What is this buzzword and what does it do? GADI enhances the standard features in the Motorola MCC 7500 Dispatch Console that provides a host of options and features to assist the dispatcher in doing their job. The GADI suite provides valuable toolsets in meeting the needs of dispatchers. The GADI suite is broken down into basically three components. These components are the Side Core, River Board and Side Car. Each providing unique features. Here are some of the features:

**Side Core:** Side Core is a separate window that share the MCC 7500 monitor at each of the work stations at Riverside County Sheriff’s Department (RSD). Several features are used on a daily basis by the dispatchers as they dispatch Sheriff units throughout the County. Some of these features are:

- **Unattended emergencies:** There are approximately 127 talk groups within Sheriff's operations. Approximately 50 of these talk groups are actively monitored on the dispatcher’s screens and the remaining are stored in the talk group list. When an emergency is declared from a subscriber on an actively monitored talk group, that emergency is routed to the console(s) that is monitoring that talk group. In the event an emergency is declared on a non-monitored talk group, the Unattended feature of GADI routes these emergencies to pre-defined dispatch consoles within the (3) Sheriff dispatch centers. A dispatcher can then acknowledge this unattended emergency and respond to the subscribers needs. Excellent feature to have.

- **Enhanced local patching:** RSO dispatchers use this feature on a daily basis. Enhanced patching allows the dispatcher to have pre-defined patches set up on their individual radio screen. What this means is if a dispatcher knows he/she will be patching 2 or more talk groups together throughout the course of their shift, they can set the patch up in one of the available patch windows. When the dispatcher is ready to activate the patch, one click of the mouse makes the patch active and the dispatcher is now dispatching the talked patch groups. Oh did I mention, this one click of the mouse patches and multi-selects the talk groups listed in the patch window. If there is a need to set up an emergency on all the patched talk groups, two clicks of the mouse and the emergency is set up on all talk groups associated with the patch. Additionally, you can add or delete talk groups from an existing patch with just two clicks of the mouse. Did I mention, this is an outstanding feature?

- **Active Patch:** Active Patch is a window that allows dispatchers to see where patches are created and active throughout the radio system. The displays shows the console that created patch, talk groups associated with the patch and what time the patch was created. The display also shows history as to when a talk group was removed from a patch, which console removed the patch and the time the resource was removed from the patch.

- **Filtered activity log:** This feature allows the dispatcher to open up a window and view talk group history based on the talk group the dispatcher has selected. The window is sizeable and the dispatcher can place this window anywhere on their screen. This log differs from the MCC 7500 Activity Log in that it dynamically updates and scrolls on each transmission (even if the same subscriber transmits multiple times), shows the time for each transmission, unit designator and even transmissions from other consoles. The activity displayed and window outline is configurable at the system level.
General transmit: This is a button that the dispatcher can depress to make a general transmit on the selected talk group. By far this is the most popular feature of the River Board (RB). We cannot imagine our dispatch center functioning without this feature.

Channel Marker: During times when the talk group is designated for emergency traffic only, the dispatcher can depress one button on the RB and activate the channel marker. When the channel marker is no longer needed, depressing the same button will turn the feature off.

Alert tones: The commonly used alert tones are featured on the RB and the same principle applies that allows the dispatcher to depress and hold the button down for the desired duration of the tone.

Silence, Acknowledge and Knocking down emergencies: Buttons are programmed on the RB to perform these functions. A separate button is also available to set-up an emergency on the selected talk group.

Activate/De-Activate a pre-programmed patch: By depressing the button affiliated with the patch field, you can activate and de-activate a pre-programmed patch.

Several other features on the RB are currently used within the RSO dispatch centers.

The Riverside County Sheriff’s Department’s Dispatch centers view the GADI applications as a welcomed feature that plays an essential role in the dispatcher’s day-to-day duties. The Riverside County Sheriff’s Department looks forward to working with Genesis and Motorola on the development of future features that will further assist the dispatcher in doing their job.
The PSEC radio system is the vital resource between Public Safety Answering Points (PSAPs – aka 9-1-1 Dispatch Centers) and the first responders to those calls for help in Riverside County utilizing Two-Way Radio Voice Communications and a vital component in delivering Public Safety mobile data. It’s all about helping our first responders to keep others safe and to keep them safe. So how does PSEC cover the entire county of Riverside and allow users to instantly talk to one another with the push of a button? There might be a little more behind it all than you think... Let me tell you a story.

Conventional Repeaters

Let’s talk about the call flow through a simple “conventional” radio system that has a repeater. You place your channel selector knob on your mobile radio “A” to channel one and push the button and talk into the microphone. The button turns on the transmitter inside the radio and your voice is modulated onto the radio wave propagating from the portable antenna. The radio wave travels from the antenna in a 360 degree pattern at the speed of light (3.00x10^8 m/s) or approximately 1000 ft. per microsecond – 26.2 Mile Marathon (138336 feet) – No problem 138 microseconds, 862 microseconds left over to make the 26.2 mile distance in one second. The Greeks would not have had to send Pheidippides running to Athens to announce the victory at the Battle of Marathon if they had a decent two way Public safety radio system…

This fantastic speed is what radio engineers use to leverage our quick responses to 9-1-1 calls! Hopefully you have enough signal to be intercepted by a receiving antenna connected to a repeater on a hilltop (keep your battery charged and speak clearly into the microphone or else! – Garbage In – Garbage Out). As the old Public Safety saying goes “You may know where you are and God may know where you are but if your dispatcher does not know where you are we hope you and God are on very good terms.”

Repeaters help with the problem of line of sight in conventional communications. If two radios want to communicate with a hilltop in the way, then there is no line of sight reducing range and building penetration. One way to overcome this is placing a repeater (or base station) at the top of a hill overcoming obstructions and ground “clutter”. PSEC has 75 hilltop locations to cover the County of Riverside. One radio communicates up to the repeater, this is called uplink, and then the repeater repeats that transmission down to the radio on the other side of the hill, this is called downlink. In goes your radio wave to the repeater and then out it goes at the speed of light to portable radio “B”. Voila your message is heard!

Repeaters are used even when there are no hills in the way as they are excellent for extending range (a standalone 300 foot tower at the Line site overlooking the Salton Sea for example). A repeater is an extremely powerful radio. Portable radios work in two to five watts, mobile radios work in 25 watts or even more powerful radios in the 50 to 100 watt range. High gain antennas also push the radio wave out further.

Repeaters are generally in fixed positions at particular geographical locations. In the PSEC system they are located in a variety of cinder block, pre-fabricated and other leased buildings. They have a cable connection to antenna systems, which are either mounted on steel towers or simply fixed to the top of the building. Mobile radios and portables can take advantage of the greater power available in the larger size of the antennas. A collection of repeaters can be connected together provide mobile portable radio users coverage over an extremely wide area, thus extending the range of communications. If they are tied together by microwave and transmit over the same frequencies at the same time so every radio in the area can hear a transmission. That is the miracle called a “Simulcast Radio System”.

A25 ARCHITECTURE CONVENTIONAL, SIMULCAST, TRUNKING, ROAMING, LOGICAL CELLS, A25 SITES, CHANNELS AND FREQUENCIES – OH MY!
Voting Comparators

But what happens if you have more than one hilltop site on the same frequency and the portable radio hits more than one hilltop repeater receiver? Which one do you rebroadcast? Which one is the best? In that case the audio is fed into “voting comparators.” The audio (or in advanced systems digitized voice data streams) from each of the receivers is brought back to a central point, then fed into a voter comparator. The voter comparator in analog systems looks at the noise content (spectral content from 2200 to 3000Hz) of the different audio inputs and selects the best input, then passes this voted audio on to the dispatcher and also repeat the audio to the hilltop repeaters. This way the best received signal is always the one rebroadcast to all of the other users. The PSEC system is digital and the voting comparator in our system looks at the signal with the best Bit Error Rate (BER). This signal is then rebroadcast to all other radios tuned into the target channel.

So now that we have pushed our button, talked clearly into the microphone, hit several hilltop repeaters and our best signal has been voted let’s rebroadcast using Simulcast technology.

Simulcast radio systems

Simulcast radio systems provide:

- Wide geographic coverage area with a uniform frequency plan
- Improved coverage in otherwise "dead spots"
- Improved building penetration for portables
- Frequency efficiency by reuse
- Compatibility with old analog and new digital radio systems
- Simplicity of operation for dispatchers

Public safety agencies across the United States (police, fire, bus, rail, and emergency) rely on seamless wide area radio communications coverage to effectively perform their daily tasks. Typically a jurisdiction will need to serve several hundred square miles or more with a handful of radio channels. A dispatcher may need to reach anyone in the serving area. But engineering wide area radio coverage with limited radio spectrum and limited number of radio channels is not easy. Generally many transmitter / receiver sites are required to get the widest possible coverage for mobiles and portables, for improved voice and data quality, and for better building penetration.

Cellular vs. Simulcast

Cellular systems use many small cells, small towers, and reuse frequencies in non-adjacent cells to achieve wide area coverage. This requires that individual radios be able to switch frequencies and the radio system be able to "handoff" from one base station to a neighboring base station as the radio user roams from one cell to the next.

This level of complexity is not always affordable or readily available to the public safety band or as utilized in the PSEC system a hybrid does the job. To achieve wide area radio coverage, public safety agencies divide the problem into two - "talk out coverage" and "talk in coverage".

- "Talk out" coverage - is communications from a dispatcher to field personnel, or also called downlink coverage. Many solutions exist to achieve the widest possible "talk out" coverage, including
  - Employing multiple transmitter sites
  - Increasing transmitter power if FCC allows
  - Raising the transmitting antenna height, or tower height, if FAA allows
  - Directing the antenna patterns optimally

- "Talk in" coverage - is communications from a dispatcher to field personnel, or also called uplink coverage. Possibilities for improving coverage here include:
  - Multiple receiver sites with central “voting receivers”
  - Pre-amplifiers at the top of a tower to boost the signal from low power portables.
  - Vehicular repeaters for portable talk-around coverage (PSEC does not use this technology because there are enough sites to cover almost the entire County)

  • Employing transmitter steering - the dispatcher (manual) selects the best transmitter site or the system selects it (automatic) - only one transmitter operating at a time
  • Employing multicast transmission - transmission on multiple frequencies from multiple sites; requires additional frequencies and may require radio users to constantly change frequencies (PSEC does not utilize this strategy because it is too complex for the user to make those decisions in pressure moments).
  • Employing simulcast transmission (discussed further below)
  • "Talk in" coverage - is communications from field personnel to dispatchers, or also called uplink coverage. Possibilities for improving coverage here include:
    - Multiple receiver sites with central “voting receivers”
    - Pre-amplifiers at the top of a tower to boost the signal from low power portables.
    - Vehicular repeaters for portable talk-around coverage (PSEC does not use this technology because there are enough sites to cover almost the entire County)
Simulcast Transmissions – The Elegant Radio Engineering Solution

“Talk-out” coverage can be greatly improved by simulcast transmission. Simulcast is the concatenation of two words “simultaneous” and “broadcast”. It is the simultaneous transmission of audio on the same frequency from two or more sites. Wide area coverage is possible with multiple transmitters. Normally if two or more transmitters were to transmit the same signal, a receiver in the field would “lock” or “capture” the stronger of the signals. If the signals are within ± 10 dB of each other, the signals either constructively or destructively combine in the receiver. To ensure that they “constructively” add together requires complex “synchronizing” transmitter equipment such that the signals are transmitted at exactly the same time (within microseconds) of each other. The most important parameters that must be precisely matched among the transmitters are:

- RF carrier frequency to within a 1 Hz
- Audio phase to within 10 degrees
- Amplitude response to within 0.1 dB
- Audio delay to within 10 microseconds

Matching parameters requires digital transmission of voice to the transmitting site, delay compensating equipment at the transmitting sites, and very accurate timing references at each of the transmitter sites. Digital transmission is commonplace these days with T1, E1, digital microwave radio, and fiber widely available. Delay compensation equipment is required to compensate for the delay variation between the dispatcher and the various transmitter sites. Digital transmission also makes this relatively easy. When delay compensation is combined with GPS, then delay adjustment due to changes in the transmission path are also easily accommodated. Accurate timing references are used to control the RF carrier frequency and to accurately set the delay compensation equipment. GPS makes this possible. In order to avoid overdependence on GPS (the military may limit access during wartime), rubidium oscillators are also used in parallel to GPS. This is the technology that PSEC utilizes to deliver our mission critical first responder voice transmissions to the tune of just under 20 million transmissions annually and growing.

The PSEC system is an engineering marvel and one of the first in the nation to provide APCO 25 compliant Phase II 700 MHz with a standalone Data System in the United States. Approximately a million and a half times a month the PSEC system delivers intelligible voice to over 4500 users in the field holding a 10 microsecond tolerance of signal in the field to portable antennas almost anywhere in Riverside County from our eleven simulcast cells (while trunking, digital and encrypted).
Cost Factors

But is it cost effective to build simulcast networks that would cover the entire County? Well if you are Orange County – Yes (BTW – OC is spending $230Mish to “upgrade” their existing system to be APCO 25 Phase I) and if they are currently using limited resources. First In First out or FIFO allows a large number of users to share talkgroups in the PSEC system. Trunking technology while I am working on this article. There are just under 250 trunked sites available for longer than a second after initially setting up.

If you are Riverside County you have to up your game at just under 8000 square miles and a much more challenging terrain (e.g. 41 different mountain ranges). With only 4,500 subscribers and the County and Contract Cities financial participation so far and 4 Law Enforcement Rate Holiday participants, creative engineering and funding models are a work in progress.

Trunking

All of the Simulcast Cells and A25 sites are “trunked” When you push the button on your radio sends a message to the site controller and zone controller requesting a channel to talk on. This is done on a dedicated channel known as the “control channel”. The control channel contacts the controllers then sends you a message back to your radio and all the radios on your talkgroup at the time of the first free channel available in the system, then it sends you a talk permit tone (sounds like dih dih da) and you can talk. If all the channels are busy the system sends you a “bonk” and puts you in a queue – First in – First Out. Currently it does not happen often in our system but occasionally it does and as soon as a channel becomes free the system calls you back, gives you the familiar talk permit tone “dih dih da” and off you go. If you are in trouble you can push the emergency button. This puts you at the top of the queue and gives you the talk permit tone.

The screenshot at the right shows how many different talkgroups are sharing the radio system resources through trunking technology while I am working on this article. There are just under 250 trunked talkgroups in the PSEC system. Trunking allows a large number of users to share limited resources. First In First out or FIFO.

Our Genesis Network allows us to capture system data and create reports and provide graphical real time pictures of how our PSEC radio system works now and capture that data for trending, troubleshooting and for healthy reporting.

Logical Cell vs. Simulcast Cell vs. Physical Site

Riverside County utilizes 9 Simulcast Cells adding A25 Sites to “fill” in coverage where needed. The Northwest (14 sites, 7 channels, 12 talkpaths), Southwest (11 sites, 5 channels, 10 talkpaths), Ortega Cell (3 sites, 3 channels, 4 talkpaths) and San Jacinto Cells (12 sites, 5 channels, 10 talkpaths) cover from the Orange County border to the Badlands and a little beyond.

Several smaller simulcast sites start the coverage into the desert, marching down the I-10 freeway east to Arizona Palm Springs (4 sites, 4 channels, 6 talkpaths), Indio (6 sites, 4 channels, 6 talkpaths), Santa Rosa (2 sites, 3 channels, 4 talkpaths), Desert (3 sites, 3 channels, 4 talkpaths), Blythe (4 sites, 6 channels, 10 talkpaths).

Where there are areas that are hard to cover, have little population and therefore traffic and/or it is not economically feasible to install a simulcast cell Astro25 aka A25 standalone sites are utilized. They are small standalone trunked systems connected to the each other and the larger Simulcast Cells to provide seamless Countywide coverage. There are 20 of these A25 sites scattered across the County of Riverside. Only one A25 site exists in the West end of the County – The Santiago Site. Once you get past the Badlands and into the County sites into desert A25 sites are installed to provide service with names like Snow Peak, Marion Ridge, Ursa, Chuckwalla. A big part of the history of Riverside County is wrapped up in it’s remote site radio names...

A simulcast cell contains from 2 to 12 physical radio sites in the PSEC system. An A25 site is just 1 physical radio site. But all of the Simulcast Cells and A25 Sites are treated as just another “logical cell” by the PSEC systems Zone controller. This device keeps track of all 4500 and growing voice subscribers and lets them “talk” across logical cells in a process called “roaming”. A subscriber in Blythe can therefore talk to a subscriber in Moreno Valley at the push of a button if the System Administrator allows it. No dialing, no waiting, right now instant gratification push to talk. The PSEC system has 30 logical cells and is designed to be able to grow if necessary. That’s how it works!
MONTHLY STATS

2014 Voice Transmissions: 18,036,029
2015 Voice Transmissions: 19,346,203

MPD-1 TG for JAN: (80000550) – 83,307
BPD-1 TG for JAN: (80000650) – 37,357

Top Talkgroup January:
Moreno Valley RSO – 102,069

JANUARY MONTHLY TRANSMISSIONS: 1,754,781

PSEC COMMUNICATIONS DIVISION MONTHLY ACTIVITY REPORT

- PORTABLE RADIO REPAIRS: 9
- RADIO ONLY BENCH CHECK AND PROGRAM: 3
- HT MICS: 3
- HT REPAIRS: 1
- PROGRAM AND IMAGES: 5
- VEHICLE INSTALLATIONS: 1
- VEHICLE REPAIRS: 3
- MICROWAVE AND ENVIRONMENTAL CRITICAL ALARMS: 35
- MICROWAVE EQUIPMENT CRITICAL ALARMS: 17
- SITE MAINTENANCE: 148
- UPS ISSUES: 3
- BLYTHE DRIVE UP REPAIRS: 3
- SITE OPTIMIZATION: 1
- REMOTE SITE REPAIR/CHECKS: 50
- DISPATCH CALL OUTS: 14
PSEC ENGRAVES

What is that number engraved on my portable? It is the system ID. Each radio on the PSEC system has a unique ID. Our ID ranges are in the 3300000 range. PSEC radios have to be turned on in the system backbone to work on the radio system. Engraving the number on the subscriber ensures the radio uses only the ID it was defined and that the portable is easily identifiable for troubleshooting and security reasons.
The PSEC Radio System within the Communications Center
By Ryan Casady
Sheriff Communications Officer II

As Sheriff’s 911 Communications Officers we have the important responsibility to relay accurate and timely information to the deputies in the field. The PSEC radio system is an invaluable tool that allows direct communication with both our own department personnel as well as other agencies as needed. The system, and corresponding Riverboard and SideCore hardware and software, allow for efficient manipulation of the radio and flexible adaptation as needed. Among other features this includes the ability to broadcast information while keeping your hands on the keyboard, quickly patching radio channels with a few clicks of the mouse, monitoring multiple radio channels simultaneously, and easily relaying information to other agencies. The digital system utilizes noise cancelling technology which helps eliminate background sounds and enables clearer transmissions. The added protection of encryption provides a greater level of security, ensuring that only authorized individuals have access to the information broadcasted over the radio system.

The Riverside County Sheriff’s Department is supported by (3) Communications Centers located in Riverside, Palm Desert, and Blythe. Each center is supported by radio consoles that perform a dual purpose of supporting a Motorola P25 Phase II 700/800 radio system and Vesta 9-1-1 phone system. The Riverside dispatch center has 6 primary radio consoles, 2 backup radio consoles, 2 supervisors’ radio consoles, 3 special operations radio consoles, and a special functions radio console. The Coachella Valley Dispatch (CVD) center has 2 primary radio consoles, 2 special operations radio consoles, 1 backup position, and 1 supervisor console. The Blythe dispatch center has 2 radio consoles. In general, each patrol station within the department has one primary dispatcher assigned to their radio channel; the exception being stations which have their radio channels patched together and have a single dispatcher assigned to them (for example the Cabazon/San Jacinto/Hemet stations). The primary dispatcher is responsible for keeping track of the units on their radio channel. This includes dispatching them to calls, broadcasting important officer safety information, checking their status to ensure they are Code 4 (okay) and maintaining an accurate accounting of their current location/status. The backup position handles deputy request such as running a subject through RMS/CLETS/DMV to check for driver license status, wants, parole, protection orders, etc. This dispatcher will also make call-outs such as tow requests, city roads, animal control, abstract warrants, and other notifications as needed. The special functions dispatcher assists primary dispatchers with high-priority incidences, makes call-outs to other agencies, answers the direct ring-down line with Riverside County Fire (RCF), monitors interagency radio channels, and other duties as needed.

One of the key features of the PSEC system is the ability for individual channels to be patched or unpatched as needed. This is useful when there is an in-progress, priority incident. For example, in the early AM hours of New Year’s Day 2016 the Southwest Station and the Hemet/Cabazon/San Jacinto Station channels were patched together when a call was received that a subject in the Hemet area was shooting at family members with an AK-47. This quickly became a major event which involved multiple units, including an RSO Swat Team, Hemet PD patrol officers, and a Hemet PD Bearcat tactical vehicle. To alleviate the burden on the dispatcher covering the incident, the Southwest channel was dropped from the patch. This allowed the incident in Hemet to not affect the Southwest station’s day-to-day duties. Furthermore, the SEB tactical channel was patched with the channel to facilitate direct communication between the patrol units and the swat units. After several hours the suspect was eventually taken into custody without further incident. This is one example of many that illustrates how the PSEC communications system allows the dispatch staff to better support the work done in the field. As the PSEC system continues to expand to include other agencies in Riverside County, interoperability amongst agencies will become seamless with the use of common channels and patching capabilities.

FCC FINES UP TO $112K FOR THOSE NOT COMPLYING WITH THE NARROWBANDING MANDATE

On January 13 the FCC released DA 16-36 providing further guidance on narrowbanding below 470 MHz. The FCC is taking new steps to ensure licensees comply with their narrowbanding mandate that was implemented over three years ago. In addition to substantial fines, the FCC now dismisses license renewal applications that list only wideband emission designators.

Beginning on February 16, the FCC will dismiss all applications that list only wideband emission designators. With the risk of substantial fines and applications being dismissed, APCO strongly urges you to check your license to ensure you are narrowband compliant. If you are unsure whether or not your license(s) needs to be narrowbanded, please contact Katherine Reynolds in APCO’s Licensing Department and we will be happy to assist you with bringing your FCC license(s) into compliance.

For more information contact:
Katherine Reynolds, Licensing Specialist, (386) 944-2469, reynoldsk@apcointl.org
February has been a great month! The Oscars are less than a week away, the Walking Dead started again, the Riverside County Fair just ended. Lots of fun events in February. Some of you might know that we have a new ITM, Gus Vasquez. He joined us from Motorola and hopefully we will have a featurette with him soon.

Important note: PSEC is no longer providing equipment installations as a service. Any questions about this can be sent to Neil Davis or Gus Vasquez.

Also next month will be the last of the monthly newsletter, we will be transitioning to a quarterly release. This will provide us more time to provide quality content, and possible turning into a PSEC magazine (jokingly).

If you are reading this and you use a PSEC radio, we would love to see it in action! Snap a photo, shoot a quick video and email it to jason.bender@rivcoit.org with information of who it is and we will include it in future newsletters; the bigger the photo the better.

Until next month,

Cheers!