Procuring the Advanced Transportation Controller (ATC) for the Oregon Department of Transportation and the State of the National Standards

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ODOT's Need for a Controller

- Ramp Metering in Eugene.
  - 70 miles away from regional TOC in Salem
  - 110 miles away from ramp metering server in Portland
  - Leased dark fiber. Gigabit Ethernet network.
- Existing Ramp Metering in Portland
  - 155 ramps all serially connected to central server
  - 170E controllers, Waipiti, SWARM
  - SWARM part of ATMS developed for Unix back in the 90's. Software/hardware outdated.
- Existing 2070 traffic signal controller as a possible upgrade path
  - Issues with networking and SCATS
  - Issues with OS-9
  - ODOT relies on Caltran's QPL

ODOT's Need for a Controller (Continued)

- **ITS Unit needs a field controller for special projects.**
  - Weather Warning Systems – replacement of PLCs and SSI/Vaisala RPU
  - Parking management system and gates for Multnomah Falls Rest Area
  - Over length detection
  - Queue warning systems
  - Local control with central recording vs central control (field controller vs. computer server).
  - Need a long term price agreement contract such that the controller is static over time. I do not want to have to change hardware, software regularly within ODOT's IS organization. There is a fence between Highway and Information Services.
  - Do not want to have to react to a manufacturer's business decision to drop a product line or change something that impacts my projects in development or in operation.
  - I wanted a controller that is accepted by the traffic community nationally and within ODOT. Support by IS technicians, traffic technicians, and electricians. Most at ODOT do not know what a PLC is. If I build it, I support it. Questions from maintenance even if it is working or not. Don't know if the black box is working.

ODOT's Need for a Controller (Continued)

- **Is the ATC ready or use the 2070E?**
  - Discussed ODOT's adoption of the 2070 several years ago with NEMA representatives at the NTCIP Joint Committee in Chicago.
  - In order to convince ODOT to use the ATC, I brought in several manufacturers of our 2070's and asked the question "From a business decision, do you want to build 2070's or ATC's? Where is your development and support at?" They always built to ODOT's specs. ODOT needs to engage the controller community to see where they are going, or want to go. They do not want to hire OS-9 developers as an example. Easier to get Linux. Prefer ITE ATC standards process than Caltrans TEES and their QPL.
  - Several DOT's receiving various versions of ATC's.
  - Manufactures stating they can meet ATC v5.2b in sales literature.
  - ODOT Traffic, wait approach for someone else to lead. Follow Caltrans.
  - My approach, if you want something done figure it out or get someone that can do it. Waiting for others to solve your problem doesn't solve YOUR problem.
  - Manage risk by writing clear requirements and test. Don't ask for something if you don't plan on testing or know how to test the requirement.

Traffic Controllers

- NEMA TS1 and TS2
  - Functionality based. Fit and form specified only for interoperability.
  - TS1 – 1976, 1983
  - TS2 – 1992, 1998, 2003
- 170E, 170 ATC
  - Caltran's and NYDOT in the 1970's.
  - TEES 1999, upgrades the CPU.
  - Hardware and software specified in detail. All boxes should be the same.
- 2070E, 2070L, 2070 ATC
  - Caltran's TEES 2009 and Errata's
- ATC
  - ITE, NEMA, AASHTO, USDOT
  - 2002 to current
- Additional Information
  - See FHWA Traffic Control Systems Handbook
  - See www.ITE.org/standards/index.asp

Controllers

ODOT Organization

- Traffic signal controllers are the responsibility of ODOT's Traffic department. All civil engineers or technicians without an understanding of hardware and software. Strong culture of following Caltran's TEES. Do not like change.
- Traffic Signal Services Unit (TSSU). Responsible for testing controllers and cabinets prior to field deployment, chamber testing. All technicians. Roles and responsibilities issues with Traffic. The Technicians know more than the Engineers. Strong culture of following Caltran's TEES. Do not like change.
- ITS Unit is primarily responsible for VMS, RWIS, HAR, CCTV, (communications and software with ODOT ISB).
- ITS Standards Engineer – Control Systems Engineer, strong background in instrumentation, controls, system software integration, and communications. Experience from the process and manufacturing industries. I sit on the NTCIP Joint Committee and the ATC Working Group. I do not have authority over the other individuals necessary to support a new controller with the Agency (change).

ITE ATC Standard

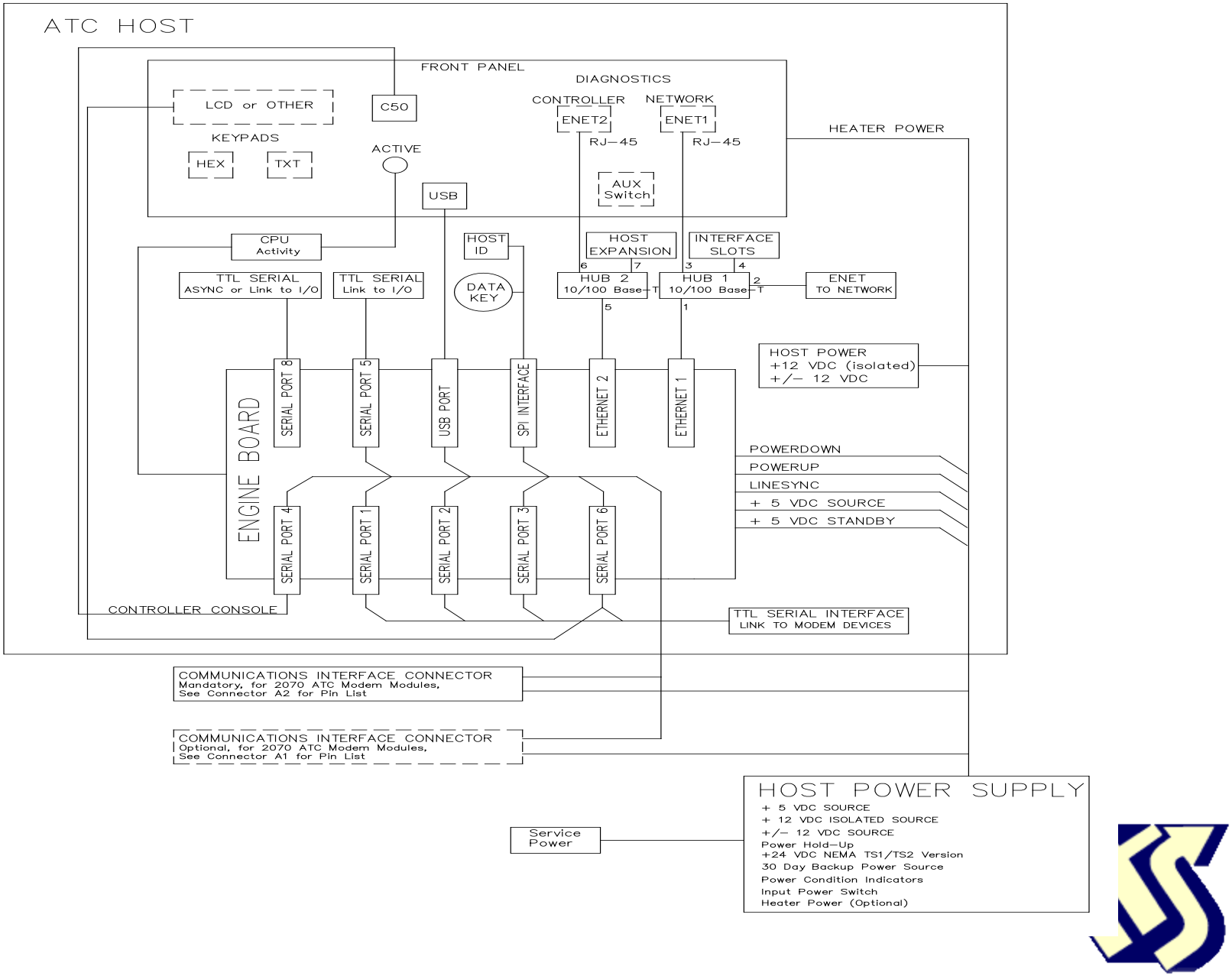
- “This standard describes a family of advanced, ruggedized field communications and process controllers that are configurable for a variety of traffic management applications.”
- “The goal of this standard is to provide an open architecture design for the next generation of transportation controller applications.”

ATC Usage

- Traffic Signal
- Traffic Surveillance
- Lane Use Signals
- Communications
- Field Masters
- Ramp Meter
- Dynamic Message Signs
- General ITS beacons
- CCTV Cameras
- Highway Rail Intersections
- Speed Monitoring
- Incident Management
- Highway Advisory Radio
- Freeway Lane Control
- High Occupancy Vehicle Systems
- Access Control
- RWIS
- Irrigation Control

ATC Hardware Components

- Front Panel Assembly
- I/O Module
- Host Board
- Engine Board
- Chassis
- Power Supply
- Communication Module


ATC HOST
FRONT PANEL
LCD or OTHER
KEYPADS
HEX
TXT
C50
ACTIVE
USB
DIAGNOSTICS
CONTROLLER
NETWORK
ENET2
ENET1
RJ-45
RJ-45
AUX Switch
HEATER POWER
CPU Activity
HOST ID
HOST EXPANSION
INTERFACE SLOTS
TTL SERIAL ASYNC or Link to I/O
TTL SERIAL Link to I/O
DATA KEY
HUB 2 10/100 Base-T
HUB 1 10/100 Base-T
ENET TO NETWORK
ENGINE BOARD
SERIAL PORT 8
SERIAL PORT 5
USB PORT
SPI INTERFACE
ETHERNET 2
ETHERNET 1
HOST POWER +12 VDC (isolated) +/- 12 VDC
POWERDOWN
POWERUP
LINESYNC
+ 5 VDC SOURCE
+ 5 VDC STANDBY
SERIAL PORT 4
SERIAL PORT 1
SERIAL PORT 2
SERIAL PORT 3
SERIAL PORT 6
CONTROLLER CONSOLE
TTL SERIAL INTERFACE LINK TO MODEM DEVICES
COMMUNICATIONS INTERFACE CONNECTOR Mandatory, for 2070 ATC Modem Modules, See Connector A2 for Pin List
COMMUNICATIONS INTERFACE CONNECTOR Optional, for 2070 ATC Modem Modules, See Connector A1 for Pin List
HOST POWER SUPPLY
+ 5 VDC SOURCE
+ 12 VDC ISOLATED SOURCE
+/- 12 VDC SOURCE
Power Hold-Up
+24 VDC NEMA TS1/TS2 Version
30 Day Backup Power Source
Power Condition Indicators
Input Power Switch
Heater Power (Optional)
Service Power

The Need for a Consultant

- Brought in Peter Ragsdale through our ITS flex service contract with consultants. I knew Peter when he was the traffic controller manager at US Traffic several years ago. He was instrumental in one of the early developments of the ATC for New York City DOT. I also sit with Peter on the NTCIP Joint Committee. Peter is also a key member of the ITE ATC Working Group Committee. I wanted someone that knew the 170, 2070, and ATC standards, Caltran's acceptance process, and could test the controller to our requirements. Peter is also very knowledgeable about the variety of manufacturer's traffic signal software.

The Need for a Consultant (Continued)

- **Peter's scope of work**
  - Meet with ODOT staff and discussed the state of the 2070E and ATC standards. Listening to issues we have with the 2070E.

    Used to get Traffic cultural buy-in.
  - Wrote the draft ATC specifications with me.
  - Review the selected Intent to Awardee's proposal. Selection made by ODOT and FHWA staff only.
  - Inspection of the hardware and software.
  - Review and approve Intent to Awardee's test plans.
  - Witness testing.

RFP Process

- First step, get FHWA involved. Have them buy-in to ODOT establishing a long term price agreement. ODOT intends to supply the ATC to construction projects as an anticipated item. Why a price agreement contract and not a QPL? ODOT does not have a TEES department like Caltrans or Florida DOT. Too much variability between controllers of different vendors.
- Mandatory requirements were easily or currently met by the industry. TEES, ITE ATC v5.2b, NEMA TS2, etc. Market survey. Desirable requirements were ATC v6 draft, API, or ODOT requirements where the standards were silent. IEC, UL, etc.

RFP Process (Continued)

- API – A concern. Siemens was paid by FHWA/ITE to develop but was never completed. Will manufacturer's have this in time? Impacts the bigger picture of using the ATC for other ITS projects. The likelihood that the ATC and Ramp Metering Firmware would be two different Contractors.
- General scoring – strength of the Proposer. Resumes' of the individuals responsible for hardware, software, management, quality assurance process. Involvement with the ATC standards process. Knowledge of Linux.

RFP Process (Continued)

- DOJ review. Attorney specialized in software licensing. Many discussions regarding the ATC standards and GPL licenses. Lengthy review caused the hardware and firmware to be broken into two RFPs. Get the ATC RFP on the street ASP since the hardware will take longer to develop.
- ITE did not post ATC v6 draft standard on their website. You had to be in the loop to have a copy. I requested ITE make available on their website.
- ITE changed the draft standard right before RFP released. Numbers referenced in the RFP impacted. ITE ATC 5201 V06.
- Price 40%, Scored Items 60%.
- Selection committee – ITS Standards Engineer, TSSU Manager, ITS Manager, Traffic Signal Standards Engineer, R1 Traffic Engineer, and FHWA ITS Engineer

Standards

- ITE ATC v5.2b. Last approved version (2006)
- Caltran's TEES 2009
- ITE ATC v6.0a draft (2011)
- NEMA TS2 (1992, 1998, 2003)
- ITE ATC API v2.06b
- ITE ATC API v2.17 draft
- ITE API VAL Suite SRS v0.100 draft

Standards (Continued)

- Many of the requirements of NEMA TS2, TEES2009, ATC, NEMA TS4 do not reference a source to the specification. Examples are vibration and shock. The documents require a specific values be met but why those values? Someone on the working group or legacy from NEMA TS2? Peter and I are trying to change the ATC standard to use existing industry standards if they exists. IEC has standards for shock and vibration that could be used. IEEE has many standards for electrical utilities that could be used.
- Traffic industry standards should be uniform for electrical and environmental. VMS, RWIS, HAR, traffic signals, communication equipment all goes in the same cabinets. Simple saying NEMA TS2 or NEMA TS4 (VMS) isn't sufficient.

Standards (Continued)

- Concern – the number of serial ports required by the ATC and the ITS cabinet is influencing the CPU. Support of 6 serial ports. Try to find a computer that supports serial ports.
- Peter and I have commented that the controller and cabinet need to support a different communication means other than serial (SDLC and HDLC). Momentum behind this from suppliers with surplus equipment and Caltran's TEES. Traffic engineers only know serial.

Proposals

- 3 Proposals
- ATC 5.2b compliant in manufacturer’s cutsheet vs their response in a proposal.
- Protest of 170E experience. Removed 170E requirement from the RFP.
- Protest to request development time of hardware
- Protest to request $100,000 for the development of the API
- Clear winner in the selection process.

ATC Proposed-General

- Linux Version
  - Linux kernel version 3.0
- BusyBox
  - Version 1.18.5
- UClibc
  - Version 0.9.32
- DRAM
  - 64 MB
- Flash Memory
  - 52 MB

ATC Proposed-Continued

- Software Development Kit
- No proprietary software. GPL v2 licensed
- API Development Tools
- CPU (Freescale 400 MHz)
  - RFP required 300 MIPS minimum. Contractor is providing 700 MIPS. Discovered MIPS is not adequate for a performance specification from discussions with Freescale. Peter feeding back to ATC committee.

Intent to Award

- Issued Intent to Award to Intelight
- Intelight sent Peter a sample of their latest controller.
- Peter found issues immediately. Intelight reworked the controller with their supplier.
- Intelight submitted schematics and BOM.
- Peter found issues from the schematics and researching the materials.
- Meeting with Intelight, Peter, James Kinnard with Adaptive Solutions Inc. (ITE ATC WG member), and myself to finalize punchlist. Several items, this is what the standards says vs. the intent of the standard or industry acceptable. Easily resolved.
- Caltrans accepted for one supplier but rejected the other. Intelight's experience with Caltran's vs. Peter's.
- Peter submitted several comments to the ATC committee for providing clarification in the standard based on this project.

List of Issues

- Initial List of Issues

ATC Testing

- Inspection Testing by Peter
  - Hardware, software, schematics, BOM
- Environmental Testing
  - Tektronix in New Jersey
- Testing at ODOT
  - SDK, timing of the controller using traffic signal software - Peter, ODOT chamber testing (ODOT internal reasons).

ATC Testing

- April 22 thru April 29th
- Link to Test Worksheet

ATC Summary

- ODOT's version ATC needs about 2-3 months of firmware development, drivers, and testing.
- Will not be done in time for ramp metering effort in Eugene.
- Intelight provided ODOT with 4 ATC v5.2b controllers for temporary use. These controllers are installed on the street in over 500 locations.

ATC Summary Continued

- **Hardware Items**
  - Power Supply (May 31st)
  - Power Supply Firmware Updates (May 31st)
  - 1C Engine Board Hardware Turn (June 7th)
  - Hardware Assembly-10 units (June 14th)
  - External Environmental Testing (June 24th-June 28th)
  - ODOT Testing (June 24th-June 28th)

ATC Summary Continued

- **Software Items**
  - DAT Program Updates (May 24th)
  - Serial Driver Updates (May 24th)
  - Front Panel API Updates (June 7th)
  - Complete PC Update Program (June 7th)
  - USB Driver Updates (June 14th)
- **Documentation**
  - Build and SDK Documentation (May 24th)
  - Updated Hardware Manual (June 28th)

Firmware Requirements

- Need ramp metering firmware for the ATC.
- Need programming services for other projects that come up. I prefer local control if possible (Control Systems Engineering 101). Not impacted by server OS patches, upgrades, database upgrades, network outages, etc. These are controlled by ODOT Information Systems.
- Traffic signal migration? Current state of traffic signal firmware on the 2070 in Oregon.
- RWIS contract issues.
- Need a replacement for PLCs.

Ramp Meter Firmware RFP

- Enterprise license for ramp metering firmware. 10 year price agreement.
- Ramp metering experience of Proposer
- Ramp metering requirements, mandatory and desirables
- Experience developing applications for Linux
- NTCIP for ramp metering involvement with the standard (I am not as familiar with NTCIP 1207. Concern of ODOT Traffic's requirements and the standards. Possible conflicts. Start up procedure, example)
- TSS data for loops and Wavetronix. Wavetronix non-TSS data desirable (85^{th} percentile, overlength detection, individual speeds, gap, headway, classification).
- Traffic signal experience. NTCIP. AB3418
- Programming Services for Other (DMS – drum sign upgrades, On/Off or Open/Close – traffic gates, parking management In/Out counter, Queue Warning, Overlength Detection)

Programming Services

- To address the procurement or development of other firmware.
- Negotiate Scope of Work, Schedule, and Cost.
- Near future.
  - Develop an A/D card for the ATC within the ATC contract. Develop NTCIP ESS firmware for the ATC to monitor RWIS data.
  - Develop parking management system (In/Out Counter) and traffic gates for Multnomah Falls on I-84 in the Columbia Gorge.

Proposals

- Selection Committee – same as the ATC.
- 3 Proposals
- Cost factor drove the selection. Cost was 40% of the RFP. 60% scored items.
- Selected Intent to Awardee – Intelight.

Intent to Award

- Ramp meter firmware and compatibility to Delcan's SWARM central software, NTCIP 1201, 1207, and 1209 standards. List of NTCIP objects are in both contracts. The requirement to work with each other. Difficult getting into Delcan's contract due to IS.
- Intelight's controller uses a web browser interface. Local panel screen matches browser. Similar interface for all their applications.
- Local database. Support of xml and csv. Looking at using xml for interfacing with ODOT custom software when NTCIP standards are not addressed (parking management status, gate status).
- Peer to Peer support.

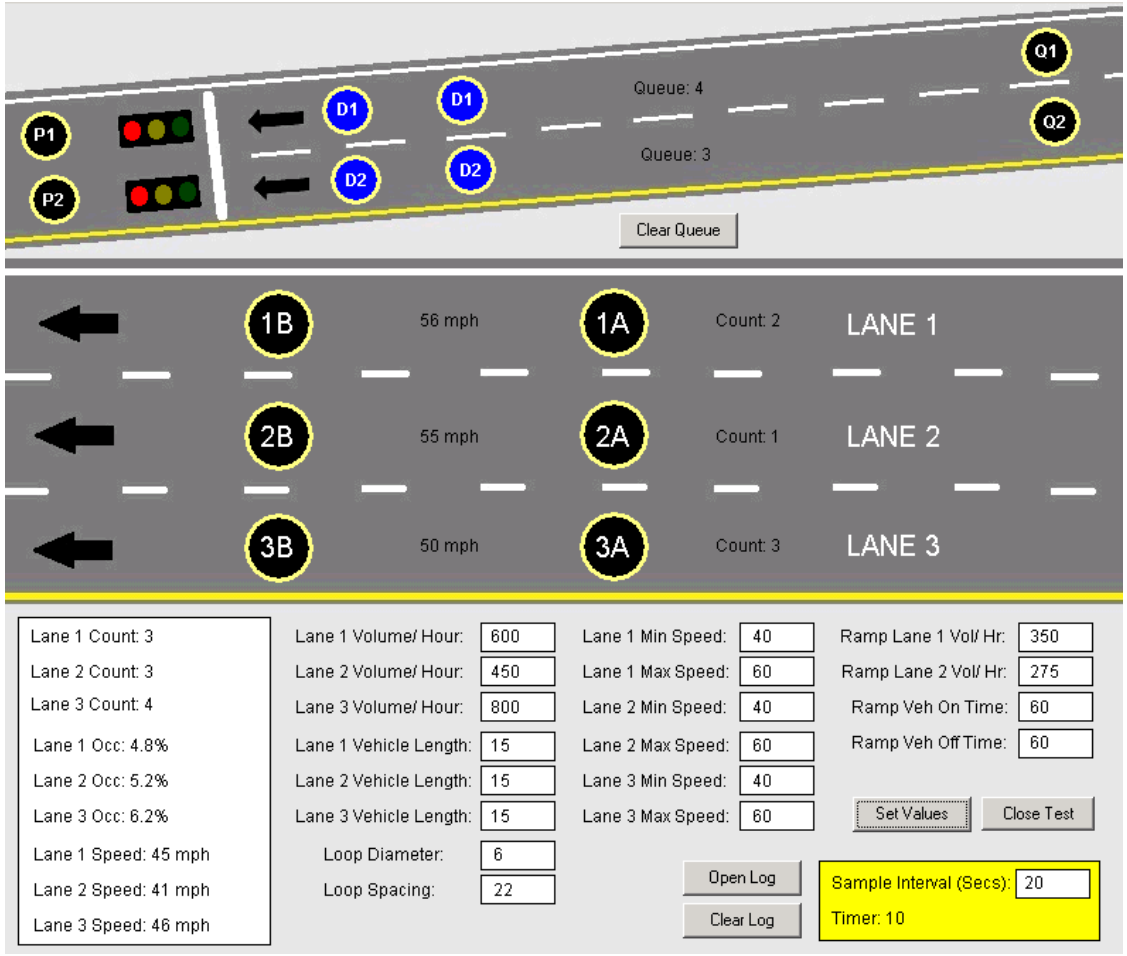
Development

- Ramp metering turn on in Eugene in June 2013. Need to be testing local and central April-May.
- Delcan's role: To develop SWARM as a web application and develop a Data Acquisition Module. This is a module between SWARM and the ATC. It communicates ramp metering and TSS. It passes traffic data to be used by other ITS application processes – travel time, queue warning, VSL, etc.
- Intelight provided a Windows and Linux version of the ramp metering software with NTCIP connectivity to ODOT for screen reviews and to Delcan for NTCIP integration.
- Delcan didn't use, their contract requires a ATC with firmware for 30 days for development purposes.

Testing

- April 22 thru April 29th
- In parallel with ATC testing.
- Running ramp metering firmware on an Intelight ATC built to an earlier version. OS the same.
- Developed a program to run on a PLC for testing local traffic responsive mode and central mode.

Simulator Interface



PLC Tester

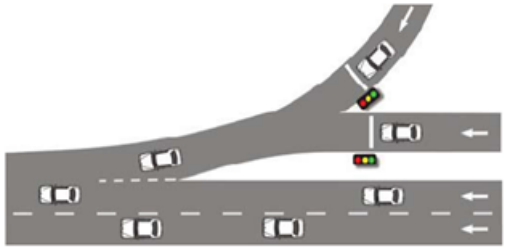
- Allows us to configure inputs (speeds, volumes, occupancy) minimum and maximum settings. The program has a random generator to vary outputs within the input range.
- Sends the data to a csv file
- C1 connector to ATC

Functional Testing

2.3 Split Entrance Ramps

Description:

The split entrance ramp scenario occurs when two ramps are closely spaced together. These ramps can either operate as one logically combined group, or as two separate ramps. When logically combining the group, the two ramps operate as one with a combined metering rate, but alternate green assignments proportionally based on the vehicle demand for each lane.



This scenario should consider configurations managed by one cabinet, including:

- Two, two-lane metered ramps
- One two-lane ramp and one one-lane ramp
- One one-lane ramp and one one-lane ramp

Req #	Category	Requirement Text	Acceptance	Test Date	Comments
5.2.4	Split Entrance Ramps	Firmware shall support flow rates of 200 to 1,800 vehicles per hour per lane.			
5.2.5	Split Entrance Ramps	The Firmware shall support red time extension using passage detectors. When cars are detected going thru the ramp meter during "red" signal, the RMC automatically extends the red time to extend the gap.			
5.2.3	Split Entrance Ramps	Ramp meter Firmware shall support metering with the following lane configurations:			
		• Each lane served consecutively			
		• One lane can operate independently with a different rate than other lanes, effectively operating as two independent ramp meters			
		• For multiple lanes (split ramp), Firmware shall have configuration option to automatically adjust the ratio of green indicators for each lane proportional to the percentage of demand from each lane			
5.2.10	Split Entrance Ramps	Metering rates shall be implemented by varying red time between constant green indications.			

Ramp Meter Firmware Interface

Lane	1	2	3	4	5	6	7	8
Interval	Red	Red	Initialization	Initialization	Initialization	Initialization	Initialization	Initialization
Active Cmd Source	Manual	Manual	Default	Default	Default	Default	Default	Default
Active Base Meter Rate	300	300	0	0	0	0	0	0
Active Meter Rate	300	300	0	0	0	0	0	0
Active Action	Fixed Rate	Fixed Rate	Dark	Dark	Dark	Dark	Dark	Dark
Set Plan	0	0	0	0	0	0	0	0
Set Fixed Rate	300	300	0	0	0	0	0	0
Set Veh/Grn	1	1	0	0	0	0	0	0
Requested Cmd Source	Manual	Manual	Default	Default	Default	Default	Default	Default
Requested Action	Fixed Rate	Fixed Rate	Dark	Dark	Dark	Dark	Dark	Dark
Requested Plan	0	0	0	0	0	0	0	0
Requested Fixed Rate	300	300	0	0	0	0	0	0
Requested Veh/Grn	1	1	0	0	0	0	0	0
Current Demand	Working	Working	Other Error	Other Error	Other Error	Other Error	Other Error	Other Error
Cycle Count	0	0	0	0	0	0	0	0
Queue Adjust	None	None	None	None	None	None	None	None
Main Queue	False	False	False	False	False	False	False	False

Firmware File Management

- Intersection Display
- Lanes Status
  - Metered Lanes
  - Mainline Lanes
  - Passage Detectors
  - Demand Detectors
  - Dependency Groups
  - Metered Queues
- TSS Data Collection
- Alarm Status
- Channel Status
- Input & Output Status
- Cabinet Status
- Peer Status
- Controller
  - General Config
  - Mainline Lanes
  - TSS Sensor Zones
  - Metered Lanes
  - Metered Lane Control
  - Metering Plans
  - Dependency Groups
  - Demand Detectors
  - Passage Detectors
  - Metered Queues
  - Historical Data Reset

Backup Current Database

Database Name: database.bin [Backup]

Manage Databases

Factory Databases	User Databases	USB Databases
332_Default Default_Blank_Database		Checking for USB key...

[Set as Active Database] [Delete] [Set as Active Database]

[Copy From Controller]

Upload New Database

[Choose File] No file chosen [Copy To Controller]

Warning:
Selecting a new database as the active database will overwrite and abort any pending changes.
To save your current database enter a name for the database and select 'Backup'

Logging Data Locally

Log Size (Kb)	3

Log Enabled	Enabled
Log History (hours)	1
Delete Log File	NoAction

Apply

CSV log format

- hourly summary
- current hourly log

XML log format

- hourly summary
- current hourly log

Ramp Metering Firmware - Issues

- Minor naming convention changes
- Add technician page
- Red time issue. ODOT operation vs NTCIP 1207 standard. Not part of ODOT's requirement. Traffic would not accept operation without correction. Caused 2 week delay.

Summary

- Final acceptance testing and training June 12th and 13th.
- Operation of ramp metering in Eugene before July 2013.

Questions?

- Contact

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