



**Technical Review  
Emergency 911 Dispatch System  
July 22, 2009**

This report is a synopsis of the Capital Improvement Plan (2009 CIP) compiled by Deltawrx Management Consultants as directed by the Grand County Emergency Telephone Service Authority (GCETSA), final draft dated May 2009.

**The primary objectives of this report:**

The GCETSA is forming a capital improvement budget to account for the replacement costs of existing equipment as well as upgrading our communications technology. This report will explore and bring direction to the following issues:

Consider emerging technology standards and opportunities, i.e. next gen networks, Digital Radio Systems (DTRS), mobile computing technologies...  
Prepare for FCC Regulatory changes, i.e. narrow banding of VHF frequencies in the year 2013

Assessment of interoperability within the county and external agencies

Cost analysis for future upgrades and equipment replacement

Funding options

The CIP was the primary concern to the Grand County Emergency Telephone Service Authority Board. (GCETSA) This board is the entity that collects telephone surcharges targeted by the Colorado Public Utilities Commission for the operation of the local Public Safety Answering Point (PSAP)

Accompanying this report is a spread sheet of the inventory of the radio infrastructure and the dispatch customer premise equipment.

2009 The Capital Improvement Plan (2009 CIP) process was began with interviews of all the end users and operators of the radio system. This included all public safety agencies, (see appendix a, pg. 71)

The report incorporates the requests, suggestions and pain points of all those interviewed regarding the communications system.

The project began with an assessment of the existing communications system infrastructure which can be categorized as follows:

- Radio Systems VHF and DTRS
- 911 Customer Premise Equipment (CPE) / Dispatch Systems
- Law Enforcement Records Management Systems
- Fire Records Management Systems

### **Work in Progress: 8/26/09**

**Upgrade of Table Mountain**, Four Channel upgrade to DTRS controller, planned summer of 2009 \$120,000 State of Colorado

See: Office of Emergency Management, Trevor Denny, must produce a

### **Upgrade Radio Consoles with DTRS cards.**

Recently a grant was awarded to all Grand County Police Departments that would put a DTRS radio in every patrol car and provide a portable radio for every officer (40 hand held radios and 35 mobile car radios) . This grant funding was withheld until Grand County could transmit from dispatch over the DTRS frequency. (See Rod Johnson and Trevor Denny, NWAHEMR North West All Hazards Emergency Management Region, Federal funding) The solution is to upgrade the dispatch radio consoles to allow DTRS transmissions.

The need to fulfill this grant requirement will be met by installing and programming an interface card into the radio consoles in dispatch. \$10,000, see pg. 100 "Dispatch radio console upgrade" Includes the comm. center DTRS transmitter/radio and antenna. The money for this was approved through the GCETSA board meeting on July 15th 2009, the work is currently in progress.

Through this work we have learned that the radio console workstations are ten years old and will not take the programming these new cards require. These work stations need to be replaced. \$50,000

### **Connect to the State of Colorado DTRS Zone Controller**

Requires a microwave link from the County DTRS dispatch channel into an existing State of Colorado DTRS controller.

### **Replace Grouse Mountain microwave link to HSS Comm. center/ Dispatch**

A microwave link that is over 20 years old connects the Grouse Mountain tower site and the Communications Center in HSS. This equipment was once owned by the State of Colorado and is no longer supported. The link is now used by Dispatch for transmitting paging from the Communication Center in HSS. It is our understanding that Grand County Dispatch will be able to connect through any DTRS site on the States Microwave backbone and connect to the DTRS Zone Controller socket located in Grand Junction. Our link to the DTRS must be digital from dispatch to Grouse Mountain. It is very

possible our microwave link will need to be upgraded to a faster, digital microwave system to participate in the DTRS. See Bob Florquist / Darrell Karsen, Legacy Communications email 8/19/2009

### **Wolford Mountain, Kremmling FD**

This site is a VHF repeater site for the general west end of the county. Currently Dave Andrews Tony tucker are looking to put a KFD repeater on San Toy Mountain at an old BLM site which has AC power. This move is in negotiation at this time.

Also see (Dave Andrews and Tony Tucker) ability to acquire tower space on San Toy Mountain, replace or co-operate with Wolford Mountain. We would need easement agreement with land owner (Jim Yost) and an electric meter. Wolford Mountain was set up years ago as a temporary or test site. San Toy is a much better facility and has better access than Wolford Mountain.

Cost to re-locate \$????

Cost to co-operate \$????

### **Replace Dictaphone recorder in Dispatch**

See: Bob Florquist on replacement plan and cost.

### **Open Qwest ticket to fix issue between Life Line 100 and Positron Power map**

See supplemental Recommendation 1 (SR-1) pg 60, Open Qwest ticket to fix issue between Life Line 100 and Positron Power map, sometimes the system pushes address data to the Power Map system and sometimes not...

### **Upgrade the Power Map program, before June 2009**

Upgrade the Power Map program, before June 2009, See supplemental Recommendation 2 (SR-2) pg 61

### **Firefighters grant**

See Todd Holzwarth and grant application to add DTRS tower site and microwave in East Grand, could satisfy this requirement.

### **2009 CIP Recommendations:**

<b>Capitol costs:</b>	<b>Five year est. support cost 10%</b>			
Join an Expanded DTRS See pg 101 add 2 sites	\$722,400 (No radios)	\$953,800	\$72,000	\$95,000
DTR Radios (550 units) See pg 11 and 101	\$1,148,000	\$2,920,000	\$148,500	\$290,600
Implement Shared VHF System Two mw sites see pg 98	\$ 340,250 (No radios)	\$578,000	\$34,000	\$57,000
VHF Radios / Voice pagers See pg 99 (radios only)	\$59,250	\$144,000	\$6,000	\$14,500

Costs to Implement a Hybrid VHF/DTRS, See pg 105

Dual Band Radios Low 13 radios high 290 radios	\$66,000	\$2,637,000	\$6,000	\$282,000
Vehicular Repeaters Low 2- High 13	\$50,000	\$410,500	\$5,000	\$50,000
Mobile Gateways Low 2 – High 8	\$20,000	\$800,000	\$2,000	\$96,000
Partial upgrade of 911 CPE Systems, See pg 107 Alt. 2	\$66,000	\$99,000	\$6,000	\$10,000
Procure new CAD system SEE PG 108, Alt 2 -3 Low CAD only, high CAD and MDC Mobile Data Computing (25 Units)	\$77,500	\$782,500	\$30,529	\$245,095
<b>Totals</b>	\$2,549,400	\$9,324,800	\$10,029	\$1,140,195

### **Existing VHF/UHF Radio and paging systems review:**

Per the 2009 CIP recommendations (see pg 59) this and other recommendations mentioned in this report were agreed upon by vote by the participants of a Communications meeting during a review of the draft form of the 2009 CIP.

Recommendation 2 (R-2) Implement Shared VHF System – *Bottom line, VHF communications is expected to remain, even if DTRS is used as a primary radio system.*

*On July 15th 2009 in a Communications meeting, members tentatively agreed that the VHF system would need to be operated for at least 10 years.*

Radio Systems in Grand County consist of VHF and UHF conventional repeated and simplex channels.

*In our example, repeated channels infer that information is transmitted over a distance and received by another radio device and then re-transmitted or repeated again extending the range of the original transmission.*

*Our obvious challenges are that this type of a system has many possible failure points, depending on the equipment used and distances transmitted across, issues of delay or latency can occur.*

*Operators of the radio communication also need to know where they are and what tower or channel is the optimum channel to use in that region. Dispatchers must also be able to find the end user sometimes guessing which channel they may be tuned to.*

The Radio System is used to support safety and general government voice and paging communications.

For this report we will focus on the existing VHF/UHF towers, antennas, repeaters, and power systems including battery and solar recharging systems.

*An equipment inventory spread sheet is included as a guide. This equipment inventory may not be complete at this time and is being updated as a work in progress.*

Grand County Dispatches from the Sheriff's Office located in Hot Sulphur Springs, called the Communications Center or Dispatch in this report. There is an 80' tower from which dispatch is transmitting to eleven different repeaters (VHF and UHF) located at six different tower locations (or known as sites) throughout the county.

The HSS tower is new (2008) and includes 11 new antennas and a new frequency combiner. All cabling and grounding between the antennas was also replaced in 2008. (\$145,000)

All repeaters located in HSS are standard Motorola equipment and all are functioning. There is no purchase record of the repeaters and age and lifecycle can only be estimated. The repeater equipment located at HSS is in good repair. The radio room is clean, and well organized. There was not any equipment in this area identified as being unable to be re-programmed to operate within the 2013 FCC narrow banding of VHF frequencies. (Per an outside source), "this facility is in very good condition and has been well maintained."

Grand County relies on six antenna sites to extend the range of its communication system from Hot Sulphur Springs to cover most areas of the county using primarily VHF frequency radio signals. UHF frequency radio frequency transmissions are supported for special medical bands, but these seem to have run their course and have become obsolete as all the local medical Clinics all have DTRS consoles. There seems to be some training and procedural issues left to iron out to make DTRS the exclusive medical radio band. (see: Ray Jennings for a complete projection on UHF and future dependencies)

These six antenna sites are all physically separate, and each transmits on at least one separate radio frequency or band, which is sometimes also referred to as a channel. In the example below the physical site "Wolford Mountain" is known to radio users as channel "SO WEST" which technically transmits over a unique FCC licensed VHF frequency, 158.730. The application and paperwork for the holders or "ownership" of these licensed frequencies mentioned are held by the Sheriff's Department. There are FCC Licenses held by other agencies including EMS, SAR, and Road and Bridge.

*Of these six antenna sites, none are physically owned by the county. There were no written agreements included in this report defining the terms for Grand County to lease or occupy these sites or any agreements for conveyance over private property as needed to access the sites.*

Of these six sites four are the VHF voice backbone for the county communications systems:

Wolford Mountain (SO West)  
East Grand Fire Station (SO East)  
Mount Chauncey (SO Blue) north Grand  
South Cottonwood (SO White) south Grand

The other two are used primarily for paging and Search and rescue.  
North Cottonwood  
Grouse Mountain (Includes microwave connection back to HSS)

### **VHF Antenna Site Descriptions:**

#### **Wolford Mountain, SO West**

(North of Kremmling)  
Shelter owned by Verizon  
Power 12V batteries / solar  
One VHF Repeater  
Site condition: acceptable

This site is a VHF repeater site for the general west end of the county. Currently Dave Andrews is looking to relocate this site to San Toy Mountain at an old BLM site which has AC power. This move is in negotiation at this time.

#### **South Cottonwood, SO White**

(South of HSS)  
Shelter owned by US Forest Service  
Power 12V batteries / solar  
Three VHF Repeaters: SO White, Public Safety and Paging  
Site condition: acceptable.  
This site seems to be susceptible to vandalism. The solar panels were destroyed this spring. Also, this site can be hard to get to in the winter for maintenance.

#### **Mount Chauncey, SO Blue**

(located between HSS and Granby)  
Shelter owned by BLM/Dave Andrews  
Power AC (backup?)  
Three repeaters, SO Blue VHF, R&B VHF and EMS UHF  
Site condition: acceptable

#### **East Grand Fire Station, SO East**

(Located in Fraser at the EG Fire station)  
Shelter owned by EGFPD  
AC power (backup?)  
One VHF repeater  
Site condition acceptable

#### **North Cottonwood**

(South of HSS)  
Shelter owned by BLM/Dave Andrews  
Power AC (backup?)

Two repeaters, Fire and EMS paging VHF and Search and Rescue VHF  
Site condition: acceptable

### **Grouse Mountain**

(west of HSS)

Shelter owned by National Forest Service

Power AC (backup?)

Two repeaters, Fire/EMS paging VHF and SO Green

**Note, the Fire/EMS paging repeater at this site is the only repeater in use today that will **not** have the capability to be re-programmed for VHF narrow banding. See pg. 96, cost = \$8-11,000**

### **Microwave link**

A microwave link that is over 20 years old connects the Grouse Mountain tower site and the Communications Center in HSS. This equipment was once owned by the State of Colorado and is no longer supported. The link is now used by Dispatch for transmitting paging from the Communication Center in HSS. It is our understanding that Grand County Dispatch will be able to connect through any DTRS site on the States Microwave backbone and connect to the DTRS Zone Controller socket located in Grand Junction. Our link to the DTRS must be digital from dispatch to Grouse Mountain. It is very possible our microwave link will need to be upgraded to a faster, digital microwave system to participate in the DTRS. See Bob Florquist / Darrell Karsen, Legacy Communications email 8/19/2009

**Replacement of this Microwave link would be \$60,000 - \$80,000 see pg. 96 for cost estimation and pg. 9 for component description.**

### **Existing VHF/UHF Radio and paging systems recommendations: Recommendation 2 (R-2) Implement Shared VHF System**

Microwave backbone 2-3 VHF sites

Per the 2009 CIP it was determined that the VHF system will need to implement Multi-band Simulcast. This upgrade of the system will allow several channels i.e. SO West, SO East, SO Blue, and SO White to transmit and receive simultaneously.

Again issues of timing and latency need to be worked out of the system. This will be accomplished by a network of microwave frequency radios that will quickly re-transmit information between the VHF radio towers. This Microwave backbone can possibly benefit or add to our options for transmitting DTRS information in the future. **See pg 96 and 98 for a two site simulcast and pg 99 for a three site simulcast. \$431, 250 - \$1,122,000**

**Rough estimate for maintaining the VHF system for five years \$57,759 - \$153,000 see pg 96, (subtract cost of paging station mentioned earlier in this report.)**

See "GC Comm Plan Draft Narrative" Last revised: 2/10/09 (per Mike Long), The proposed change would provide a single, geographically appropriate, operations channel... this report presents options to improve radio coverage and establish VHF talk channels to better accommodate radio communications during emergency situations.

Also see (Dave Andrews and Tony Tucker) ability to acquire tower space on San Toy Mountain, replace or co-operate with Wolford Mountain. We would need easement agreement with land owner (Jim Yost) and an electric meter. Wolford Mountain was set up years ago as a temporary or test site. San Toy is a much better facility and has better access.

Cost to re-locate \$????

Cost to co-operate \$????

### **Existing Digital Trunked Radio System (DTRS) review:**

The existing State of Colorado DTRS repeater towers inside of Grand County are as follows:

Blue Ridge / South Grand

Grouse / Central Grand

Table Mountain / East Grand

**Note: upgrade of Table Mountain, Four Channel upgrade to DTRS controller, planned summer of 2009 \$120,000 Grant per Office of Emergency Management**

The existing State of Colorado DTRS repeater towers peripheral of Grand County are as follows:

Mines / South Peripheral

Walton / Northwest Peripheral

Buffalo Pass / Northwest Peripheral

King / Southwest Peripheral

Prospect / Northeast Peripheral

Dakota / Southeast Peripheral

So far we know that at least one DTRS site, Table Mountain was not configured within the State of Colorado minimum equipment standard. As noted above Grand County OEM has received funding to upgrade that site from a 3 channel to a 5 channel digital repeater. There is no analysis in the 2009 CIP that reflects the channel capacity of the DTRS sites or the capacity of the microwave backbone connecting these sites. It is assumed that all functional issues regarding capacity and performance have been revealed at this time. This comment is made cautiously.

### **Digital Trunked Radio System (DTRS) Recommendation 1 (R-1) Join an expanded DTRS**

Grand County Radio Communications will participate in the Statewide DTRS. As the equipment is owned and supported by the State, it has already proven out that there are costs and issues left to be dealt with by the local community.

We will need to add additional DTRS repeater sites to provide adequate coverage. There are two coverage concerns:

Mobile radios, these are usually mounted in vehicles and tend to have larger antennas and more power. The DTRS coverage for these radios is fair at this time.

Portable or handheld radios, these are smaller radios carried on ones person. The antennas are small and the power is based on battery capacity. The DTRS coverage of these radios is less than what we have with VFH now.

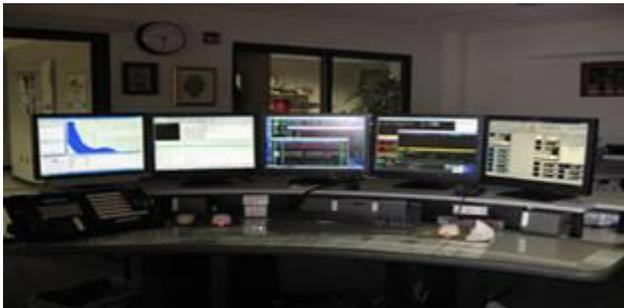
The 2009 CIP suggests that we will need to add at least 2 new DTRS sites. See pg 101, \$2,347,900-\$5,499,400 \*Note this cost includes radios; this will not be accurate with recent and future acquisitions through grant funding.

Note: The 2009 CIP suggests that we have local personnel test the coverage on the present system to gain an accurate idea were the coverage is unacceptable. We will be able to begin this study as soon as we are able implement the recent acquisition of one mobile and one portable radio for each law enforcement officer. With these radios in the field we should begin to see a clear picture of where the trouble spots are, and then begin to discuss new DTRS site locations.

Note additional costs to implement a hybrid VHF/DTRS system, Cross band vehicle repeaters and mobile gateways \$130,000 -\$3.2 M capital outlay, see pg 105

### **Existing 911 Customer Premise Equipment (CPE) / Dispatch Systems review:**

Bottom line is that the majority of the electronic components used in dispatch is approaching ten years old and are ready for replacement. Recent workstation failures have revealed an aged system not aligned to participate with the opportunities or demands of today's technology options and industry standards.



### **Telecommunications and call records systems**

The heart of the system is a system of 4 trunked phone lines routed through an exclusive sub system of the Qwest telecommunications system or E-911 (see pg 13-14)

The components of this communication system include an Automatic Number Identification (ANI), and Automatic Location Identification (ALI) controller, this device pulls the location and number data from a header on any call placed to 911 and pushes that information to the:

"Life Line 100 module" which is integrated into the "IAP Plus" phone console

The IAP phone console and Life Line 100 module Interfaces with the Dictaphone logging recorder to time stamp and record incoming calls.

As a call is taken the information regarding the location, caller, emergency type, area, and responding agency is recorded in an information system called Computer Aided Dispatch or CAD (see pg 16). This is a separate system with its own monitor screen and keyboard.

*The ANI and ALI information is currently only displayed on the small telephone displays. This information should be pushed to and become part of the Computer Aided Dispatch program; it currently does not populate these fields due to a timing issue that slows down the system.*

*Dispatchers must now copy this information off their phone display and type it into the CAD call record for any call received.*

Colorado Criminal Information Center and  
Department of Revenue Database Access Terminal

These information systems occupy another computer, monitor mouse and keyboard for the dispatchers.

### **Radio Communications:**

The equipment used by Dispatch Operators to transmit a message is the "radio console" The radio console is built in two parts: There is an actual console with a microphone and a base that has interface cards which are cabled to the radio room, a connection for each frequency is made to a radio set and each radio set has an antenna to broadcast on that frequency or channel. The second part is the "radio console workstation," and Motorola Centracom Elite Software version R08.04.07, which consists of a computer with its own monitor, mouse and keyboard connected to the radio console. From the radio console workstation the dispatcher activates a channel or a group of channels they wish to transmit on. This is done by clicking on the desired desktop icon on the computer monitor that represents the channel or group of channels needed, making it the frequency or channel that will be active when the dispatcher speaks over the radio microphone.

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*The need to fulfill this grant requirement will be met by installing and programming an interface card into the radio consoles in dispatch. \$10,000, see pg. 100 "Dispatch radio console upgrade" Includes the comm. center DTRS transmitter/radio and antenna. The money for this was approved through the GCETSA board meeting on July 15th 2009, the work is currently in progress.*

*Through this work we have learned that the radio console workstations are ten years old and will not take the programming these new cards require. These work stations need to be replaced. \$50,000*

## **Customer Premise Equipment (CPE) / Dispatch Systems, Recommendation 3(R3) Implement Partial Upgrade of 911 CPE system**

Positrons Power MAP

Another separate computer, monitor mouse and keyboard for the dispatchers. Connected directly to the Life Line 100, ALI/ANI system, and using a private company (Intrado) Master Street Address Guide, and the Counties GIS records. The application displays the location of incoming 911 calls.

There is both a functional issue with the Life Line 100 and a mismatch of records occurring between Intrados address database and the Counties GIS. (See pg 14)

See supplemental Recommendation 1 (SR-1) pg 60, Open Qwest ticket to fix issue between Life Line 100 and Positron Power map, sometimes the system pushes address data to the Power Map system and sometimes not...

Upgrade the Power Map program, before June 2009, See supplemental Recommendation 2 (SR-2) pg 61

Match up GIS records and Intrado address records. See supplemental Recommendation 3 (SR-3) pg 61, Historically County address records reflect county roads numbers, Intrado uses primarily street names. The County offices that funded and contributed to GIS has preferred County road numbers, now GIS is trying to produce both. This is a very typical issue for many rural Counties. This is a very extensive job of which our GIS department can only afford limited time to address. In the case of Park County and others this task was contracted to consultants that have access to both editing privileges to the Intrado and County GIS systems. We will need to do the same to expect acceptable benefits from the investments made so far.

### **Computer Aided Dispatch**

Bottom line, the existing Slueth CAD software will not properly interface with the Life Line 100 module, dispatchers are typing into CAD records, location and name data which should be automatically populated by the Life Line 100 module

See supplemental Recommendation 4 (SR-4) pg 59, note additional concern is the ability of this system (Slueth) to generate call reports and statistics for other agencies and billing purposes.

### **Time clock Synchronization**

Comm. Center does not have a time stamp/clock synchronization system. Information Systems, Radio Systems and the Dictaphone system are all on their own clocks. The time settings on these systems drift off and make it difficult to coordinate the records of past events

See supplemental Recommendation 3 (SR-3) pg 59, also see pg 36. \$15,000