# A207a: Building an ITS Infrastructure Based on the Advanced Transportation Controller (ATC) 5201 Standard Part 1 of 2

STANDARDS
ITS
TRAINING

STUDENT SUPPLEMENT

RITA Intelligent Transportation Systems
Joint Program Office

# A207a: Building an ITS Infrastructure Based on the ATC 5201 Standard Part 1 of 2

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## 1.    Introduction/Purpose

*A207a: Building an ITS Infrastructure Based on the ATC 5201 Standard Part 1 of 2* is the first of two modules of the Professional Capacity Building (PCB) program on using the Advanced Transportation Controller (ATC) 5201 Standard. A207a explains the purpose of the ATC family of standards and identifies the basic components and operation of transportation field cabinet systems (TFCSs). This module provides the background information necessary to understand *A207b: Building an ITS Infrastructure Based on the ATC 5201 Standard Part 2 of 2*.

## 2.    Traffic Concepts

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



**Non-Actuated**     **Semi-Actuated**

**Actuated**
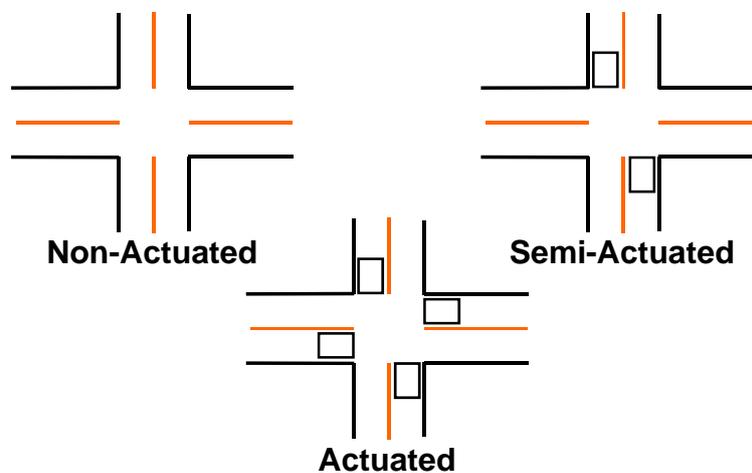
Figure 1

**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 signal 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 through 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.
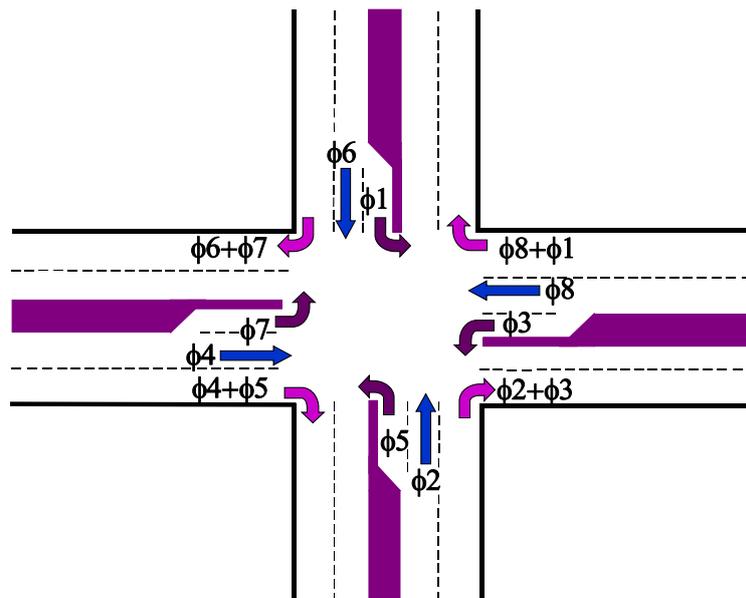


Figure 2

**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 <u>multi-ring</u> controller at which all rings are interlocked. Barriers assure there will be no concurrent selection and timing of conflicting phases for traffic movements are 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.
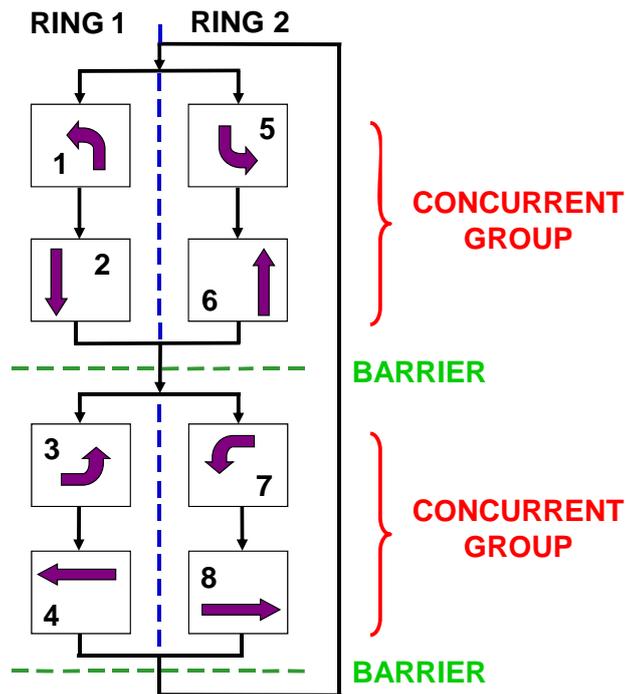
Figure 3

## 3. 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 |

| Term | Definition |
|---|---|
| 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 |
| 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 |

| Term | Definition |
|---|---|
| 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 |
| 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) |

| Term | Definition |
|------|------------|
| 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 |
| 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 |

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## 4. 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. www.ite.org/standards/index.asp

- Institute of Transportation Engineers, *ATC 5202 Model 2070 Controller* Standard *Version 03.* ATC Joint Committee, 28 December 2012.
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.
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.

## 5. References

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

- ITS PCB Training
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.
www.fhwa.dot.gov/cadiv/segb/

## 6. Study Questions
## Participant Questions Included in Presentation

1) **Which of the following is NOT an application area that has been identified for ATC controller units?**
   a) Emergency Management
   b) Personal Computer Backup Systems
   c) Traffic Signal Control / Traffic Management
   d) Connected Vehicle Systems

2) **Which of the following is not in the ATC family of standards?**
   a) Application Programming Interface Standard

b) ITS Roadside Cabinet Standard
c) Model 170 Standard
d) Advanced Transportation Controller Standard

3) **Specifying an ATC 5202 Model 2070 controller unit guarantees conformance with the ATC 5201 Standard.**
a) True
b) False

4) **Which element of a TFCS determines the sequence of traffic movements to provide service to a vehicle?**
a) Inputs
b) Controller
c) Outputs
d) Monitoring