Latest in the Signal Phase and Timing and Related Messages at Signalized Intersections

ITS Texas

November 13, 2015

Connected Vehicle Initiative

- USDOT initiative to test and evaluate technology that will enable cars, buses, trucks, trains, infrastructure, smart phones and other devices to talk to each other.
- Use short range, low latency radio for communications
- Improve safety, mobility and environment

USDOT Constraints

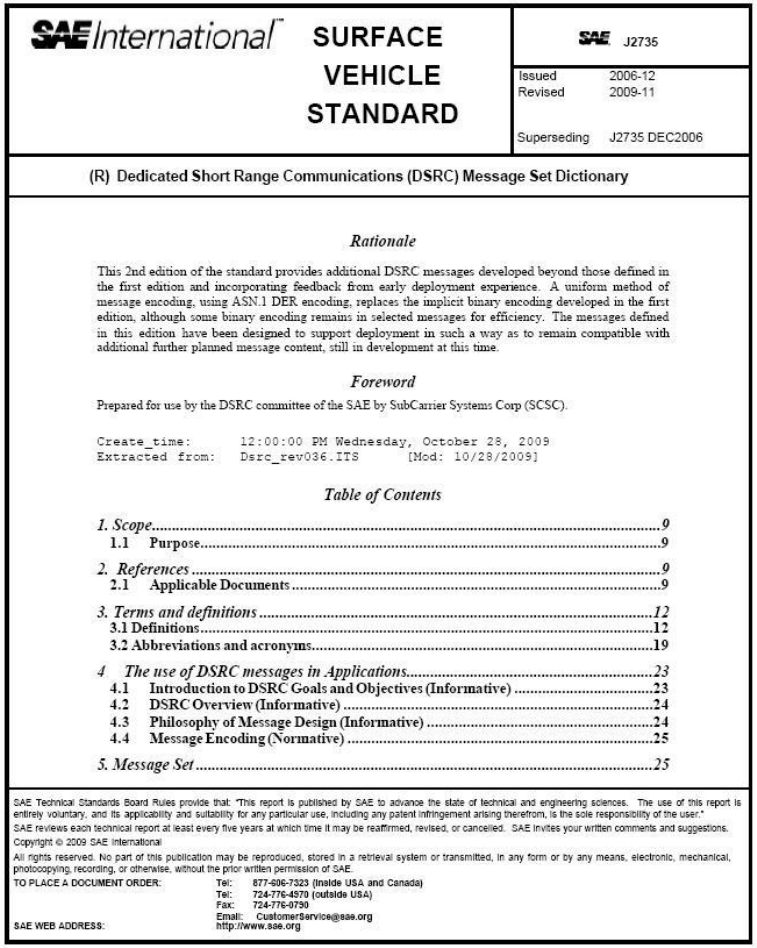
- Use existing standards
  - SAE J2735 – 2009
  - NTCIP 1201
  - NTCIP 1202
  - NTCIP 1211

Objective of this Presentation

- Present Signal Phase and Timing and related messages as they are implemented by FHWA
- Discuss future modifications to these messages

What are these Messages?

- Signal Phase and Timing (SPaT)
- MAP
- Radio Technical Commission for Maritime Services (RTCM)
- Signal Request Message (SRM) and Signal Status Message (SSM) Messages
- Included in SAE J2735



SAE International™ SURFACE VEHICLE STANDARD

SAE J2735

Issued 2006-12
Revised 2009-11

Superseding J2735 DEC2006

(R) Dedicated Short Range Communications (DSRC) Message Set Dictionary

Rationale

This 2nd edition of the standard provides additional DSRC messages developed beyond those defined in the first edition and incorporating feedback from early deployment experience. A uniform method of message encoding, using ASN.1 DER encoding, replaces the implicit binary encoding developed in the first edition, although some binary encoding remains in selected messages for efficiency. The messages defined in this edition have been designed to support deployment in such a way as to remain compatible with additional further planned message content, still in development at this time.

Foreword

Prepared for use by the DSRC committee of the SAE by SubCarrier Systems Corp (SCSC).

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Create_time:      12:00:00 PM Wednesday, October 28, 2009
Extracted from:   Dsrc_rev036.ITS      [Mod: 10/28/2009]
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TO PLACE A DOCUMENT ORDER:
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SPaT System

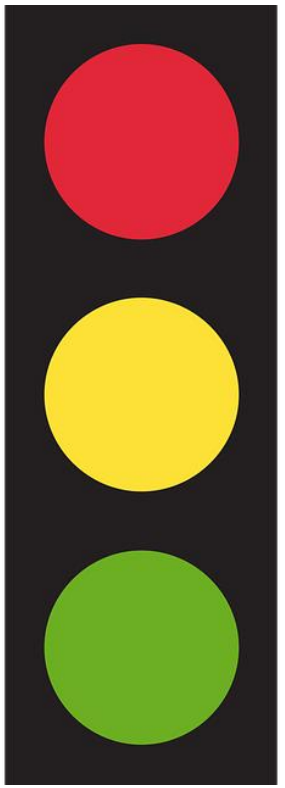
- Obtains status and other information using the NTCIP 1202 from traffic signal controller
  - Initially developed for Econolite and Siemens
- Produces a new SPaT message every tenth of a second
- Converts the phase status information to the lane-movement based information using phase-to-lane movement mapping table

Phase-to-Lane Mapping Table

Record	Intersection ID (Unique in a region)	Lane # (Unique at an intersection)	Movement Type	Protected / Permitted / Prohibited	Signal Phase #	Start Date	Start Time	End Date	End Time
1	1	1	RTM	Permitted	2				
2	1	1	TM		2				
3	1	2	TM		2				
4	1	3	LTM	Prohibited	5		6 AM		9 AM
5	1	3	LTM	Protected	5		9 AM		6 AM
6	1	3	LTM	Permitted	2		9 AM		6 AM
7	1	4	RTM	Permitted	4				
8	1	5	LTM	Protected	4				
9	1	6	RTM	Permitted	6				
10	1	6	RTM	Protected	4				
11	1	7	TM		6				
12	1	8	TM		6				
13	1	9	LTM	Protected	1				
14	1	9	LTM	Permitted	6				
15	1	10	RTM	Permitted	3				
16	1	11	TM		3				
17	1	11	LTM	Protected	3				

SPaT Message Components

- Current state of the signal indications governing each vehicle and pedestrian movement.
- The current operating state of the intersection (i.e. normal or in a special mode).
  - including Flash and color of Flash
- The presence of users such as pedestrians and bicycles located in defined cross-walk areas within the intersection.
- Current time remaining until the next change in state of the traffic signal indications.



SPATMsg | SPAT Activity Logs | SPAT System Configuration | Enable SPAT Msg Push | Phase Properties | Future Status Objects

Connected to Traffic Signal Controller: 10.201.12.28::501

Timestamp 11:16:48::528

	PHASE Status	OVLP Status	PED Status	Ped Mvmt	V-Min Time	V-Max Time	P-Min Time	P-Max Time	O-Min Time	O-Max Time
1				DONTWALI	2	6	0	0	2	6
2				DONTWALI	7	11	7	11	0	0
3				DONTWALI	41	46	0	0	0	0
4				DONTWALI	51	66	51	66	0	0
5				DONTWALI	2	6	0	0	0	0
6				DONTWALI	7	11	7	11	0	0
7				DONTWALI	41	46	0	0	0	0
8				DONTWALI	51	66	51	66	0	0
9				DONTWALI	0	0	0	0	0	0
10				DONTWALI	0	0	0	0	0	0
11				DONTWALI	0	0	0	0	0	0
12				DONTWALI	0	0	0	0	0	0
13				DONTWALI	0	0	0	0	0	0
14				DONTWALI	0	0	0	0	0	0
15				DONTWALI	0	0	0	0	0	0
16				DONTWALI	0	0	0	0	0	0

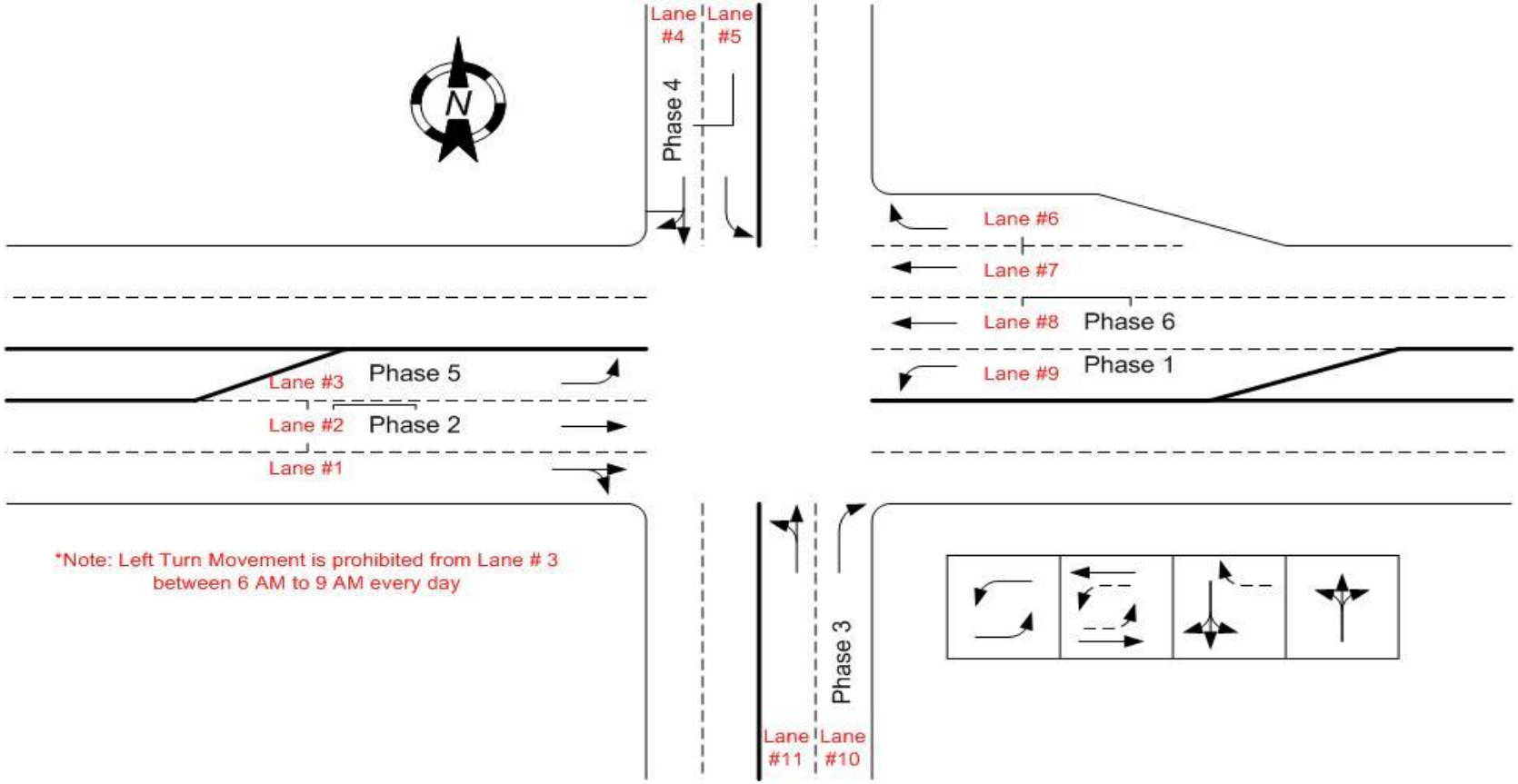
1

- [ ] DiscontinuousFlag
- [ ] Manual Control Active
- [ ] Stop Time Active
- [ ] Fault Flash Active
- [ ] Preempt Active
- [ ] TSP Active
- [x] Coordination Active
- [ ] Coordination In Transition Active
- [ ] Programmed Flash Active

MAP Message

- Defines the lanes and possible movements from each lane for all approaches within an intersection,
- Broadcast to vehicles approaching the intersection continually at the rate of once per second.
  - Only those vehicles that need the message will consume it.
- MAP configuration table will be maintained that describes each configuration of the intersection

Map Configuration



SPaT Applications

- ECO Driving
- Dilemma Zone Protection
- Red-Light Running Alerts
- Transit Vehicle Ped-Crossing Alerts

RTCM

- Real-time corrections to improve GPS accuracy of mobile devices
- Vehicle has to determine the lane it is in
  - Require meter-level GPS accuracy
  - Use the SPaT timing information associated with it
- Obtains from Continuously Operating Reference Stations (CORS) throughout the United States

SRM and SSM Messages

- Receive Signal Request Message from mobile devices and generate Signal Status Message to be broadcast to mobile devices
  - Vehicle Actuations, signal priority, preemption
- Using a dummy method to implement SRM as NTCIP 1211 is not implemented in signal controllers

Identification of Conflicts

- Controller in a test mode
  - Operating normally and generating a SPaT Message
  - Cabinet is in flash
- Pedestrian detected in crosswalk
  - SPaT Message is aware of it
  - Controller is not
- Communication corruption or Loss of Communication
- Security Issues (Message received from trusted source)

New Standards

- New J2735 2015 Standard has been adopted
  - New format for MAP and SPaT and other messages
- Working group deliberating New NTCIP 1202
  - Significant changes
  - Incorporating CV requirements including elements of Intersection Geometry i.e., MAP within the controller

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