
- Digital trunked Radio Systems
- ARMER
- Olmsted County's use of ARMER
- Equipment for Monitoring
- References

### **CONVENTIONAL RADIO**

- In conventional (traditional) radio communications, a single frequency or channel is used to send and receive information
- In Amateur Radio terms, SIMPLEX
- Each radio must have enough power to reach to the other radios and vice versa

"Point to point" communications

Uses one frequency total

### REPEATERS

- To increase the range of Simplex communications, a repeater may be used
- Receives signal on one frequency and broadcasts on a second frequency
- Each radio only needs to reach the repeater thereby extending the range
- Uses two frequencies total

# **USES OF FREQUENCIES**

- Assume you have several groups of users and each group should only receive that group's traffic
- Therefore, each group needs its own simplex frequency or repeater system
- Requires lots of frequencies and equipment
- Often channel is silent
- Very inefficient use of resources

# TRUNKED RADIO

- Rather than using one or two set frequencies, a pool of channels is setup
- Frequencies from this pool are shared amongst several groups of users
- Each group of users is assigned a "Talkgroup" identity
- One frequency is designated as the "Control Channel"
- The rest of the frequencies are "Communication Channels"

# TALKGROUPS

- Each group of users is considered a Talkgroup
- Each transmission on a trunked radio system includes an embedded Talkgroup identifier
- Equipment is setup to only receive communications for particular Talkgroups
- Talkgroups become the separator instead of frequencies

### **CONTROL CHANNEL**

- The Control Channel provides a signal that works like a traffic cop
- Temporarily allocates one of the available Communication Channels (frequencies) from the pool to a particular Talkgroup
- Radios constantly monitor the Control Channel for traffic in their Talkgroup
- When desired traffic is found, the Control Channel tells the radio which Communication Channel from the pool to switch to
- Control Channel is always a digital signal

### TRAFFIC TRANSMISSION

 The actual traffic flows over one of the Communication Channels from the pool

 No communications are carried on the Control Channel, only allocation commands

- When the traffic is concluded, the frequency is released back to the pool
- This means a question and response may actually go over different Communication Channels
- Radio handles frequency switch based on data from the Control Channel

### **MULTIPLE "CHANNELS"**

- Radios can have multiple "channels"
- Rather than changing the frequency monitored, they change the Talkgroup that is monitored for on the Control Channel
- To the end user, the underlying technology should not make a difference in the experience

### **TRUNKED RADIO SYSTEMS**

- Since radios need to understand the various Control Channel commands, all radios in a trunked radio system need to use the same protocol
- Popular trunked radio systems include:
  - Ericsson GE (GE Mark V)
  - Motorola (Type I and Type II)
  - Logic trunked Radio (LTR Standard and LTR Passport)
  - APCO (APCO-16)
  - TETRA (TETRA)

### ADVANTAGES TO TRUNKED RADIO

- Since there is often dead air, a "one frequency to one group" approach is extremely wasteful to bandwidth and hardware
- By sharing a pool of frequencies and hardware, many more groups are able to share a smaller group of resources

### ADVANTAGES TO TRUNKED RADIO

- For example, assume a 10 frequency pool
  - 1 Control Channel
  - 9 Communication Channels
  - Can maintain 9 distinct communications at all times
  - 10 frequencies/channels can easily support upwards of 50 to 100 Talkgroups
    - Depends on the transmission to silence ratio

# DIGITAL TRUNKED SYSTEMS

- While the Control Channel is always digital, the Communication Channel may be analog or digital
- In a Digital trunked System, all channels are digital
- Results in much cleaner audio fidelity
- Smaller bandwidth per frequency
   25 KHz to 12.5 KHz to 6.25 KHz
- Allows sensitive Talkgroup's traffic to be encrypted

## DIGITAL TRUNKED SYSTEMS

- Popular digital trunked radio systems include:
  - Ericsson GE (EDACS)
  - Motorola (Type II SmartZone)
  - APCO (APCO-25)
  - TETRA (TETRAPOL)

# "CALLER ID"

- Each radio is digitally tagged with its user ("John Smith") or tactical use ("Engine 123")
- This tag is included with each transmission
- Receiving radios display this tag to show who is transmitting
- Can also be recorded by central repeaters for easy logging

## ARMER

- State of Minnesota created the Allied Radio Matrix for Emergency Response (ARMER) system in 2002
- Response to 9-11 events
- 800 MHz digital trunked radio system using APCO-25 protocol
- State of Minnesota wants all counties to switch to a compatible system

 State provides half of the funding for conversion into ARMER

# **STATE PLAN**



### **ARMER AS OF APRIL 2009**

### **ARMER Backbone Sites**



### ARMER AS OF 2010 ARMER Backbone Sites

On The Air In 2010



## OLMSTED COUNTY

- Olmsted County has migrated to ARMER
- Simulcast particular key Talkgroups on conventional frequencies

- Talkgroup 20502 simulcast on 155.490

 Particular tactical Talkgroups are encrypted

# **OLMSTED COUNTY TOWERS**

- Olmsted County has 5 towers for coverage
  - Guggenheim Building
  - New Haven
  - Pleasant Grove
  - Rock Dell
  - Viola



# **OLMSTED FREQUENCIES**

- 851.05000
- 851.15000
- 851.23750
- 851.30000
- 851.53750
- 853.26250
- 853.51250
- 853.61250 Control Channel
- 853.77500
- 857.48750
- 858.48750

# **OLMSTED TALKGROUP LIST**

### Olmsted County - Sherrif Talkgroups >

DEC	HEX	Mode	Alpha Tag	Description	Tag
20456	4fe8	D	OLMS LEC 2	LEC 2 Back-Up (alternately used with 20502)	Law Dispatch
20502	5016	D	OLMS LEC 2	LEC 2 (Simulcast of 155.4900)	Law Dispatch
20506	501a	D	OLMS LEC 1	LEC 1 (simulcast of 155.5800)	Law Dispatch
20514	5022	D	OLMS SO INV	Sheriff - Invesigations	Law Talk
20520	5028	D	OLMS SO PARK	Park Patrol	Law Talk
20534	5036	D	OLMS SO C2C	Sheriff Tactical Car to Car	Law Talk
20536	5038	D	OLMS SO BAIL	Court Baliffs	Law Talk
20540	503c	D	OLMS SO TAC4	Sheriff - Tactical 4	Law Tac
20542	503e	D	OLMS SO TAC5	Sheriff - Tactical 5	Law Tac
20544	5040	D	OLMS SO TAC6	Sheriff - Tactical 6	Law Tac
20546	5042	D	OLMS SO TAC7	Sheriff - Tactical 7	Law Tac
20560	5050	D	OLMS SO EOC	Emergency Operations Center	Emergency Ops
20562	5052	D	OLMS EOCTAC1	EOC Tactical 1	Emergency Ops
20564	5054	D	OLMS EOCTAC1	EOC Tactical 2	Emergency Ops
20566	5056	D	OLMS SO JAIL	Jail	Corrections
20578	5062	D	OLMS SO JAIL	Jail	Corrections
20580	5064	D	OLMS SO JAIL	Jail	Corrections

#### Olmsted County - Fire Talkgroups 🕨

DEC	HEX	Mode	Alpha Tag	Description	Tag
20494	500e	D	OLMS FIRE	County Fire	Fire-Talk
20496	5010	D	BYRON FIRE	Byron Fire	Fire-Talk
20498	5012	D	ORONOCO FIRE	Oronoco Fire	Fire-Talk
20024	4e38	D	MSP 2100 DSP	Rochester Dispatch "2100"	Law Dispatch
20026	4e3a	D	MSP 2100 C2C	Rochester Car to Car	Law Tac

# **OLMSTED TALKGROUP LIST**

### Olmsted County - Rochester Talkgroups >

DEC	HEX	Mode	Alpha Tag	Description	Tag
20466	4ff2	D	RCH PD C2C	Police Tactical Car to Car	Law Talk
20472	4ff8	D	RCH FIRE 2	Rochester Fire Department Ch. 2	Fire-Tac
20476	4ffc	D	RCH FIRE DI	Rochester Fire Dispatch (154.370)	Fire Dispatch
20478	4ffe	D	RCH FIRE T 1	Fire Tac 1	Fire-Talk
20480	5000	D	RCH FIRE T 2	Fire Tac 2	Fire-Talk
20482	5002	D	RCH FIRE T 3	Fire Tac 3	Fire-Talk
20484	5004	D	RCH FIRE T 4	Fire Tac 4	Fire-Talk
20492	500c	D	RCH FIRE MYO	Fire - Mayo Clinic Incidents	Fire-Talk
20526	502e	D	ROCH PD C2C	Police Car to Car	Law Talk

### Olmsted County - EMS Talkgroups 🕨

DEC	HEX	Mode	Alpha Tag	Description	Tag
20434	4fd2	D	MEDUPDATE	Gold Cross Ambulance Dispatch - Rochester (simulcast of 155.2800)	Multi-Talk
20598	5076	D	OLMS EMS	Rochester Methodist Hospital	Hospital
21608	5468	D	GCROSS C2C	Gold Cross - Rochester - Car to Car	EMS-Talk
21610	546a	D	GCROSS DISP	Gold Cross - Rochester - Dispatch	EMS Dispatch
21612	546c	D	GCROSS INFO	Gold Cross - Rochester - Info	EMS-Talk
21614	546e	D	GCROSS STMRY	Gold Cross - Rochester - Saint Marys	EMS Dispatch
21616	5470	D	OLMS MED CTR	Olmsted Medical Center	Hospital
21618	5472	D	ST MARYS HSP	Saint Marys Hospital - Rochester	Hospital

#### Olmsted County - Airport Fire Talkgroups >

DEC	HEX	Mode	Alpha Tag	Description	Tag
20440	4fd8	D	RCH APT FIRE	Airport Fire Tactical	Fire-Tac
20448	4fe0	D	RCH APT FIRE	Airport Fire Dispatch	Fire Dispatch
794	31a	D	DNR MAIN ROH	Rochester Enforcement Main	Law Tac
20052	4e54	D	DOT DIST 6	District 6 (Rochester/Owatonna) Snowplows	Public Works

# EQUIPMENT TO MONITOR

- Traditional scanners and extended receive amateur radios are limited to conventional frequencies
- There are both Analog trunked Scanners and Digital trunked Scanners
- To monitor ARMER, you need at least a 9600 baud Digital trunked Scanner
- First define the channels in the pool
- Second define the Talkgroups to monitor or Wildcard (all) Talkgroups

# EQUIPMENT TO MONITOR

- Most brands have a handheld and desktop form factor
  - RadioShack PRO-106 and PRO-197
  - GRE PSR-500 and PSR-600
  - Uniden Bearcat BCD396XT and BCD996XT





### **MOBILE SCANNING LAW**

- Minnesota Statue 299C.37 covers use of "Police Communications Equipment"
  - "No person other than peace officers within the state, the members of the State Patrol, and persons who hold an amateur radio license issued by the Federal Communications Commission, shall equip any motor vehicle with any radio equipment or combination of equipment, capable of receiving any radio signal, message, or information from any police emergency frequency, or install, use, or possess the equipment in a motor vehicle without permission from the superintendent of the bureau upon a form prescribed by the superintendent."

# QUESTIONS???

### REFERENCES

- http://en.wikipedia.org/wiki/Conventional\_radio
- http://en.wikipedia.org/wiki/Radio\_repeater
- http://en.wikipedia.org/wiki/Trunked\_radio\_system
- http://en.wikipedia.org/wiki/Talkgroup
- http://en.wikipedia.org/wiki/APCO\_Project\_25
- http://en.wikipedia.org/wiki/ARMER
- http://www.srb.state.mn.us/
- http://www.radioreference.com/apps/db/?sid=350
  8
- http://www.radioreference.com/apps/db/?ctid=13 64
- http://www.scannermaster.com/Digital\_Scanners\_s /269.htm