A207b: Building an ITS Infrastructure Based on the Advanced Transportation Controller (ATC) 5201 Standard Part 2 of 2

STUDENT SUPPLEMENT

RITA Intelligent Transportation Systems Joint Program Office

A207b: Building an ITS Infrastructure Based on the Advanced Transportation Controller (ATC) 5201 Standard Part 2 of 2

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1. Introduction/Purpose

A207b: Building an ITS Infrastructure Based on the Advanced Transportation Controller (ATC) 5201 Standard (Part 2 of 2) is the second of two modules of the Professional Capacity Building (PCB) program on using the Advanced Transportation Controller (ATC) 5201 Standard. A207b identifies the features of the ATC 5201 Standard, describes the architecture, describes how the standard works with other ITS standards, and helps users specify ATC equipment for procurements. This module provides the background information necessary to understand *A208: Using the ATC 5401 Application Programming Interface Standard to Leverage ITS Infrastructures*.

2. Traffic Concepts

Intersection Actuation – The extent at which an intersection is equipped for vehicle detection.

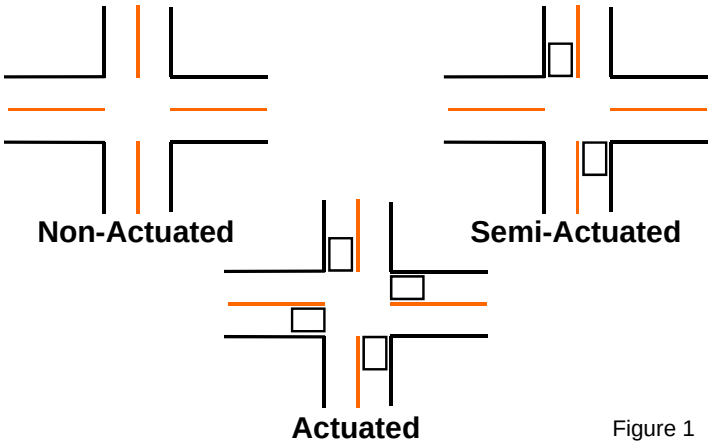


Figure 1

Cycle – The time required for one complete revolution of the timing dial (old definition). One complete sequence of signal indications.

Interval – Any one of the several divisions of the time cycle during which signals indications do not change. Examples:

- Minimum Green
- Vehicle Extension (passage)
- Pedestrian Clearance Interval
- Red Clearance Interval
- Yellow Change Interval

Phase – Any combination of traffic movements receiving right-of-way simultaneously during one or more intervals

- Vehicular/Pedestrian Phases
- Conflicting / Non-Conflicting Phases

Overlap – A traffic movement timed concurrently with one or more phases (parent phases). Typically, the yellow and red clearance timing of the overlap is equal to that of the phase terminating the overlap.

Standard Quad or 8-Phase Intersection. The odd numbered phases represent left turn movements. The even numbered phases represent though movements. Overlaps are indicated by the plus signs and indicate that the right arrow would appear during the timing of the two phases indicated. Example: The overlap Φ8 + Φ1 would be allowed during the timing of Φ8 and Φ1. No U-turns on left arrow allowed.

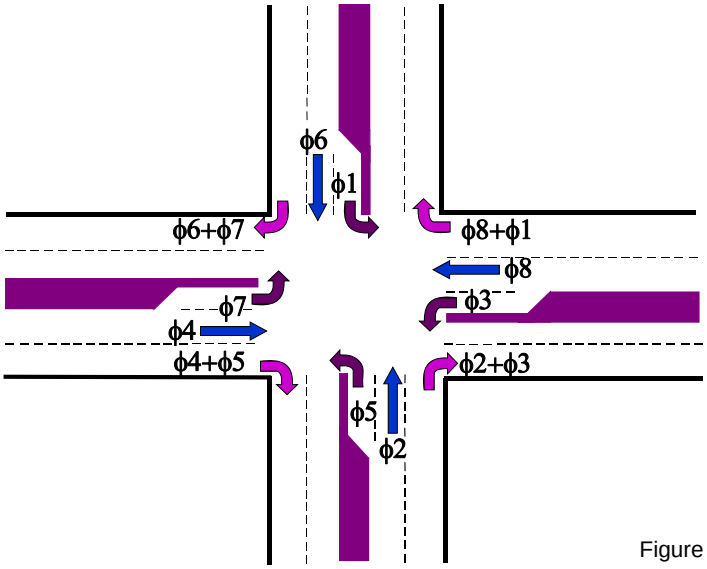


Figure 2

Ring – Consists of two or more sequentially timed and individually selected conflicting phases so arranged as to occur in an established order.

Barrier – A reference point in the preferred sequence of a multi-ring controller at which all rings are interlocked. Barriers assure there will be no concurrent selection and timing of conflicting phases for traffic movements in different rings. All rings cross the barrier simultaneously to select and time phases on the other side.

Concurrent Groups – All of the phases between two barriers. Typically, they are the left turn and through movements on a single street.

Dual Ring Operation for a Standard Quad – See diagram below. There are two rings. The first consists of phases 1-4 and the second consists of phases 5-8. A phase in Ring 1 can time with a phase in Ring 2 provided they are a part of the same concurrent group.

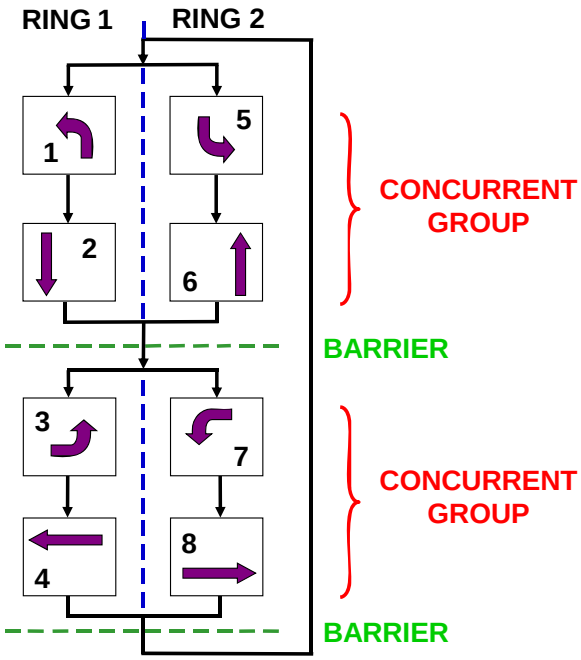

RING 1
RING 2
1
2
3
4
5
6
7
8
CONCURRENT GROUP
BARRIER
CONCURRENT GROUP
BARRIER

Figure 3

3. Transportation Field Cabinet Systems (TFCSs)

Field Architectures for Performing Traffic Management

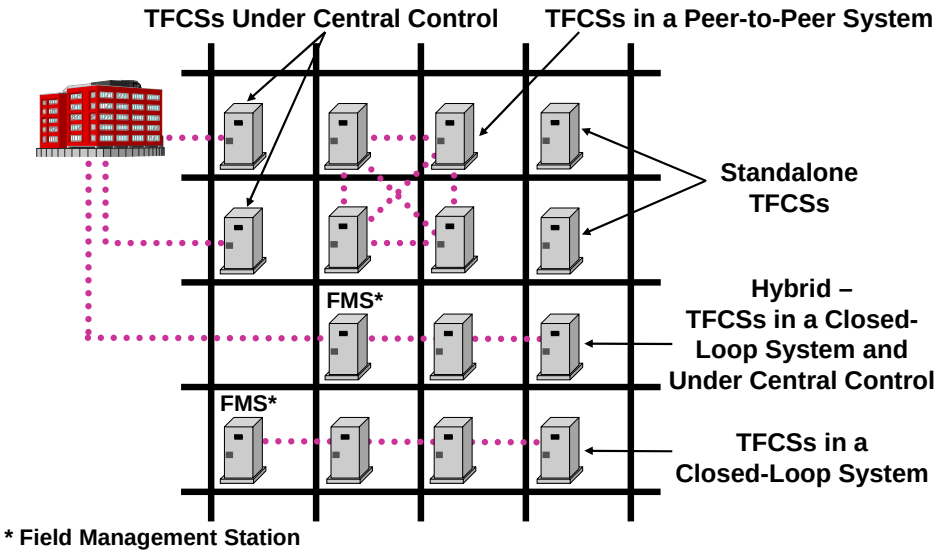


Figure 4

Evolution of Transportation Control Equipment

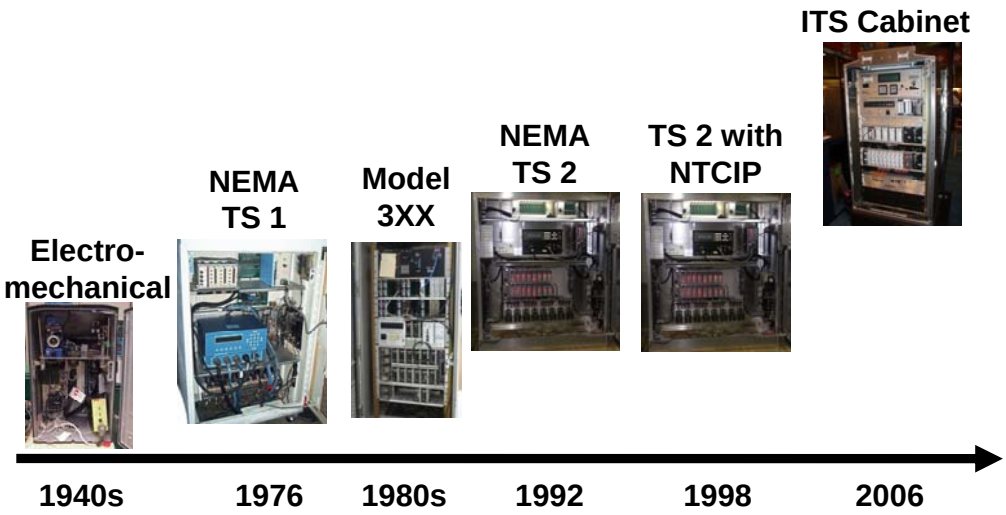


Figure 5

Basic Transportation Field Cabinet System Components

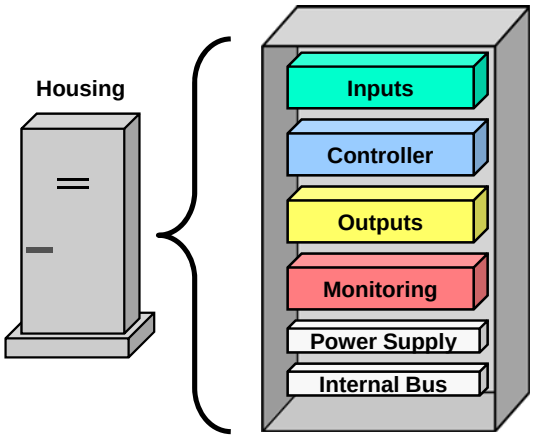


Figure 6

Basic Transportation Field Cabinet System Operation

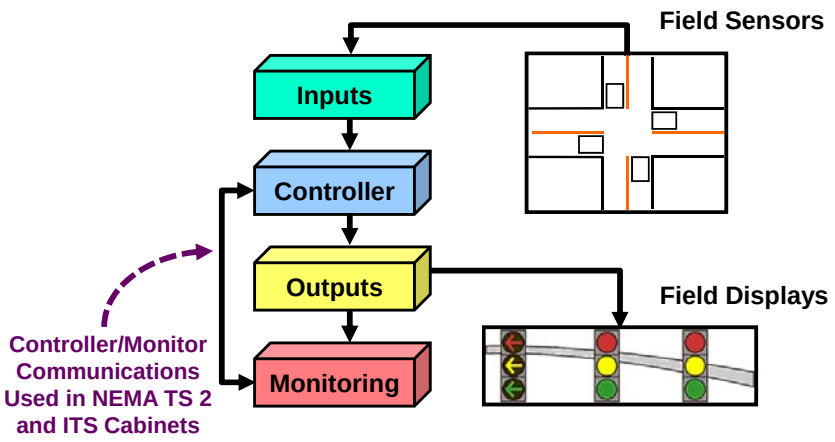


Figure 7

Differences in Transportation Field Cabinet System

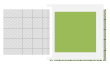
TFCS	Physical Mounting	Internal Bus	Signal Monitor	Input Channels	Monitored Output Channels
NEMA TS 1	Shelf	Parallel / Discrete Wiring	Conflict Monitor	8	3/6/12/18
Caltrans Model 33X	Rack	Parallel / Discrete Wiring	Conflict Monitor	44	16/18
NEMA TS 2	Shelf	Serial 153.6 kbps	Malfunction Management Unit	64	16
ITS Cabinet v01	Rack	Serial 614.4 kbps	Cabinet Monitor Unit	120	28

Figure 8

4. Glossary

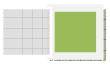
Term	Definition
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
AC-	120 VAC, 60 Hz neutral (grounded return to the power source)
AC+	120 VAC, 60 Hz line source (ungrounded)
ANSI	American National Standard Institute
ASCII	American Standard Code for Information Interchange
Assembly	A complete machine, structure, or unit of a machine that was manufactured by fitting together parts and/or modules
ASTM	American Society for Testing and Materials
ATC	Advanced Transportation Controller
AWG	American Wire Gage
BSP	Board Support Package
Cabinet	An outdoor enclosure generally housing the controller unit and associated equipment
Caltrans	California Department of Transportation
CD	Carrier Detect
Component	Any electrical or electronic device
CPU	Central Processing Unit
CTS	Clear to send (data)
CU	Controller Unit, that portion of the controller assembly devoted to the operational control of the logic decisions programmed into the assembly
DAT	Design Acceptance Testing
DC	Direct Current
DCD	Data Carrier Detect (receive line signal detector)
DRAM	Dynamic Random Access Memory
EEPROM	Electrically Erasable Programmable Read-Only Memory
EG	Equipment Ground
EIA	Electronic Industries Association
EL	Electro-luminescent

Term	Definition
EMI	Electromagnetic Interference
ENET	Ethernet
EPROM	Ultraviolet Erasable, Programmable, Read-Only Memory
Equal	Connectors: comply to physical dimensions, contact material, plating and method of connection. Devices: comply to function, pin out, electrical and operating parameter requirements, access times and interface parameters of the specified device
ETL	Electrical Testing Laboratories, Inc.
FCU	Field Control Unit
Firmware	A computer program or software stored permanently in PROM, EPROM, ROM, or semi-permanently in EEPROM
FLASH	A form of EEPROM that allows multiple memory locations to be erased or written in one programming operation. It is solid-state, permanent and non-volatile memory typically having fast access and read/write cycles
FPA	Front Panel Assembly
FSK	Frequency Shift Keying
HDLC	High-level Data Link Control
I/O	Input/Output
IEEE	Institute of Electrical and Electronics Engineers
IP	Internet Protocol
ISO	International Standards Organization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
Jumper	A means of connecting/disconnecting two or more conductors by soldering/desoldering a conductive wire or by PCB post jumper
Keyed	Means by which like connectors can be physically altered to prevent improper insertion
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LOGIC	Negative logic convention (Ground True) state
logic-level	HCT or equivalent TTL – compatible voltage interface levels
lsb	Least Significant Bit



Term	Definition
LSB	Least Significant Byte
MIPS	Million Instructions Per Second
Module	A functional unit that plugs into an assembly
msb	Most Significant Bit
MS	Military Specification, Mil-Spec or Mil-Standard
MSB	Most Significant Byte
NA	Presently Not Assigned. Cannot be used by the contractor for other purposes.
NEMA	National Electrical Manufacturer's Association
NETA	National Electrical Testing Association, Inc.
NLSB	Next Least Significant Byte
NMSB	Next Most Significant Byte
NTCIP	National Transportation Communication for ITS Protocols
OST	Operating System Time
NYSDOT	New York State Department of Transportation
O/S	Operating System
Open System	Standardized hardware interfaces in a module
PCB	Printed Circuit Board
PDA	Personal Data Assistant (electronic)
RAM	Random Access Memory
RF	Radio Frequency
RMS	Root mean square
ROM	Read only memory
RTC	Real Time Clock
RTS	Request to send (data)
RX	Abbreviation for “Receive” when used to describe communication signals. Typically a prefix for other character(s).
RXC	Receive Clock
RXD	Receive Data
SDLC	Synchronous Data Link Control
SP	Serial Port
SPI	Serial Peripheral Interface

Term	Definition
SRAM	Static Random Access Memory
TEES	Transportation Electrical Equipment Specifications
TMC	Transportation Management Center
TOD	Time Of Day Clock
TTL	Transistor-Transistor Logic
TX	Abbreviation for “Transmit” when used to describe communication signals. Typically a prefix for other character(s).
TXC	Transmit Clock
TXD	Transmit Data
UL	Underwriter's Laboratories, Inc.
USB	Universal Serial Bus
VAC	Volts Alternating Current
VDC	Volts Direct Current
WDT	Watchdog Timer: A monitoring circuit, external to the device watched, which senses an Output Line from the device and reacts



5. Reference to Other Standards

- Institute of Transportation Engineers, *Application Programming Interface (API) Standard for the Advanced Transportation Controller (ATC) v02.17*. ATC Joint Committee, 1 September 2011. http://www.ite.org/standards/index.asp

- Institute of Transportation Engineers, *ATC 5202 Model 2070 Controller* Standard *Version 03.* ATC Joint Committee, 28 December 2012. http://www.ite.org/standards/index.asp

- Institute of Transportation Engineers, *Intelligent Transportation System (ITS) Standard Specification for Roadside Cabinets v01.02.17b.* ATC Joint Committee, 16 November 2006. http://www.ite.org/standards/index.asp

- National Electrical Manufacturers Association, *NEMA Standards Publication TS 2-2003 v02.06 Traffic Controller Assemblies with NTCIP Requirements*. NEMA, 2003.

- National Electrical Manufacturers Association, *NEMA Standards Publication TS 1-1989 Traffic Control Systems*. NEMA, 1989.

6. References

- California Department of Transportation, *Caltrans Transportation Electrical Equipment Specifications (TEES).* California Department of Transportation, 12 March 2009.

- ITS PCB Training http://www.pcb.its.dot.gov/stds_training.aspx.

- United States Department of Transportation Federal Highway Administration. *Systems Engineering Guidebook for Intelligent Transportation Systems Version 3.0.* November 2009. http://www.fhwa.dot.gov/cadiv/segb/

7. Study Questions

Participant Questions Included in Presentation

1) **Which of the following is NOT a purpose of the ATC standards program?**
   a) General Purpose Field Computing Platform
   b) Grow with technology
   c) Open Architecture
   d) Compact

2) **Which of the following is NOT a major feature of ATC controller units?**
   a) Manage/Configure applications
   b) Windows operating system
   c) Manage external devices
   d) Facilitate ease of maintenance and future hardware/software updates

3) **Which of the following is critical to being able to replace an Engine Board with a more powerful Engine Board in the future?**
   a) Identical Pinout
   b) New Host Module
   c) Same Processor Family
   d) Same Engine Board Manufacturer

4) **Which of the following ATC controller resources is NOT shared/managed by the API software?**
   a) Real-Time Clock
   b) Front Panel
   c) Datakey
   d) Field Input/Output

5) **Which of the following is a TRUE statement?**
   a) API Software provides NTCIP communications software for multiple applications
   b) ATC 5201 allows multiple applications to use NTCIP communications simultaneously
   c) ATC environmental requirements are generally the same as TFCS standards and specifications
   d) Most 170 controllers are suitable for NTCIP ASC communications

6) **What is the best way to migrate to ATC equipment?**
   a) Use existing TFCSs and replace older controllers with ATC controller units
   b) Use existing operational software that has a version suitable for ATC controller units
   c) Replace controller units as part of regular scheduled maintenance
   d) All equally good and it depends on the needs of the agency

7) **Which of the following is a good practice when preparing a specification using ATC 5201 v06?**
   a) Establish a precedence of referenced standards and specifications
   b) Always specify the fastest CPU available
   c) Always specify several extra serial ports than you need
   d) Never exceed the minimum user interface requirements of the ATC 5201 Standard