

Western States Rural Transportation Technology Implementers Forum

Control of DMS, CCTV, HAR, and 511

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I.T. Systems Analyst
May 21, 2014



What is ITS?

**Intelligent
Transportation
Systems**

What are ITS devices?

- Dynamic Message Signs (DMS)
- Highway Advisory Radio (HAR)
- Closed Circuit Television (CCTV) Cameras
- Road Weather Information Systems (RWIS)
- Detectors - Bluetooth / Wi-Fi / Microwave
- Automatic Traffic Detectors (ATR)
- Commercial Vehicle Systems (Weigh-In-Motion, WIM, CVISN)
- Traffic Signal Systems
- Network Communications – Wireless, Wire Line, Fiber
- Computer Software and Hardware

I.T. Department

- For today's discussion, the "I.T." department is short for the "Information Technology" department or computer services. This is the section that provides computer services, programs the department's computers and PCs, runs the computer rooms, **manages the department's networks**, and may now include telephone services. I.T.D.'s is now called "Enterprise Technology Services" or "ETS".

5 Year Plan and Federal Aid

- 5 Year Plan. HQ Staff went to all 6 state districts to explain requirements. Only a 90 day window given to districts to plan out five years worth of projects.
- District plans rolled up into one state plan.
- Federal requirements.

Federal Aid Requirements

- FHWA and FTA require that a current ITS Strategic Plan and ITS Architecture be approved before approving funding for ITS projects.
- In addition, a Systems Engineering Analysis is required for all ITS projects submitted for Federal Aid funding

Background

- The before environment of ITS network control
 - Hard to use software product
 - Shared use with local agency – ITD didn't have full device control
 - Outdated technology
 - Limited functionality (DMS)

Loss of ownership

- ITD's District 3, includes the capital city and the Treasure Valley – a population over 600,000. District 3 gave control of all device assets to a local county highway district. ACHD managed all the local CCTV cameras, statewide DMS, and tried to control 24 HAR statewide. HAR control failed. ITD is still not allowed to turn cameras (on state owned freeways and highways.) Fiber optic cable management was turned over to ACHD too. The district didn't want to manage its resources.

New Control System Project

- Goals:
 - Statewide Integration and Control of CCTV Video
 - Video sharing between state and local agencies

Ada County Highway District's TMC



Ada County Highway District's TMC



Ada County Highway District's TMC



ITD Contracting Process

- Could have used:
 - RFP Request For Proposal – What types of systems are available?
 - RFI – Request for information – not a bid – but a vendor can tell us what they do.
 - RFQ – Request For Quote. Can turn into a purchase if under \$100,000. Over \$100,000 a formal bid process must be issued but an “ITB – Invitation To Bid” can be sent to the company.
 - Best Value verses Low Bid. Best Value hot two years ago, but now declining in ITD use.

ITD Contracting Process

- ITD held a Pre-Bid Conference. ITD gained much.
- Best Value verses Low Bid. We chose Best Value.
- Basic Scope of Work Defined.
- Value Added Items for Consideration.
 - Adding Modules:
 - Center-to-Center (TMC to TMC).
 - Exchanging or trading out line items:
 - Crestron Touch Pads, Out – 70 Inch Monitor, In.
 - Items no longer needed in the project – exchanged for new items.

Contract Management

- Followed Risk Management Process of Best Value
- Delcan Corporation (Parsons) Selected
- Three Phase Implementation Accepted By The State
 - Later Phase 3 was rolled into Phase 1
- Value Added Items for Consideration Included
 - Added DMS and HAR control to scope
 - Center to Center Module Option Exercised March 2014

Technical Challenges

- Network Communications
 - Who owns the fiber?
 - District 3 (D3) put their fiber under a local highway district's control. Many years later – ownership is an issue.
 - Who owns each fiber communication channel? ACHD absorbed ITD's? Who owns the equipment?
 - D3 tried to quit paying the \$300,000 yearly bill, perceiving they were not receiving any benefits.
 - IP addresses are ACHD's. We have to use a Network Address Translation (NAT) IP address to see one of ITD's devices on their side of the firewall.

Technical Challenges - Continued

- Network Communications
 - Who owns the fiber? - Continued
 - D3 and ACHD mid-level management quit talking with each other. Now elevated to the directors of each organization.
 - Being on the bottom of the staffing structure - I interact carefully, and low-key – and I have not had any trouble getting things done.
 - Out comes: In 2014 D3 was told to take back their devices and fiber within two years. A month later it appears it means to the D3 staff that they will own it – but ACHD will still be involved – essentially no change.

Technical Challenges - Continued

- Network Communications
 - Who owns the fiber? - Continued
 - D5 is now trying to outsource management of their cameras to the city where two freeways meet. We are creating the nightmare all over again.
 - Service From Telecomm Providers – Dropped packets
 - Bandwidth of Data From Devices – HD Cameras
 - Main I.T. Network Person Was Not Given A Raise And Another State Agency Hired Him Away From Us

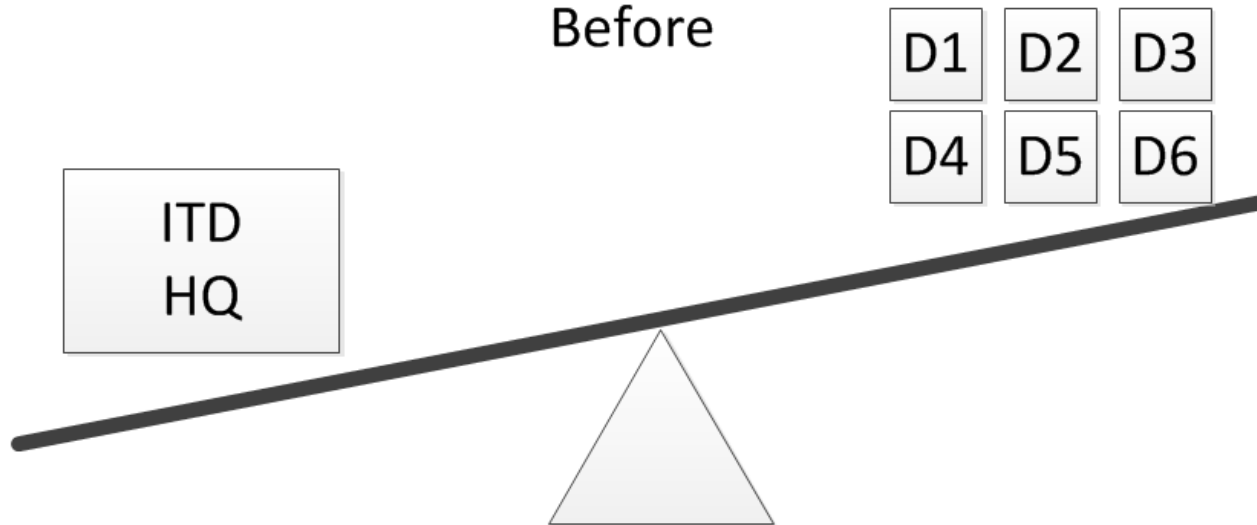
CCTV Issues

- Bosch CCTV Cameras
 - Poor Support
 - Can't Jump Firmware Versions In Older Cameras – Install In The Wrong Order or Skip a Version And The Camera Has To Be Tossed or To Shipped Away To Be Fixed. Bosch May Have Overcome This On New Cameras.
 - Partner Agency Has A Heavy Bosch Inventory That Is Maintained For ITD and Old Analog Cameras.
 - The Partner Agency Is Going With A Generic Bid On The Next Order Per Their Understanding Of FHWA's Requirements – Unknown Brand and Model Coming

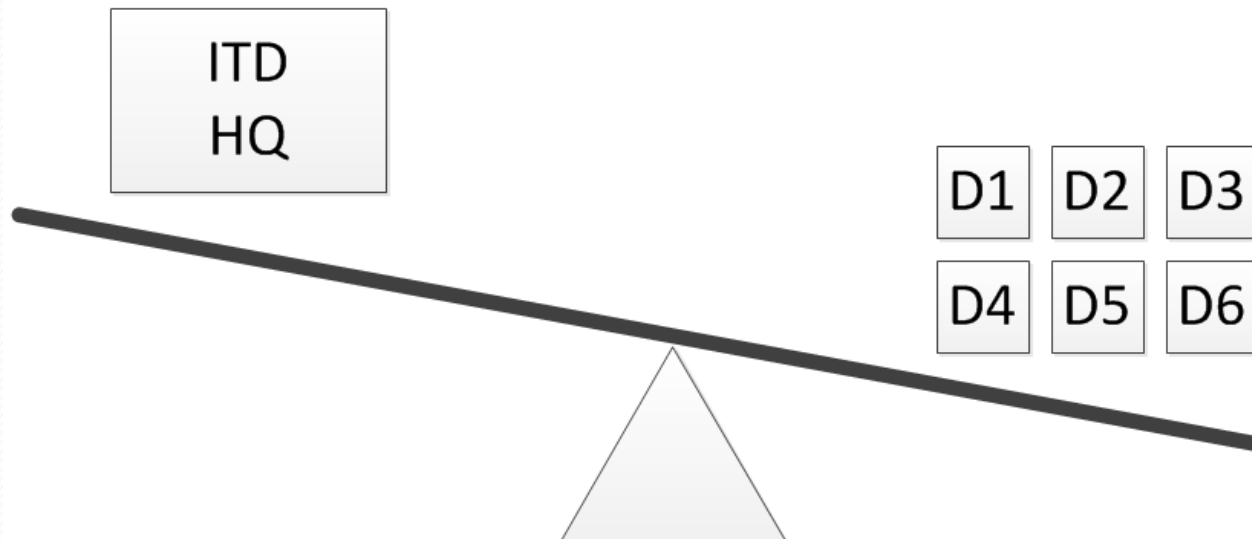
CCTV Issues

- Since that order was placed, they placed a second order under \$100,000 so the brand could be chosen or narrowed down.
- The deployment of HD cameras has been suspended until network loops can be upgraded with 10 Gigabit Switches.
- Getting hardened 10 Gigabit Ethernet Fiber Optic Switches has caused a delay. EtherWAN doesn't have the product. Cisco has yearly maintenance fees. Ruggedcom came and showed their product.

Before



After 17 years and 3 Directors, the Districts
are in the driver's seat



HQ's Lost Knowledge

- HQ's ETS group didn't know where all of our network was. HQ was no longer in control. The Districts had the information.
- Where is fiber optic cable currently installed? Mobility Services started to pay to track it. The ETS Manager saw the light and hired a person to bring it under the ETS umbrella – but not on the network team.
- Where can I put new full motion cameras on fiber and other devices?
- HQ needs to set standards, but Districts are in control.

CCTV New Camera Standard

- AXIS CCTV Cameras
 - ITD Contacted Large CCTV Users - Atlanta
 - ITD Had A Shoot Out of the Top Three Cameras
 - Axis Won (Cohu and Bosch Lost)
 - Four Cameras Styles Were Selected By The I.T. Section For Instant Approval For Three Years.
 - Outdoor PTZ Dome AXIS Q6042-E
 - Outdoor Fixed Dome AXIS P3363-VE (✓ Lens)
 - Indoor PTZ Dome AXIS P5532
 - Indoor Fixed Dome AXIS P3353 (✓ Lens)

Hardware Integration

- Four Cameras Styles Were Selected By The I.T. Section For Instant Approval For Three Years.
 - Approval means it works on our network.
 - Approval does not mean the deployment location has enough bandwidth.
 - Approval does not mean the deployment location has electrical services.
 - Approval does not mean the deployment location has network services, cell services, fiber optic connections, user approval, structural support.

Camera Temperature Ranges

- Idaho Has Extreme Weather Conditions
 - Road elevations from 756 feet above sea-level at Lewiston to 4,720 feet at Lookout Pass on I-90, and even higher at 8,701 feet at Galena Summit on SH-75;
 - Record temperature ranges on I-84 with highs over 100° on five summer months, and record lows below -15° over three months – the cameras need to be dependable and affordable.
 - On SH-75, ITD cameras are in use in the ski resort city of Ketchum (Sun Valley) which had a record low of -37° in a December. January's average daily low is 4° .
 - Stanley's record low is -54° .

Camera Criteria

- Some brands of cameras offer a higher priced pressurized dome. Warranty rules do not allow for local technicians to fix it.
- One design company cloned camera specifications from a 10 year old local highway district project. The analog camera had not been manufactured for years – but what if the builder found a new one on e-Bay. We would have been stuck with an unusable analog camera. We desire IP digital cameras.

Camera Criteria

- Non-pressurized.
- Standard definition not high definition.
- H.264 compression.
- Use of Power over Ethernet – PoE.
- -40 degrees Fahrenheit to 122 degrees. Heated.
(The 2014 Axis PTZ cameras operate from -58° F to 122° F.)
- Day-Night Camera (Infrared usable).
- IP camera with standard RJ45 socket
for CAT5-E or CAT6 Ethernet connection.
- Shaped for IP66 rated connector to keep water out.
- Our partner agency desired “ONVIF Profile S” until March, 2014. Regular ONVIF was our desire.

Hardware Integration

- AXIS Q6042-E PTZ Camera



Hardware Integration

- 50' Pole with Camera Lowering System



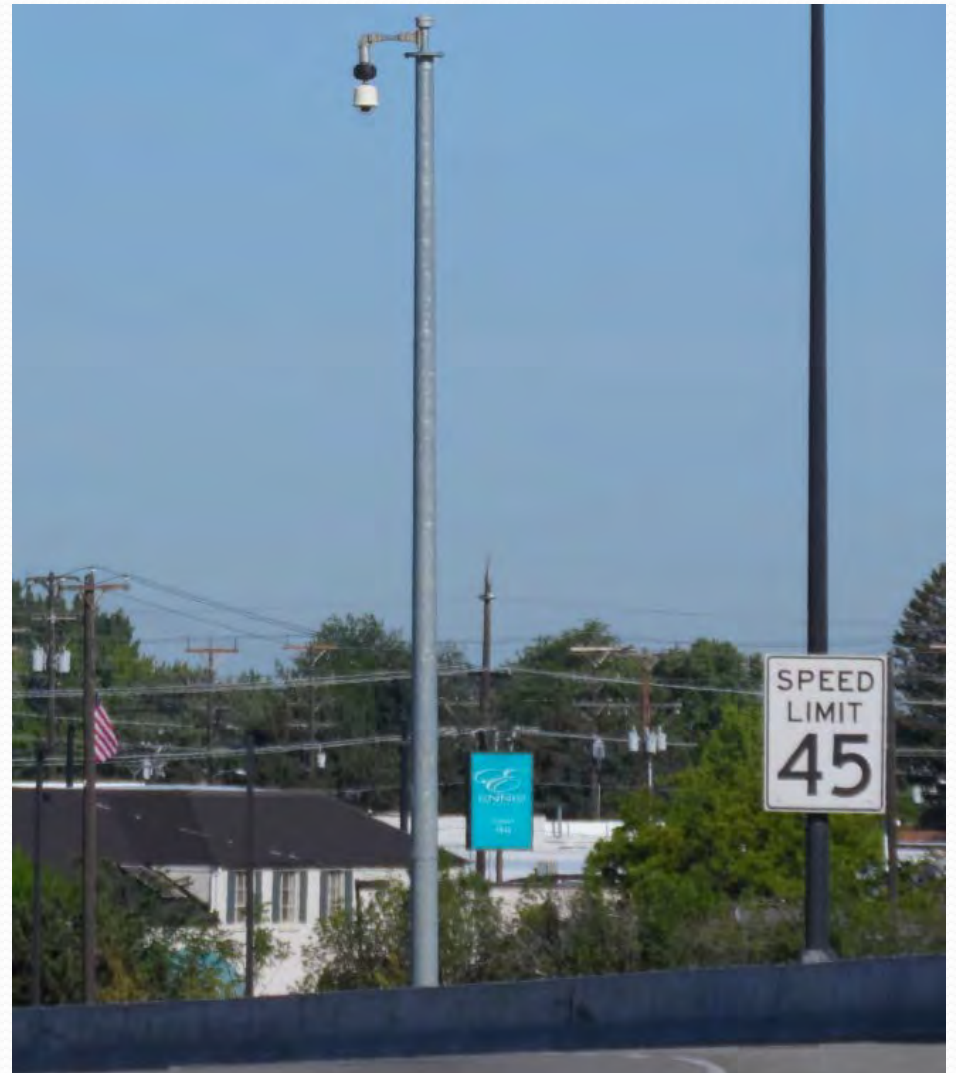
Clean 3
cameras
an hour
without
traffic
control.

Hardware Integration

- The $[MG]^2$ Pole Recommended. (Read as MG Squared.)

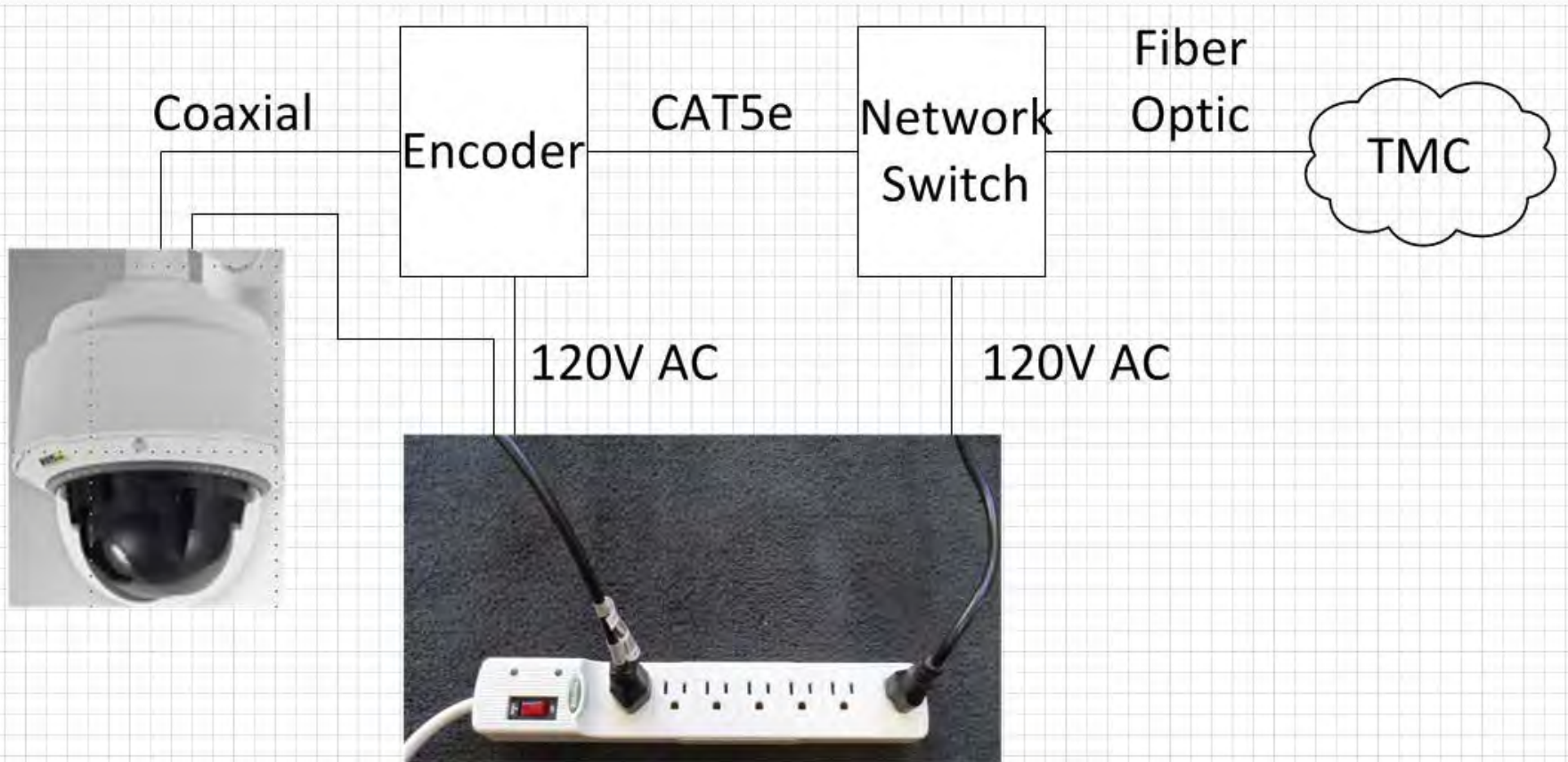


- [MG]² Pole with Camera Lowering System in Boise

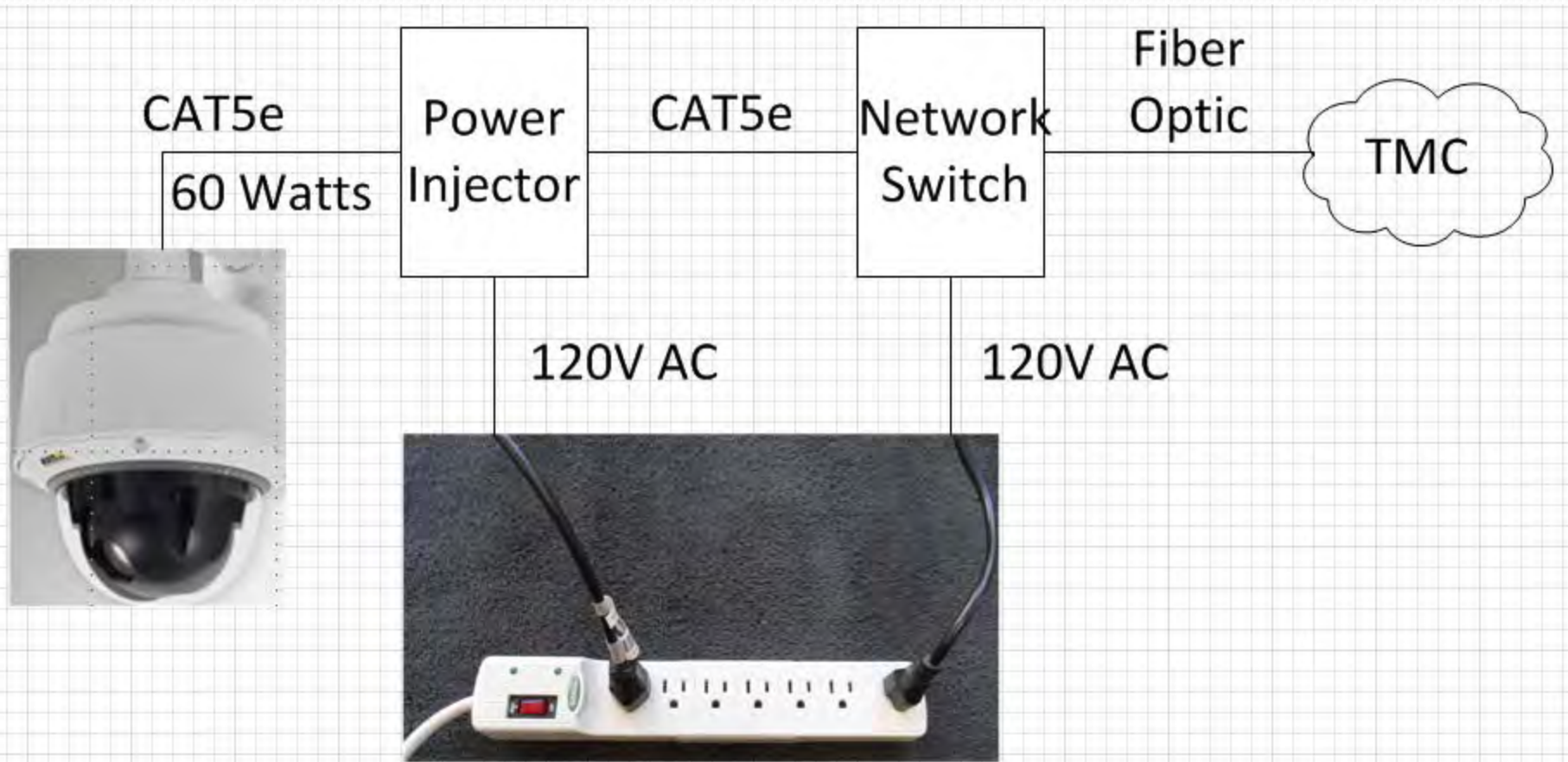


Phil Braun

Old Analog Camera Integration

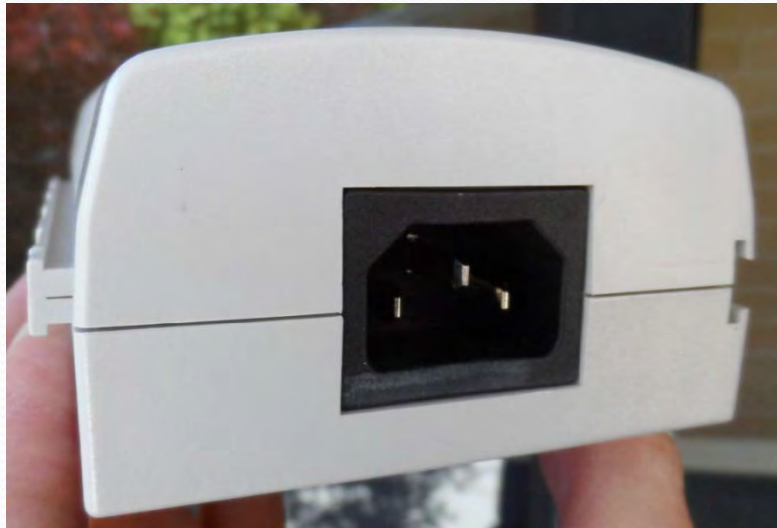


PoE Camera Integration



Hardware Integration

- PoE Camera. Power-over-Ethernet.
 - Power Injector.
 - Only one cable to camera.
 - 15.4, 25.5, 30, 45, & 60 watts.




Hardware Integration

- Fiber Optic Network Switch for camera data packets.
 - Rugged Com's - RuggedSwitch RS900
 - RS900-HI-D-L2-L2-TX-XX
 - -40°F to 185°F
 - Lifetime guarantee (one time purchase) verses a Cisco switch with yearly fees



Cables

- CAT5e Cable Standard
 - CAT6/CAT6e Great – but may cost more
- 
- Must be:
 - Shielded
 - Outdoor Rated
 - Not burial type if used in conduit and pole
 - Belden 7919A CAT5e
 - Use shielded RJ-45 connectors. AXIS requires IP-66 Rated Connector to keep water out of camera.

Hardware Integration

- Fiber Network – Video Failures – Data Packet Loss
 - The company loaned us a device to put at D1 and they had another in Boise. It proved data/image packets were being dropped over their network.
 - The company used three other companies to connect our districts. One of those did not set up their fiber optic switches correctly. Video traffic packets were not handled correctly.
 - Network traffic has to be prioritized. For us, high-to-low: voice/telephone, video, data/files, email.

CCTV Integration Success

- AXIS Q6042-E PTZ Dome Camera

+

- MG² Pole with Lowering Device

+

- Axis PoE Power Injector

+

- Rugged Comm – RS900 Ethernet Switch

+

- Belden 7919A CAT5e Cable

=

Winning Combination

High Definition – First Need

- AXIS Q6045-E PTZ Dome Camera.
- RWIS – Replacing up to four fixed Mobotix M12 & M15 cameras at a weather station site. View pavement for snow, ice, or precipitation.
- D3 transitional sites with ACHD?
- AXIS P3367-V might be chosen for counter surveillance at Ports of Entry. It could replace two or three standard definition cameras. 80 pixels or more (150 pixels per foot) for facial identification. A 17 foot wide counter could be covered (at 5 MP.) Use a P3346-V for 13 feet wide coverage (at 3 MP.)

ITD's State Comm 24 Hr Dispatch



Phil Braun

Idaho State Police 24 Hr Dispatch



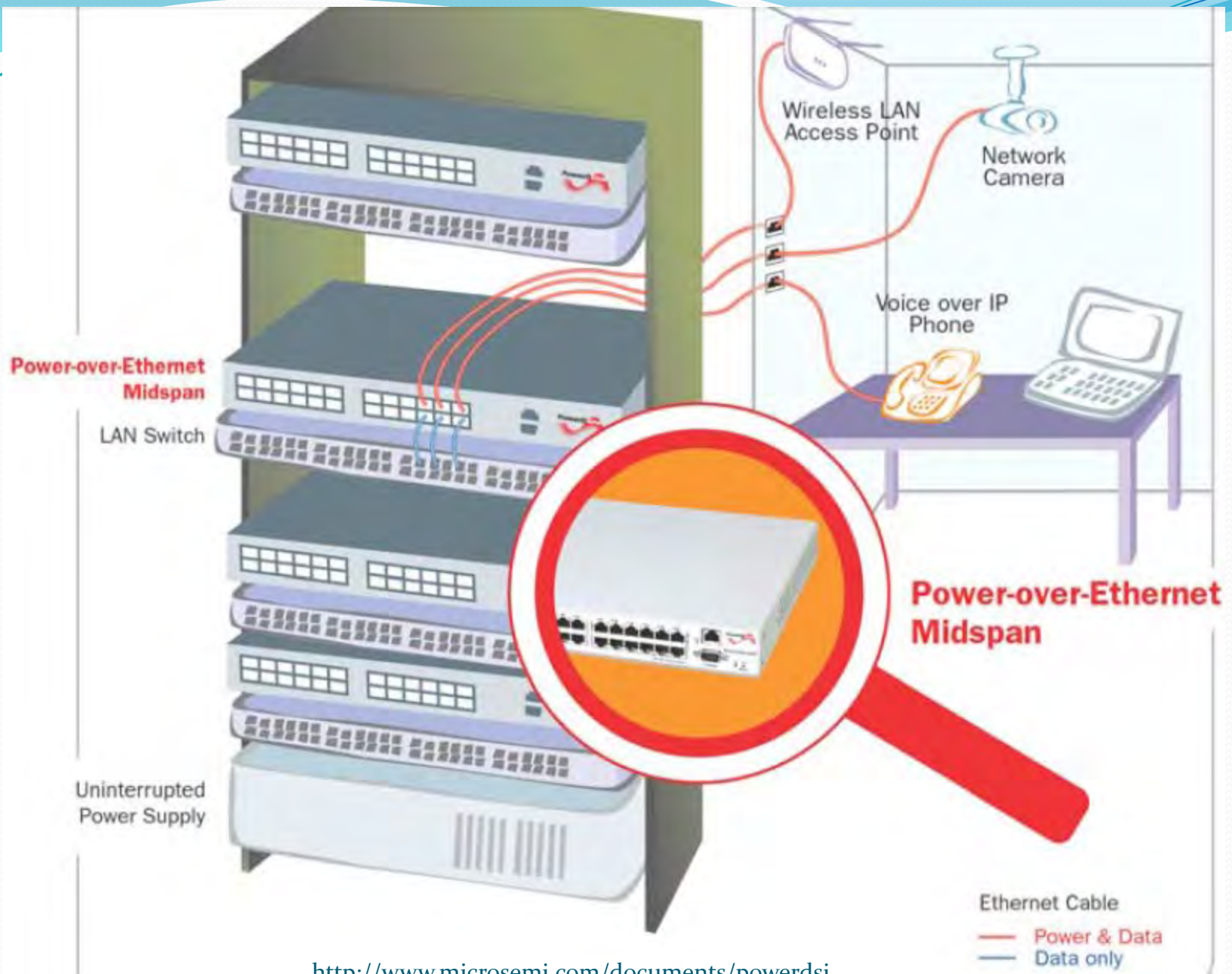
Current Project Status

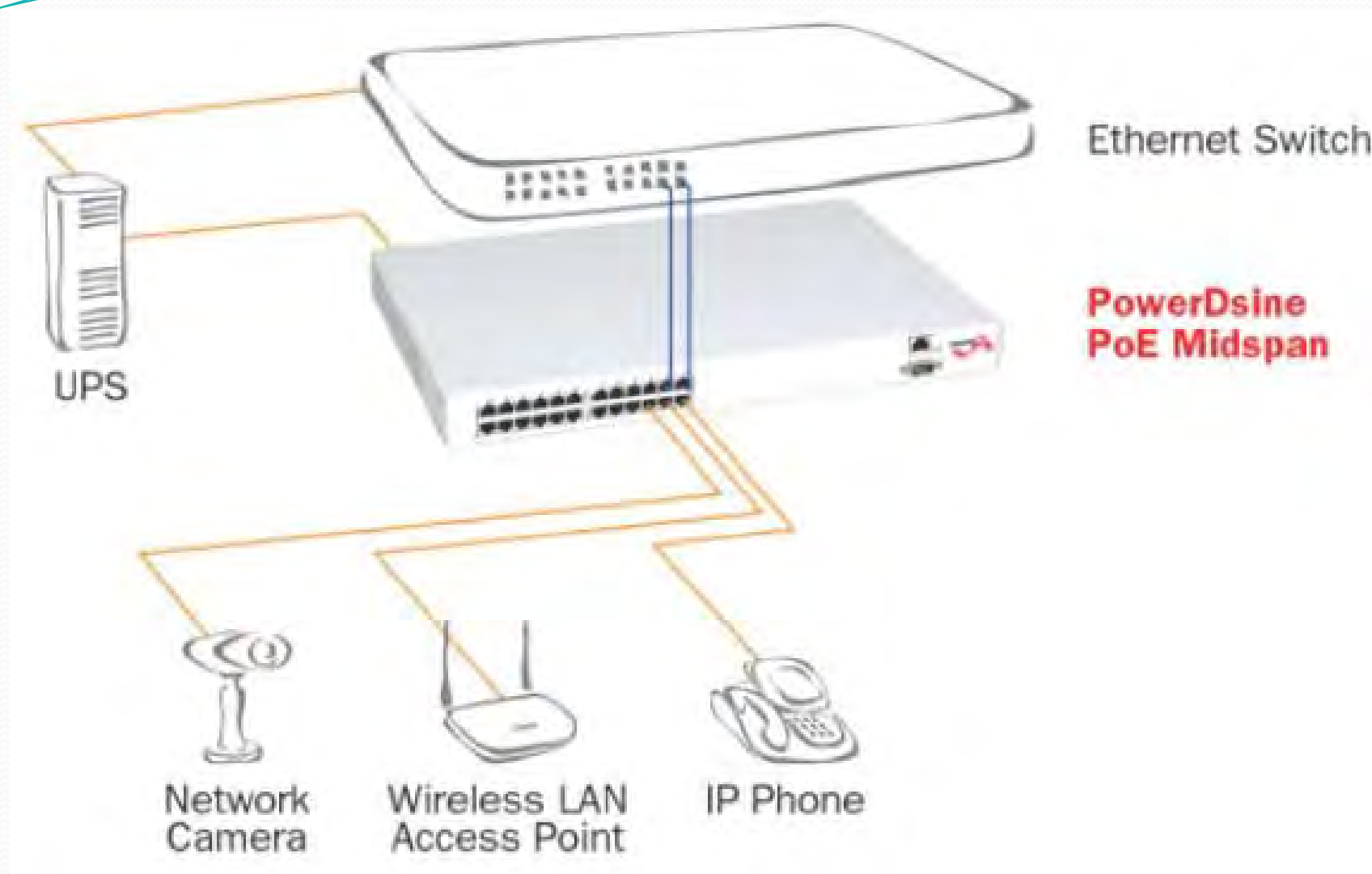
- North Idaho cameras are now viewable at the State Communications Center 400 miles to the south.
- The private network failed to pass all packets a second time. Both times it took time to convince the internal network team that something was wrong.
- D3 cameras are not integrated.
 - Design is in flux. The proposed solution must be tested.
 - ACHD has nine different cameras/encoders models to integrate.
- We question the maturity of the product.

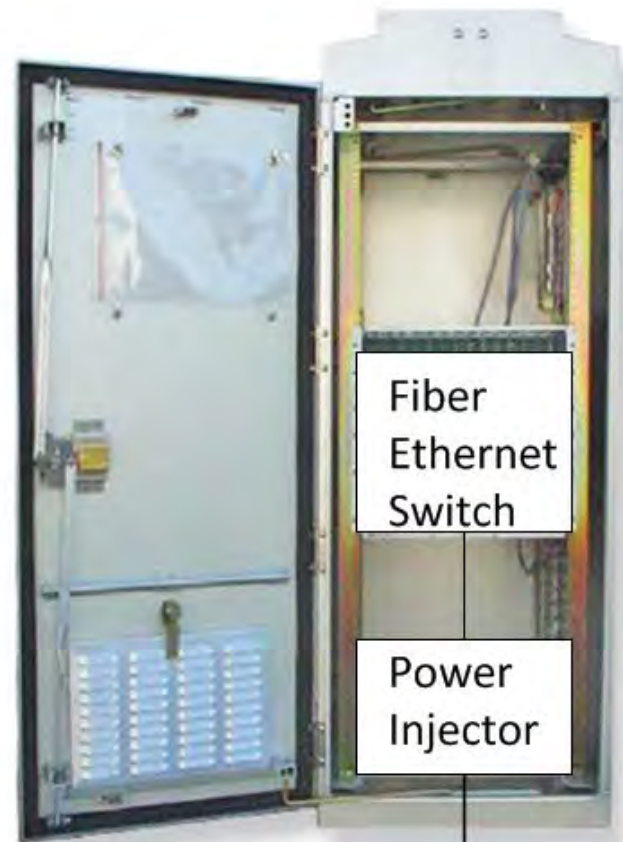
More on PoE –

Power over Ethernet

- A device does not need a separate power cable.
- The data cable (CAT5e) carries data both ways and delivers power to a device.
- On the next two examples the Ethernet Switch and the PoE Midspan can be purchased as single box/device.
- Two more examples ↓



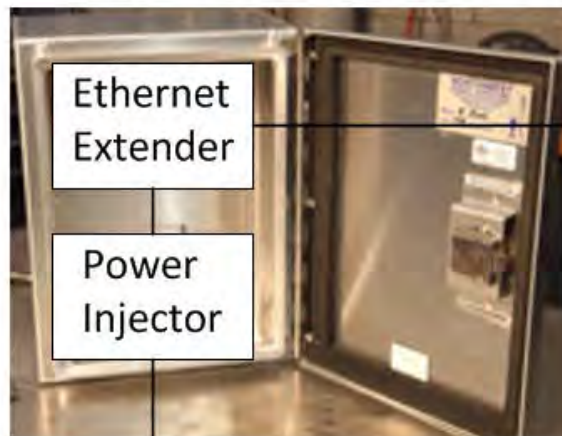




Maximum 328 feet from camera to fiber Ethernet switch

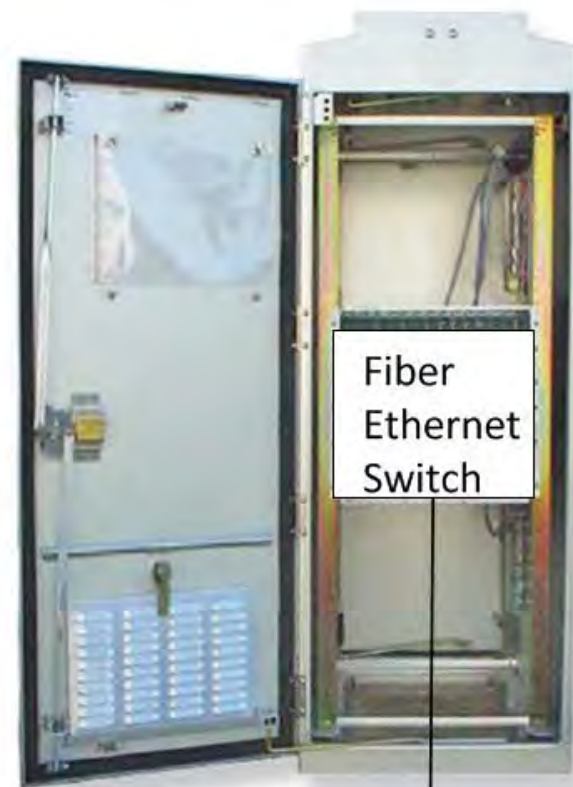


AC/DC Power Needed



Ethernet
Extender

Power
Injector



Fiber
Ethernet
Switch

328 feet max from camera to extender

328 feet max from extender to switch

Using CAT5e or CAT6 cable, 656 feet maximum
from camera though extender to switch

PoE Problems

- The wattage put out by a PoE switch or PoE Midspan may not match the need of the device to be powered.
- The heated, outdoor Axis Q6042-E comes with a 60 watt power injector. Don't use a PoE switch or other brand of midspan to power it.
- The class of power is important. Know how the switch or midspan allocates power. Know what your PoE powered device needs.

DMS Control Previously

- State control of DMS was through the IBI product owned by a county highway district.
- The highway district 511 map did display current DMS messages statewide but the public did not really know it. State 511 map didn't show msgs.
- Slow connection even though cell service used at most sites.
- Broken or unreachable signs not quickly identified.

Walk-In DMS on US 95 in North Idaho

Daktronics



Arterial DMS on US 95 in South Idaho

ADDCO



DMS Hardware Integration

- Modems for Verizon cell connections
 - AirLink LS300



- Replacing AirLink Raven X when failing. Product recalled.



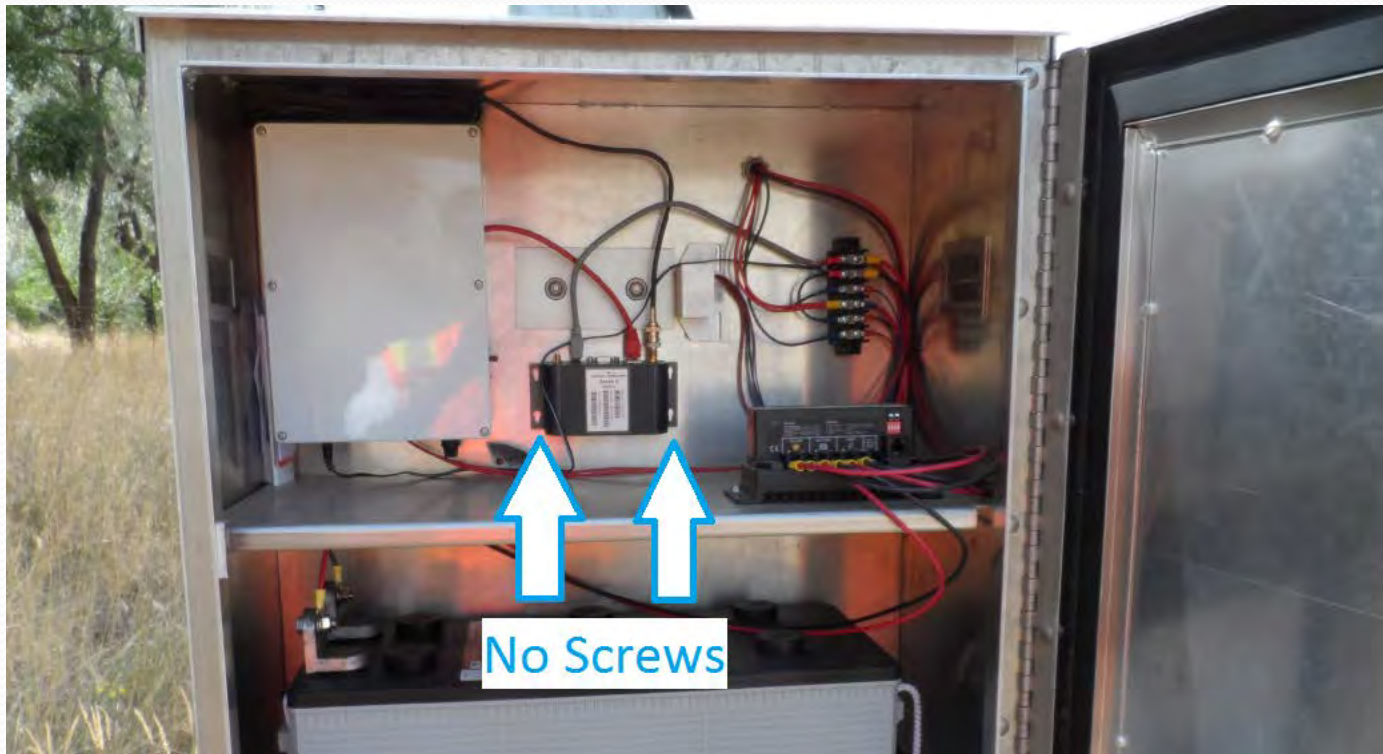
Modem Lesson Learned

- Modems in new HAR cabinets had lights facing the side wall. Lights can not be seen. Use Velcro®.



Modem Lesson Learned

- Modems lights appeared to be un-viewable in new HAR Beacon Cabinets but Velcro® was used for quick removal and checking.



DMS Hardware Integration

- ClearRF's Machine-To-Machine Cell Signal Booster for Verizon cell connections
 - WRE2700-S-001
 - If loosing touch with a DMS too often - consider adding a cellular amplifier



DMS Hardware Integration

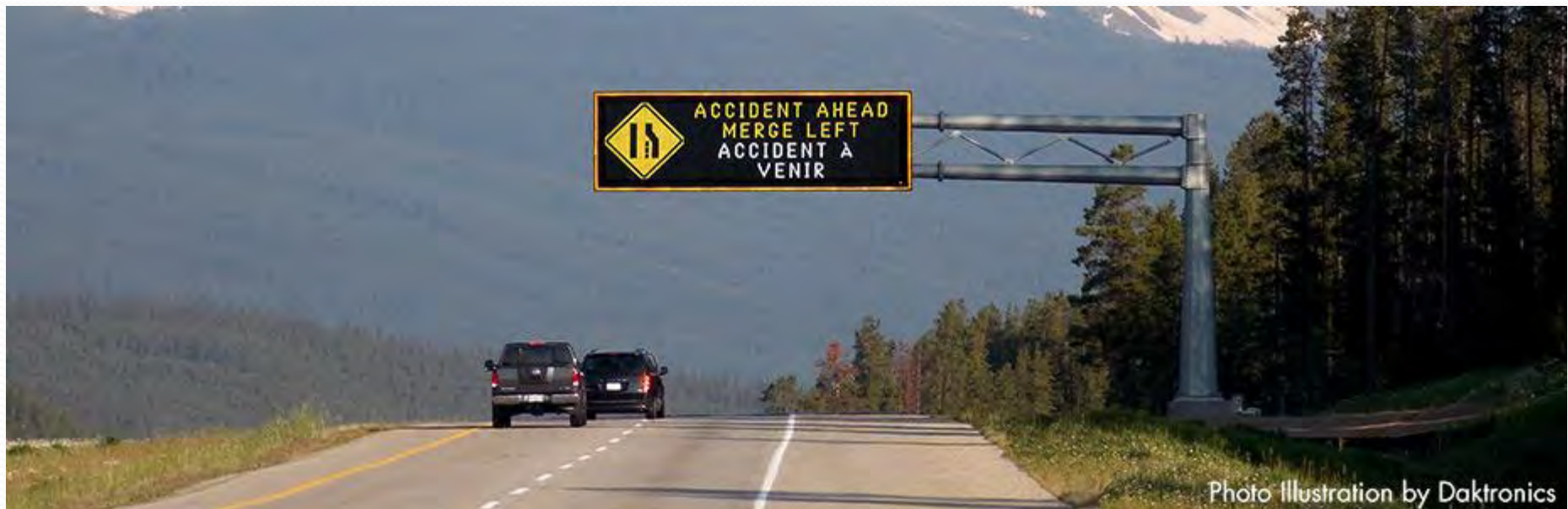
- 55 DMS Statewide With State Communication Center's Control
 - 37 Daktronics
 - 17 ADDCO
 - 1 3M (MOR Display Technologies)
- Some portable DMS could be integrated in the future.
- Four DMS are located in neighboring states.
 - Weather issues – Utah Storm – Local Power Out
 - Oregon Blue Mountain Closures – Turn on more DMS

Hardware Integration

- UPS (Uninterruptable Power Supply) installed in the cabinet. Good investment.
- Some DMS have two controllers, one for communications and one for sign board control. The communications controller, modem, and booster should be on the UPS to stop minor power glitches from putting the DMS out of touch.

DMS Lessons Learned

- Put main controller, modem, and cell signal booster, on a UPS.
- Daktronics – Recommend future purchases
- ADDCO- Recommend containment
 - Interim owner of ADDCO used lower quality suppliers.
 - High repair costs
 - More repairs
- Some expensive coax cables for the modem's RF signal were bad. The center core solid wire may not have extended out far enough from the connector to make a good contact with the devices; or the connectors were not attached properly at the factory. We found that the cell signal booster was NOT needed after the cable was replaced.



Phil Braun testing in Idaho,
Daktronics in Washington State

New Bucket Truck Was Cleaning Luminaires.
Staff Didn't Lower The Truck Boom Between
Poles And Damaged The DMS.



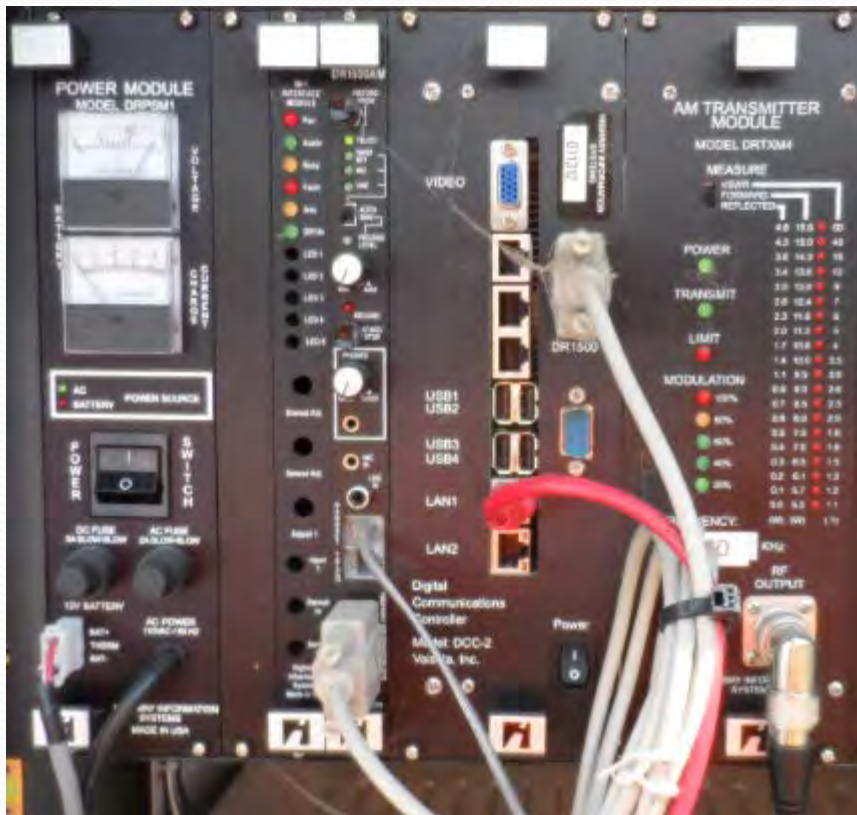


HAR – Highway Advisory Radio

HAR on SH-55 Eagle, Idaho



HAR on SH-55



Background

- Highway Advisory Radio - HAR
 - 25 Statewide
 - Status
 - iNET testing has started
 - 3 analog telephone sites deferred – added cost.
 - Verizon closed out our IP range. Upside, more IP's put on cheaper M2M account and on a private network. A DMS was hacked from overseas this spring on the public network.
 - Vendor didn't understand the FCC requirement of broadcasting a call sign every 30 minutes.

Background

- Highway Advisory Radio - HAR
 - Status Continued
 - Text-to-Voice quality issues.
 - Adding pauses between spoken words or syllables.
 - ITD has not taken delivery of the HAR sites from the construction builder. Successful remote connection required. Sites sat unused for 3 and 4 years. If not covered in plastic - citizens and districts complain.

HAR Lessons Learned

- Use a UPS on the complete system.
- Antenna is grounded at the pole and again in the transmitter cabinet.
- Place modems so the status lights can be observed.
- Use cabinets with front and rear doors.
- Concrete standing pads are good at main testing sites. Plants with spiders and standing in mud is not enjoyable.
- Pull out drawers for laptops should be required.
- Velcro® handsets in place.

Highway Advisory Radio at Idaho City



Future Plans and Opportunities

Consider additional modules and cross platform integration:

- **Traffic Signal Control**
- **AVL: Automatic Vehicle Location Module**
 - Interface to vehicles – Displays location on a map
- **ESS: Environmental Sensor Station Module**
 - Interface to RWIS weather conditions statewide.

Future Plans and Opportunities

Snow Plow: Intelligent Snow Plow Module

- Interface to Maintenance Vehicles.

• **TT: Travel Times Module**

- Interface to DMS for travel time functionality.

• **ATIS/511: Advanced Travel Information System**

- Interface to 511.

• **C2C: Center-to-Center Module**

- Interface to other agencies

RWIS – Road Weather Info. System

- Idaho has over 115 RWIS sites.
- Idaho has more noninvasive sites than any other state or country. Vaisala optical sensors are used instead of in-pavement sensors which require cutting and drilling to install.
- Snow plow drivers check conditions and load the proper material to disperse. Idaho has saved thousands of dollars in material cost and increased the grip, safety, and drivability of our roads.

RWIS at Montana-Idaho Border



ITD Staff or Phil Braun



RWIS at Highland Valley Summit



Non Invasive Pavement Sensors





Demo – If time allows.

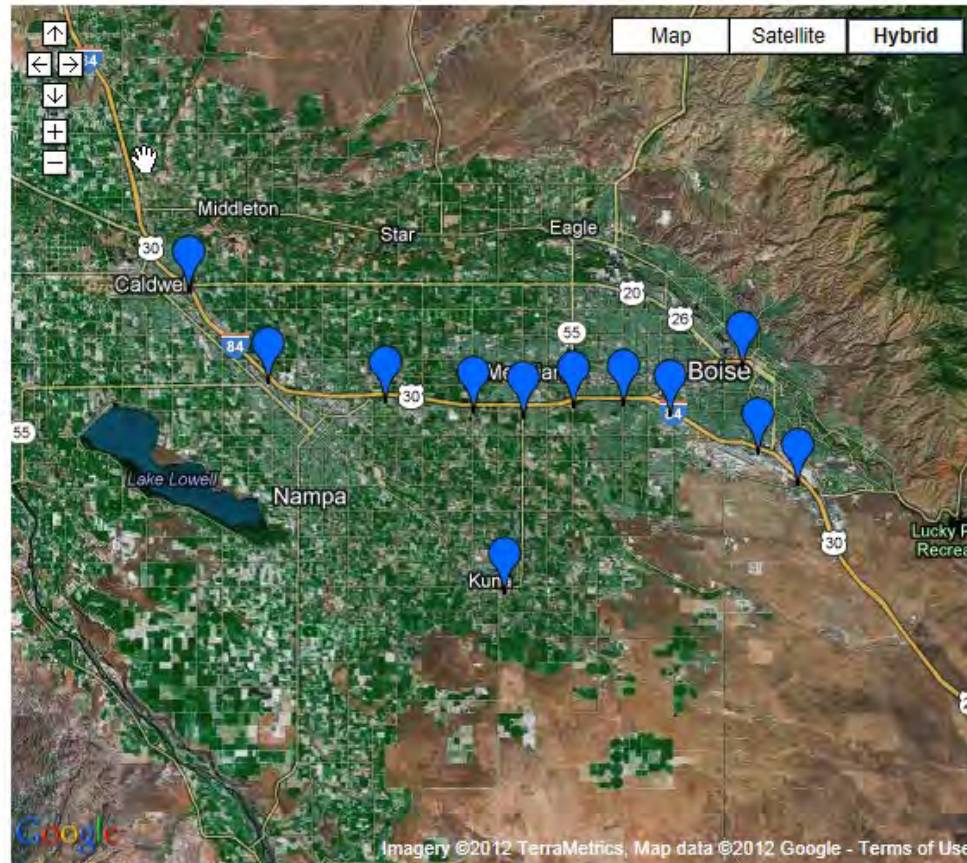
Bonus 1 -

Freeway Congestion Monitoring

- ITD started a pilot project to quantify freeway congestion in the Boise area (I-84 and I-184)
- Contract with a 3rd party data provider was executed
- After several months of study the team concluded that the data service was not meeting our needs due to data round off and defaulting to historical data
- The team decided to try a Bluetooth data collection approach
- RFP was advertised and a vendor selected to furnish 10 units plus the data service
- After initial problems were resolved data collection is going well

Bluetooth Detectors on I-84/I-184

Status: **Active**



Bluetooth Detector with Cellular Communications and Solar Power



Bluetooth Segments

- The BlueTOAD detector listens for the Device ID Profile - Media Access Control (MAC) address of any passing bluetooth device, such as a phone or toy. It records and time stamps detections. The neighboring BlueTOAD devices do the same. Periodically the data is uploaded to the vendor – via cell phone links.
- When a report is desired the begin and end road section are selected, the dates, & time range. Data is smoothed. A report matches up MAC address that passed by and calculates the time of travel.

Bluetooth Data for I-84 Segment

Report Parameters

Pair / Route

4391: (I-84 & Eagle Rd (u1201) to I-84 & S Five Mile Rd (u470))

Start Date

2012-09-10 00:00:00

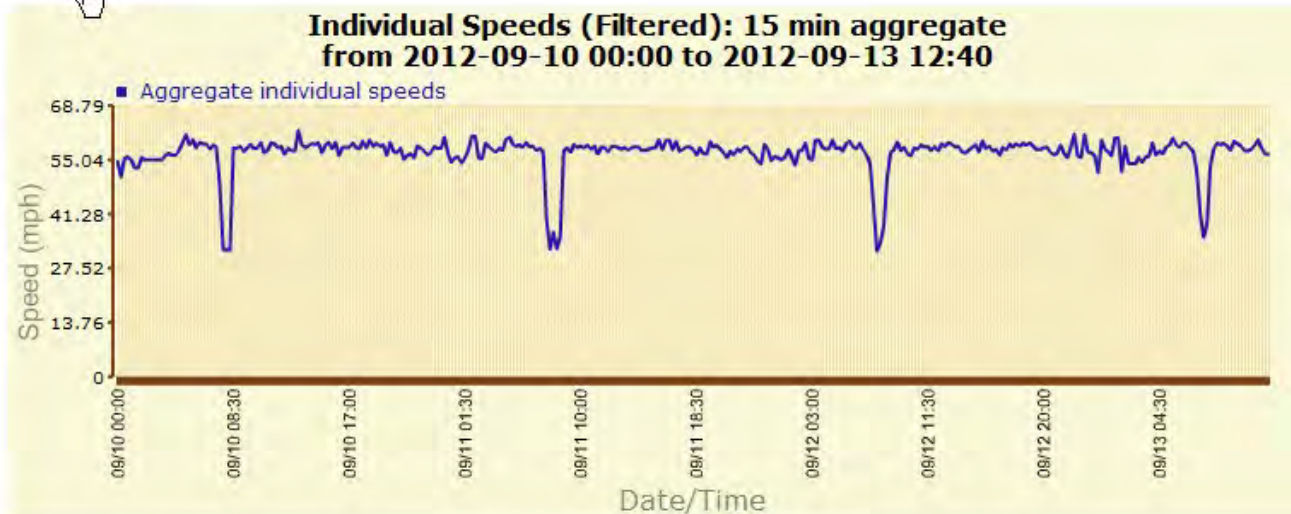
End Date

2012-09-13 12:40:14

Type

Individual Speeds (Filtered): 15 min aggregate

Chart Options



Bluetooth Data for Entire Route

Report Parameters

Pair / Route

Route 4746: (I-84 & Franklin Blvd (u1204) to I-84 & N of Gowen Rd (u1206) - East Bound)

Start Date

2012-09-13 00:00:00

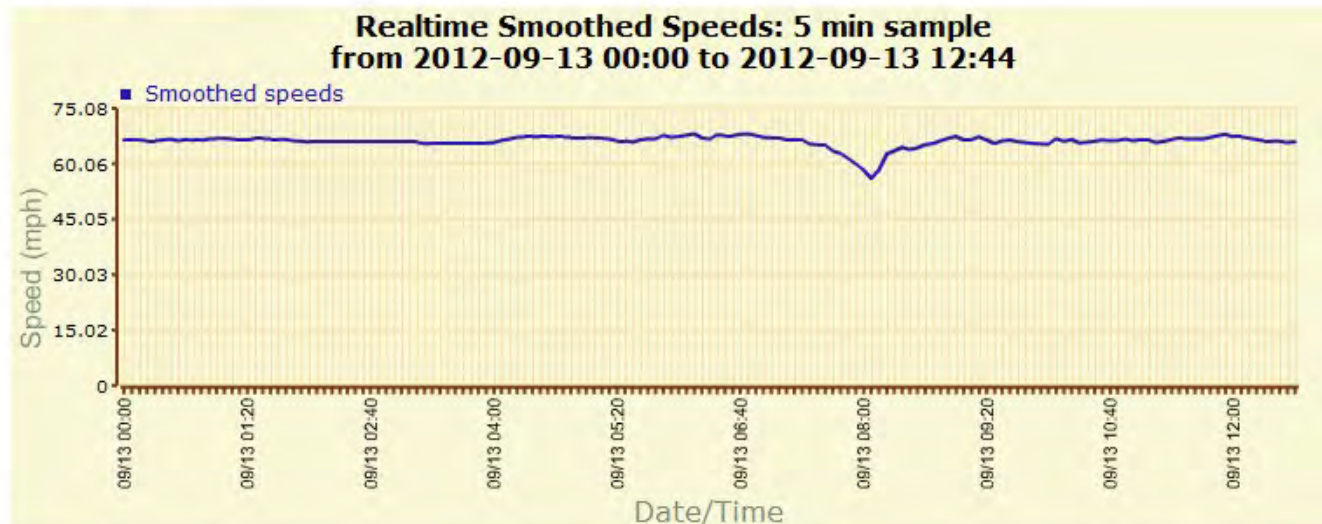
End Date

2012-09-13 12:44:25

Type


Realtime Smoothed Speeds: 5 min sample

Chart Options



Adaptive Signal Control Project



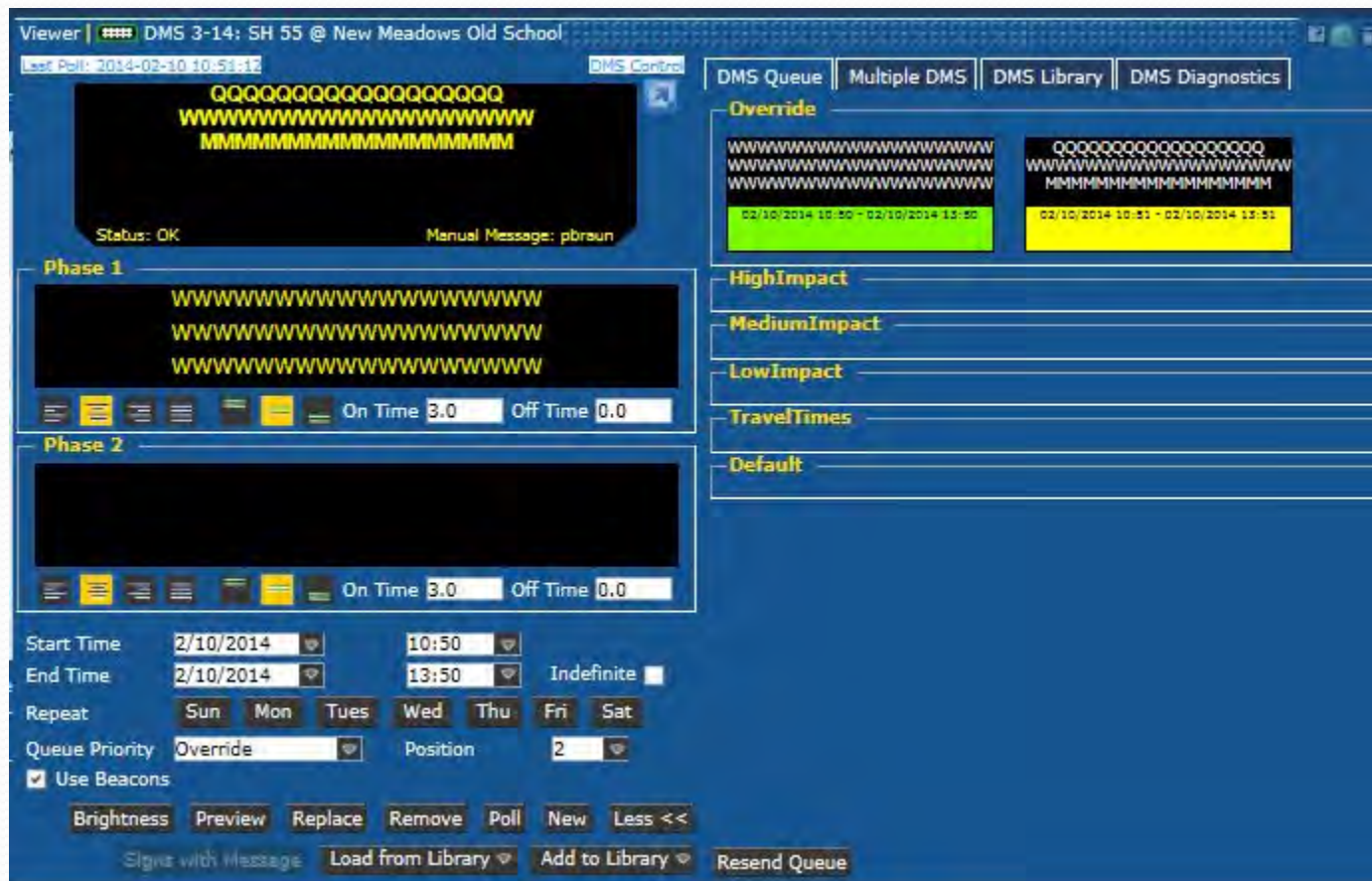


Bonus 2 - iNET Examples

PC Control of CCTV



PC Control of DMS



District 1 Office Video Wall



District 3 Office Video Wall In Progress



Bonus 3 -

ACHD's CCTV Bracket From Off The Shelf Parts

- Poles with matched CCTV arms from pole manufacturer.



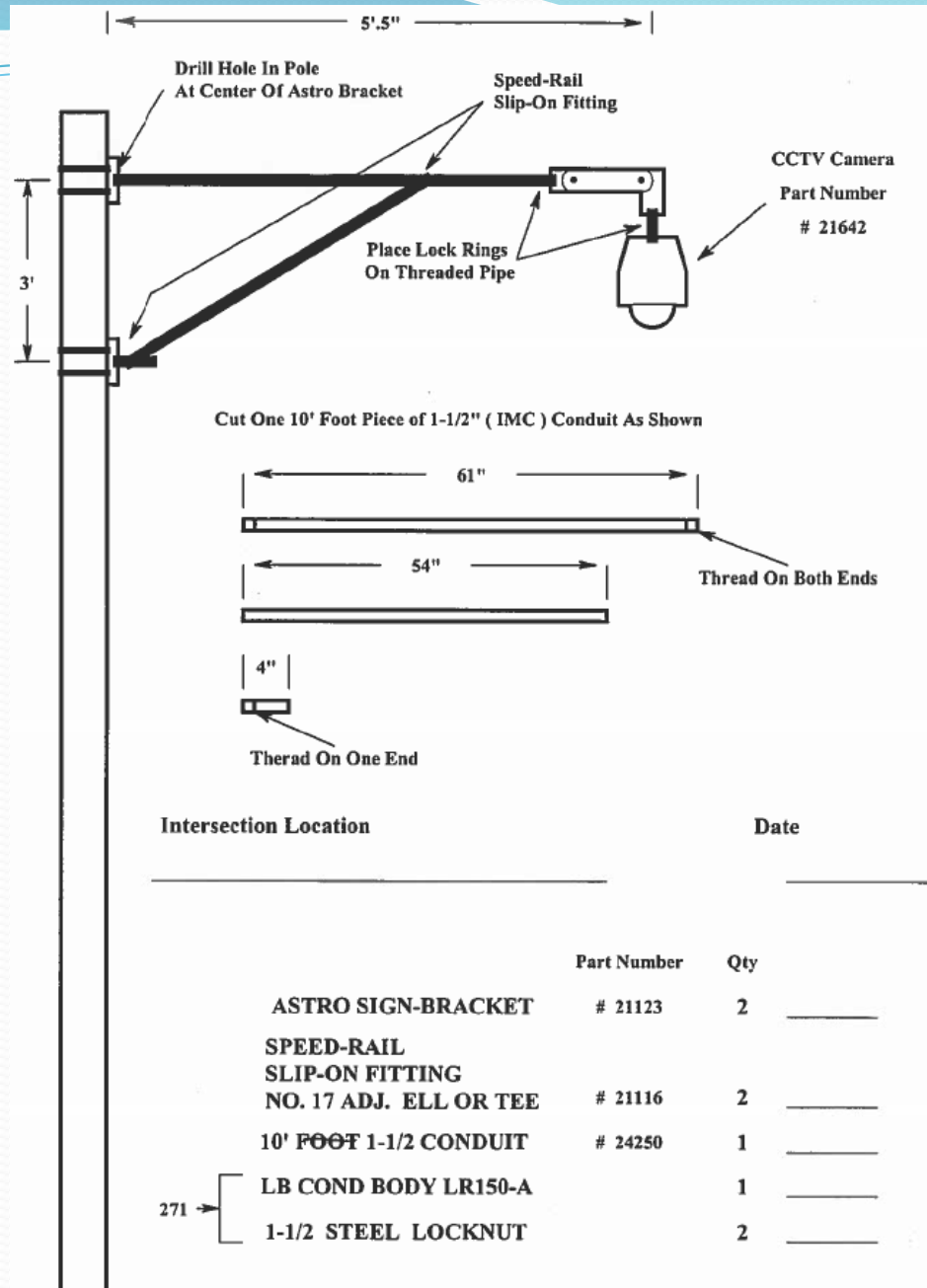
ACHD's CCTV Bracket



ACHD's CCTV Bracket



ACHD's CCTV Bracket



POLE MOUNT CAMERA BRACKET ASSEMBLY



Comments or Questions?

Control of DMS, CCTV, & HAR Presentation

Definitions

By Phil Braun

D1-D6 - ITD separated the state into six districts for better local support of state mandated tasks. D3 is District 3 - which services the capital city of Idaho.

511 - A website for displaying current travel information, road closures, highway photos, danger zones, and construction warnings.

ACHD - The Ada County Highway District.

ALPR - Automated License Plate Readers.

ATIS - Advanced Travel Information System.

ATR - Automatic Traffic Detectors.

AVI - Automatic Vehicle Identification.

AVL - Automatic Vehicle Location - On board a vehicle, a GPS receiver passes current location information (latitude and longitude data) to a transmitter which sends it to a TMC. The computer at the TMC displays the vehicle's location on a visual map for instant reference.

Bluetooth - A type of radio communication used with cell phones and ear pieces, laptop PCs, headsets, networks, remote speakers, gaming controllers, cars, and toys.

C2C - Center-to-center. Exchange data between TMCs, systems, and organizations.

CAT5e - Type of Ethernet communication cable.

CAT6 - Type of Ethernet communication cable.

CCTV - Closed Circuit Television.

CVISN - Commercial Vehicle Information Systems and Networks.

DMS - Dynamic Message Signs.

ETS - ITD's Enterprise Technology Services (computers, networks, telephones).

ESS - Environmental Sensor Station.

FHWA- Federal Highway Administration.

FTA - Federal Transit Administration.

GPS - Global Positioning System - Using satellites a device calculates the location (longitude and latitude) of the antenna/device.

HAR - Highway Advisory Radio.

HQ - Headquarters (Main state office for the state highway department).

iNET - Intelligent NETworks®. ITS software by Parsons (Delcan) to control DMS, CCTV, HAR, Traffic Signals, AVL, Congestion Monitoring, etc.

IP - Internet Protocol.

IP66 - International Protection Marking, numbers indicate level of protection.

IT - Information Technology (Computer Services).

ITB - Invitation To Bid.

ITD - The Idaho Transportation Department.

ITS - Intelligent Transportation Systems.

M2M - Machine-to-Machine, A type of cell service account that is cheaper.

MAC - Media Access Control address.

Midspan – Injects power and passes through data on Ethernet CAT5e & CAT6.

NAT - Network Address Translation (A device on Network AA wants data from a device X on Network BB. Network AA sets up an IP address on the AA Network but when a request is made to that address - the AA Network translates the request to the actual address on the BB Network, handles the network pass through & firewall issues, and sends the packet on to device X.

POE - Port of Entry.

PoE - Power over Ethernet.

PTZ - Pan-Tilt-Zoom, movement of a camera and lens.

RFI – Request for information – not a bid.

RFP - Request For Proposal – What types of solutions are available?

RFQ – Request For Quote.

RWIS - Road Weather Information Systems.

TMC - Traffic Management Center.

TT - Travel Times.

UPS - Uninterruptable Power Supply.

Wi-Fi - A type of radio communication used with laptop PCs, networks, cell phones, cars, toys, and other devices.

WIM - Weigh-in-motion.

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FHWA - Federal Highway Administration.

FTA - Federal Transit Administration.

GPS - Global Positioning System - Using satellites a device calculates the location (longitude and latitude) of the antenna/device.

HAR - Highway Advisory Radio.

HQ - Headquarters (Main state office for the state highway department).

iNET - Intelligent NETworks®. ITS software by Parsons (Delcan) to control DMS, CCTV, HAR, Traffic Signals, AVL, Congestion Monitoring, etc.

IP - Internet Protocol.

IP66 - International Protection Marking, numbers indicate level of protection.

IT - Information Technology (Computer Services).

ITB - Invitation To Bid.

ITD - The Idaho Transportation Department.

ITS - Intelligent Transportation Systems.

M2M - Machine-to-Machine, A type of cell service account that is cheaper.

MAC - Media Access Control address.

Midspan – Injects power and passes through data on Ethernet CAT5e & CAT6.

NAT - Network Address Translation (A device on Network AA wants data from a device X on Network BB. Network AA sets up an IP address on the AA Network but when a request is made to that address - the AA Network translates the request to the actual address on the BB Network, handles the network pass through & firewall issues, and sends the packet on to device X.

POE - Port of Entry.

PoE - Power over Ethernet.

PTZ - Pan-Tilt-Zoom, movement of a camera and lens.

RFI – Request for information – not a bid.

RFP - Request For Proposal – What types of solutions are available?

RFQ – Request For Quote.

RWIS - Road Weather Information Systems.

TMC - Traffic Management Center.

TT - Travel Times.

UPS - Uninterruptable Power Supply.

Wi-Fi - A type of radio communication used with laptop PCs, networks, cell phones, cars, toys, and other devices.

WIM - Weigh-in-motion.