# U.S. National ITS Architecture: A Framework for ITS Standards and Regional Institutional Integration in the U.S. and Other Countries

**NIST Standards in Trade**
**Workshop on Intelligent Transportation Systems (ITS)**

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# ITS Architectures Facilitate Transportation Infrastructure Integration

Public Safety

Rail

**ITSIA is a plan for Transportation Infrastructure Integration**

Roadways

Public Transport

# Scope of ITS Services

- Traffic Management
- Traveler Information
- Transit Management
- Emergency Management
- Commercial Vehicle Operations
- Maintenance and Construction
- Archived Data Management
- Advanced Vehicle Safety

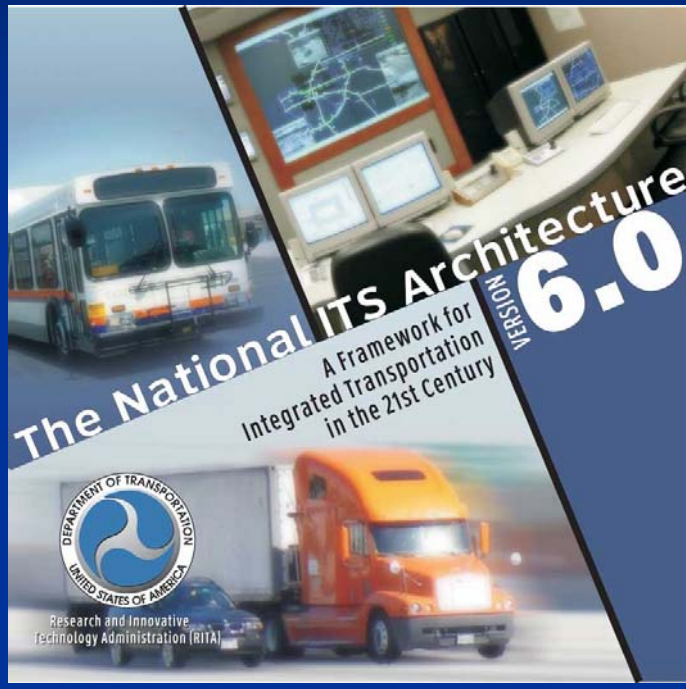
# FHWA Rule 940/FTA Policy

## Regional ITS Architecture Requirements

1. Description of the region
2. Identification of participating agencies and other stakeholders
3. Operational concept
4. Agreements required for implementation
5. System functional requirements
6. Interface requirements
7. <u>Identification of ITS standards</u>
8. Sequence of projects required for implementation
9. Process for maintaining your Regional ITS Architecture

# US National ITS Architecture is a "Living Document"

- Continuing evolution of the architecture over 14 years
- Version 6.1 (Nov 2008) continues support for ITS technical evolution and deployment




User Services 1993

Phase I & II Development 1993-6

Architecture Published 1996

HRI 1997

Ver 2.0 1998

ADUS Ver 3.0 1999

MCO Ver 4.0 2002

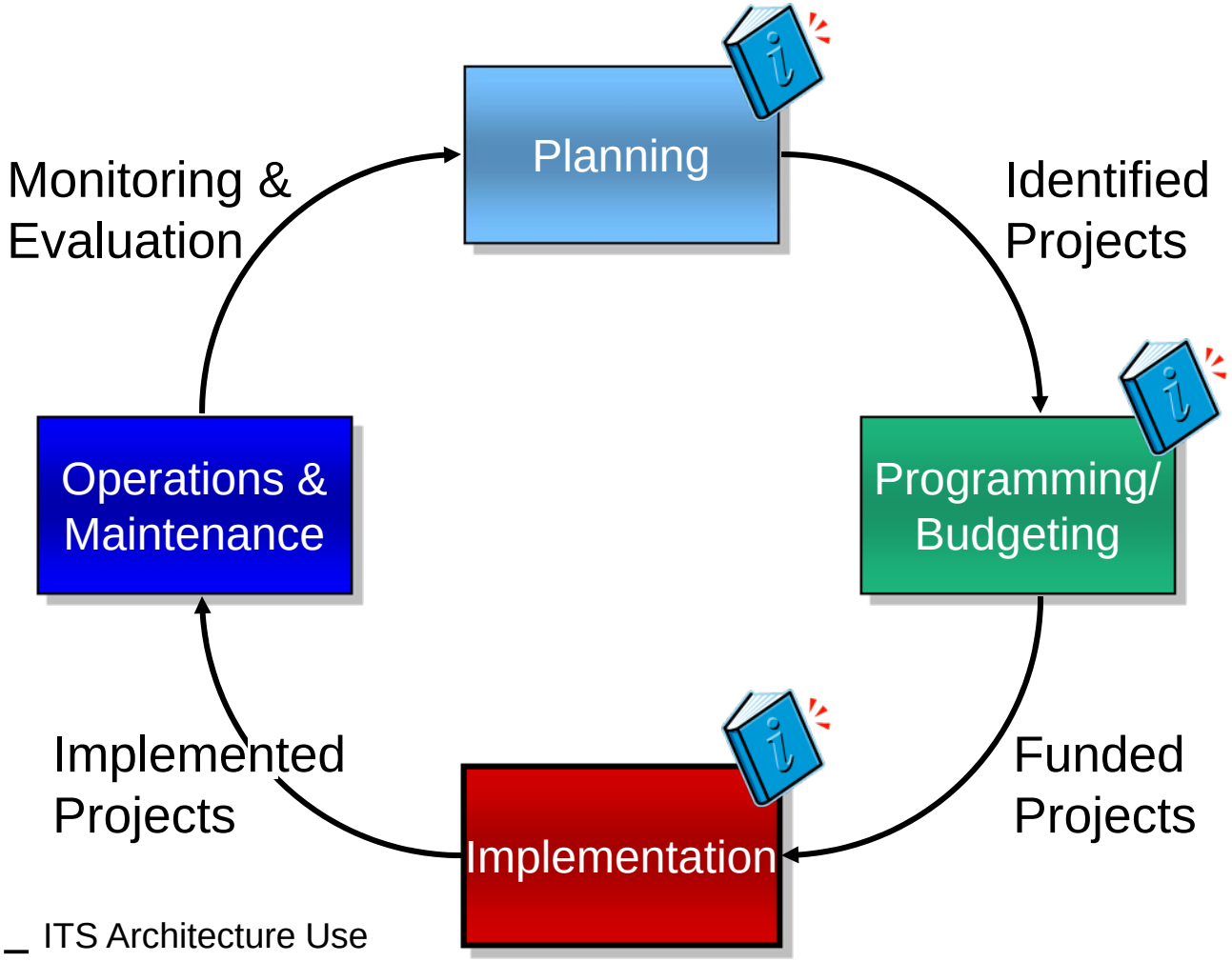
Transportation Security Ver 5.0 2003

Version 6.0 2007

# US ITS Architecture Fully Adopted and Adapted By:

- Japan
- Peoples Republic of China
- Nationalist China (Taiwan)
- Canada
- Chile
- Columbia
- Israel

# ITS Architectures Support the Project Life Cycle




= ITS Architecture Use

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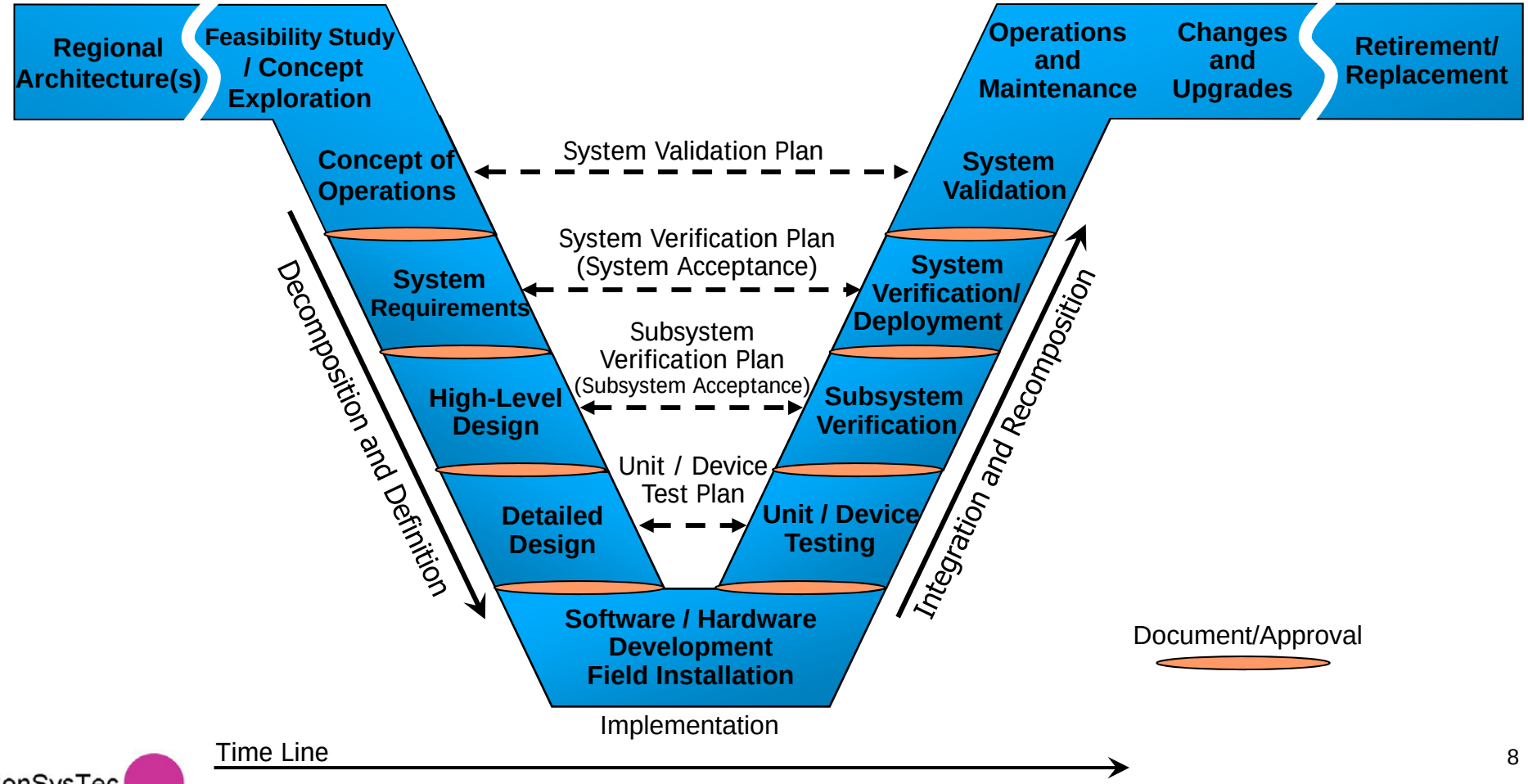
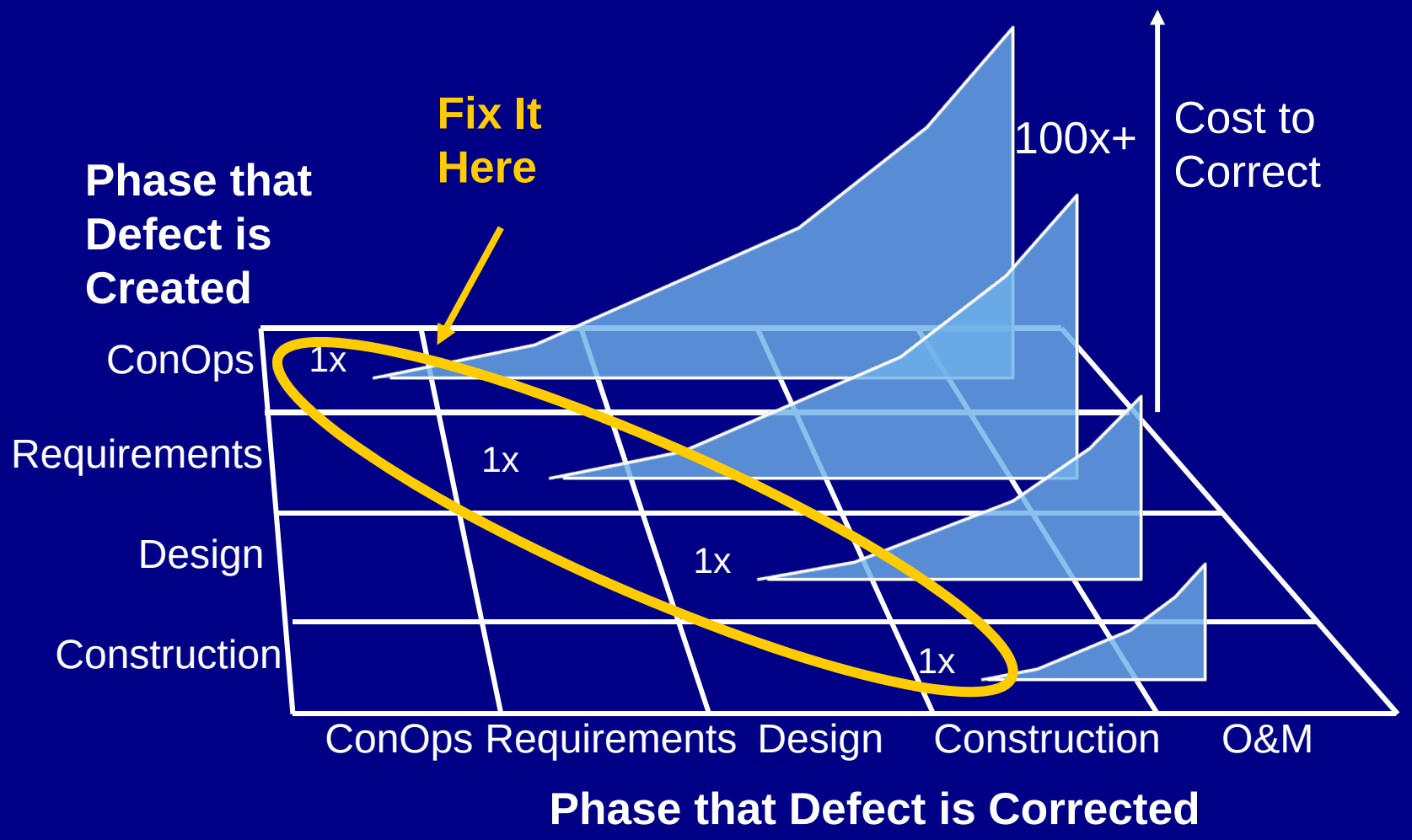
# Systems Engineering Project Lifecycle



# Cost of Correcting System Defects




(Adapted from McConnel, Steve, “Code Complete”)

# Project Critical Success Factors (reduce to a few bullets)

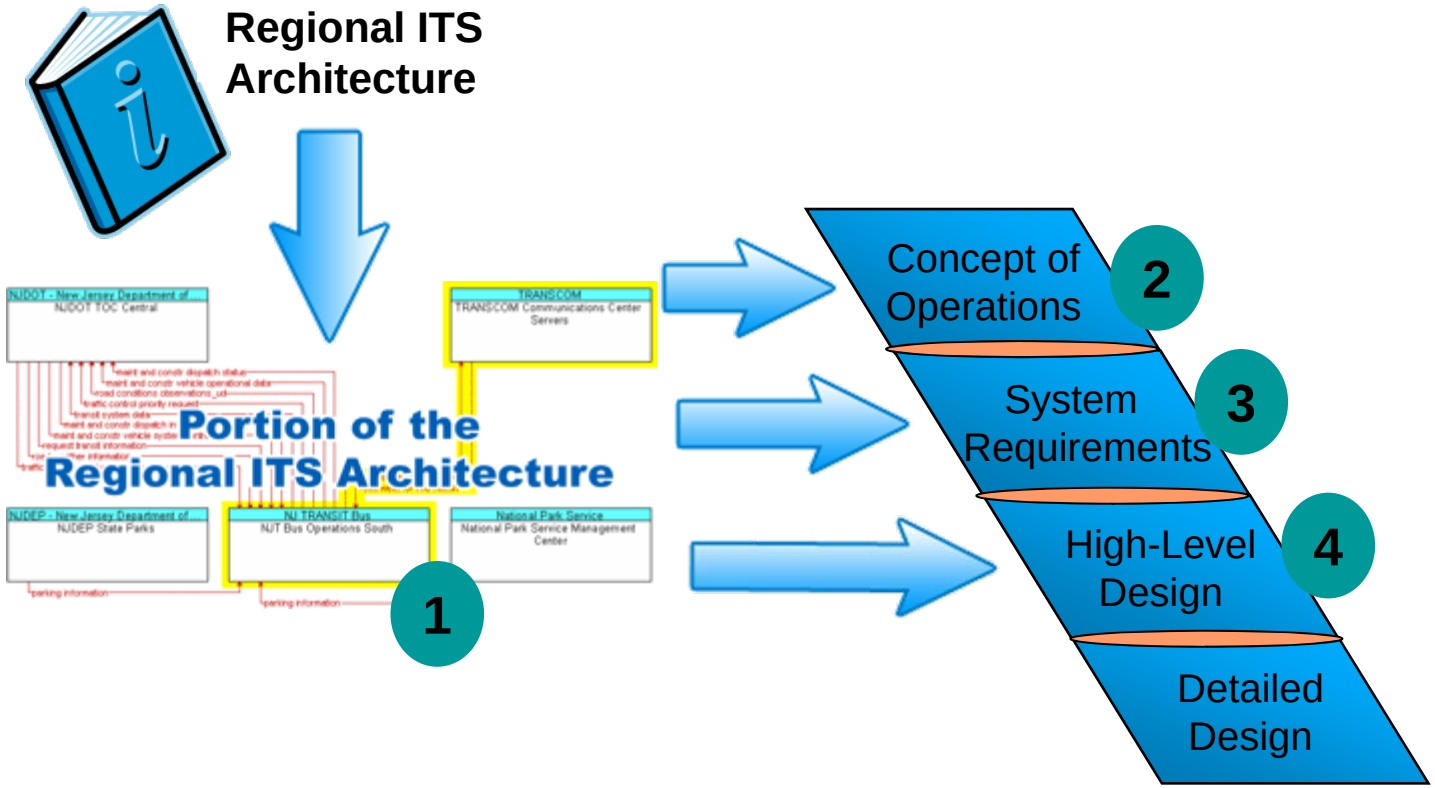
- *From a Standish Group Report*

| Project Success Factors | Success Points |
|---|---|
| 1. User Involvement | 19 |
| 2. Executive Management Support | 16 |
| 3. Clear Statement of Requirements | 15 |
| 4. Proper Planning | 11 |
| 5. Realistic Expectations | 10 |
| 6. Smaller Project Milestones | 9 |
| 7. Competent Staff | 8 |
| 8. Ownership | 6 |
| 9. Clear Vision & Objectives | 3 |
| 10. Hard-Working, Focused Staff | 3 |
| Total | 100% |

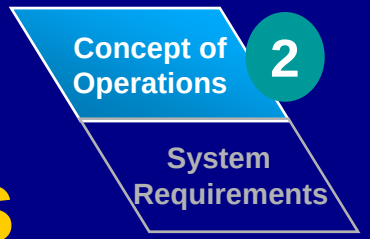
# Contribution of ITS Architecture and Systems Engineering to Project Success

| Project Success Factors | Points | Success Potential of Your Project<br>Yes = Add Points Value; No = 0 |
|---|---|---|
| **1. User Involvement** | 19 | ITS Architecture: Involves all stakeholders |
| **2. Executive Management Support** | 16 | ITS Architecture: Involves Executive Mgmt. & Policy Makers |
| **3. Clear Statement of Requirements** | 15 | Systems Engineering: Requirements Mgmt. |
| **4. Proper Planning** | 11 | ITS Architecture & Systems Engineering: Planning throughout Project Life-Cycle |
| **5. Realistic Expectations** | 0 | *Project Specific* |
| **6. Smaller Project Milestones** | 0 | *Project Specific* |
| **7. Competent Staff** | 0 | *Project Specific* |
| **8. Ownership** | 0 | *Project Specific* |
| **9. Clear Vision & Objectives** | 0 | *Project Specific* |
| **10. Hard-Working, Focused Staff** | 0 | *Project Specific* |
| **Total** | 61% | |

# Architecture Use in Project Development



# Architecture Use in Concept of Operations

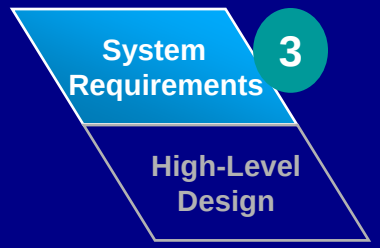



- **The architecture provides a good start for a project concept of operations**

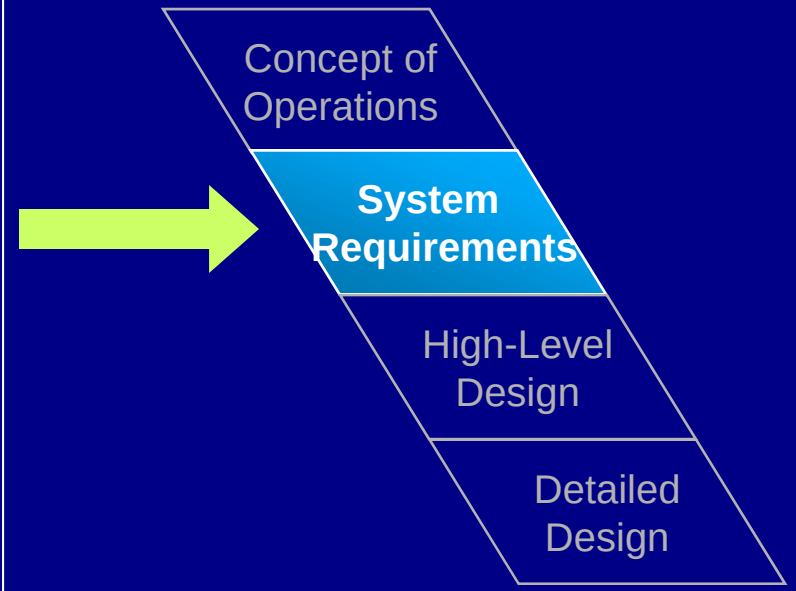
| Regional ITS Architecture | Concept of Operations * |
|---|---|
| 1. Region description | 1. Scope |
| 2. Stakeholder identification | 2. Referenced Documents |
| 3. Operational concept | 3. User-Oriented Operational Description |
| 4. Functional requirements | 4. Operational Needs |
| 5. Interfaces / Information flows | 5. System Overview |
| 6. Standards identification | 6. Operational Environment |
| 7. Project sequencing | 7. Support Environment |
| 8. Maintenance plan | 8. Operational Scenarios |

* Outline per ANSI/AIAA G-043-1992

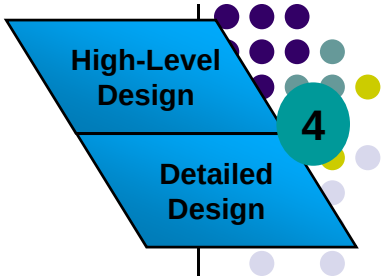
# Architecture Use in System Requirements



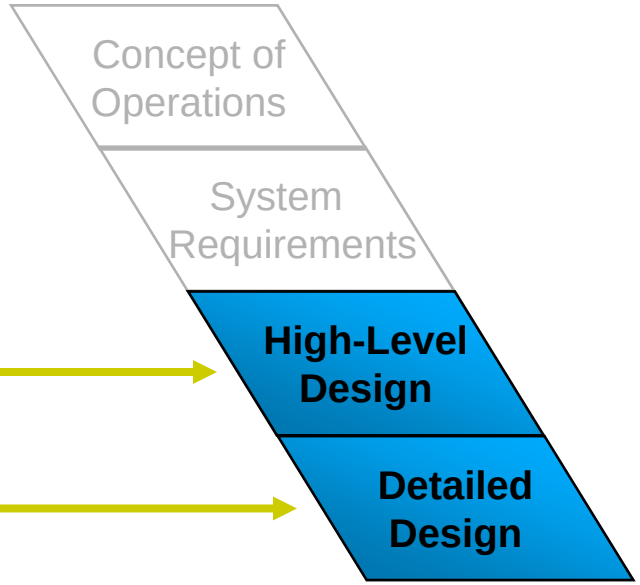

1. Region description
2. Stakeholder identification
3. Operational concept
4. **Functional requirements**
5. **Interfaces/Information flows**
6. Standards identification
7. Project sequencing
8. Maintenance plan



# Architecture Use in Project Design

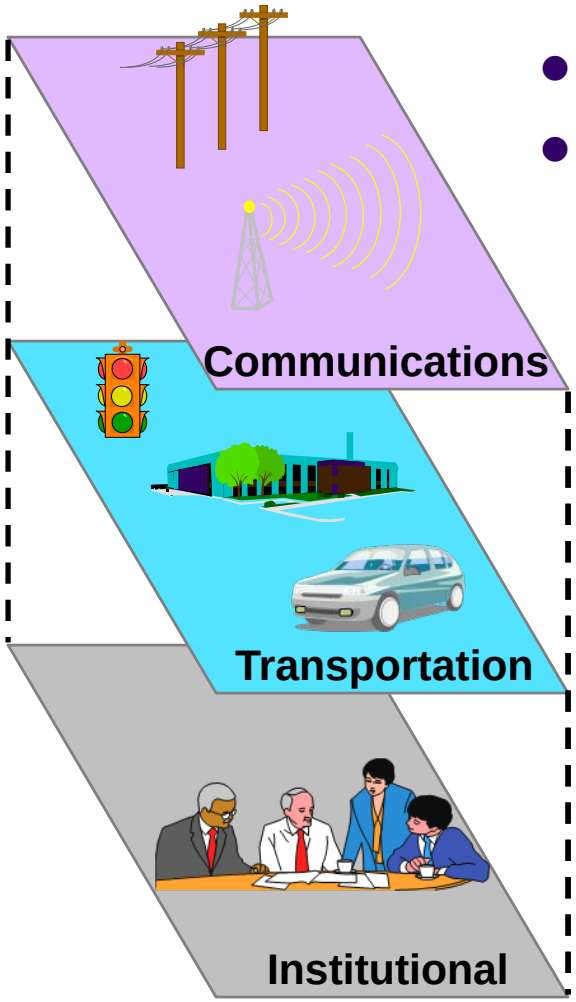



1. Region description
2. Stakeholder identification
3. Operational concept
4. Functional requirements
5. Interfaces/Information flows
6. Agreements
7. Standards identification
8. Project sequencing
9. Maintenance plan



# ITS Architecture Layers

- Defines physical entity interfaces
- Distributes functionality
- 3 layers




Interfaces

Solutions

Needs (Objectives & Requirements)

*Communications Layer*

- **How information is transferred between ITS elements**
- **<u>ITS Standards</u>**

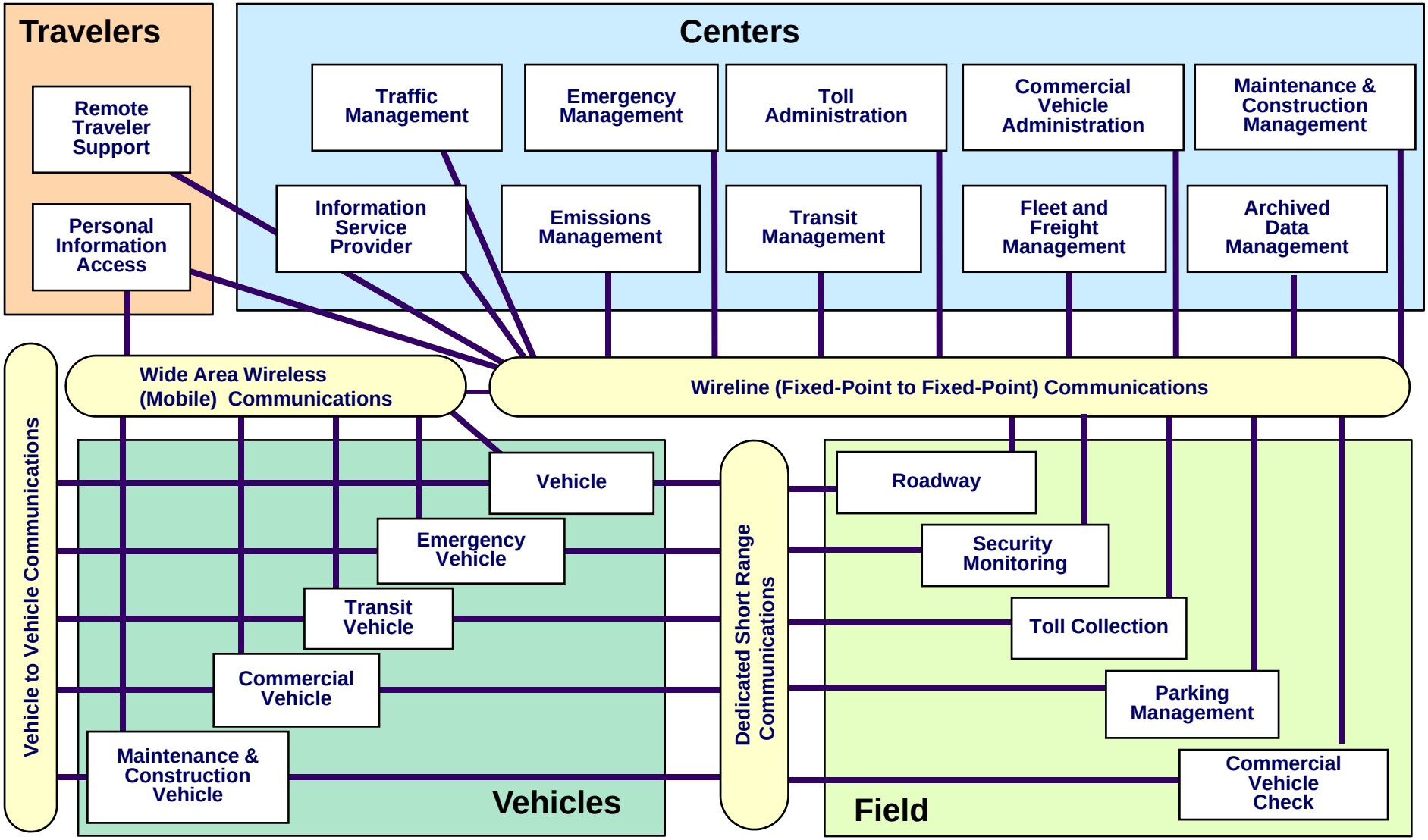
*Transportation Layer*

- **What ITS elements transfer what information**

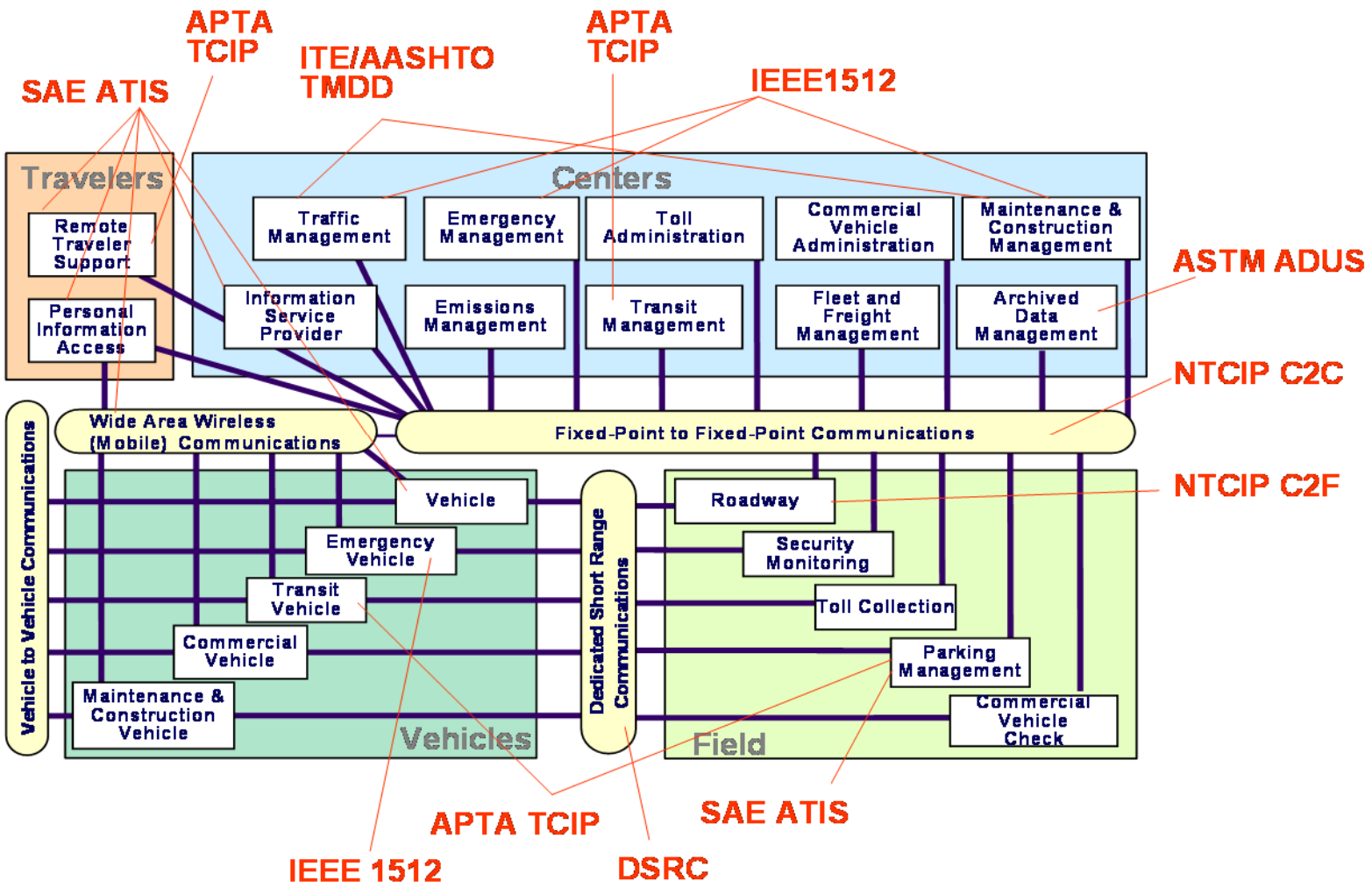
*Institutional Layer*

- **Supporting institutional structure, policy, and strategies**
- **<u>Stakeholder Driven</u>**

# National ITS Architecture Framework



# ITS Standards Mapped to the National ITS Architecture

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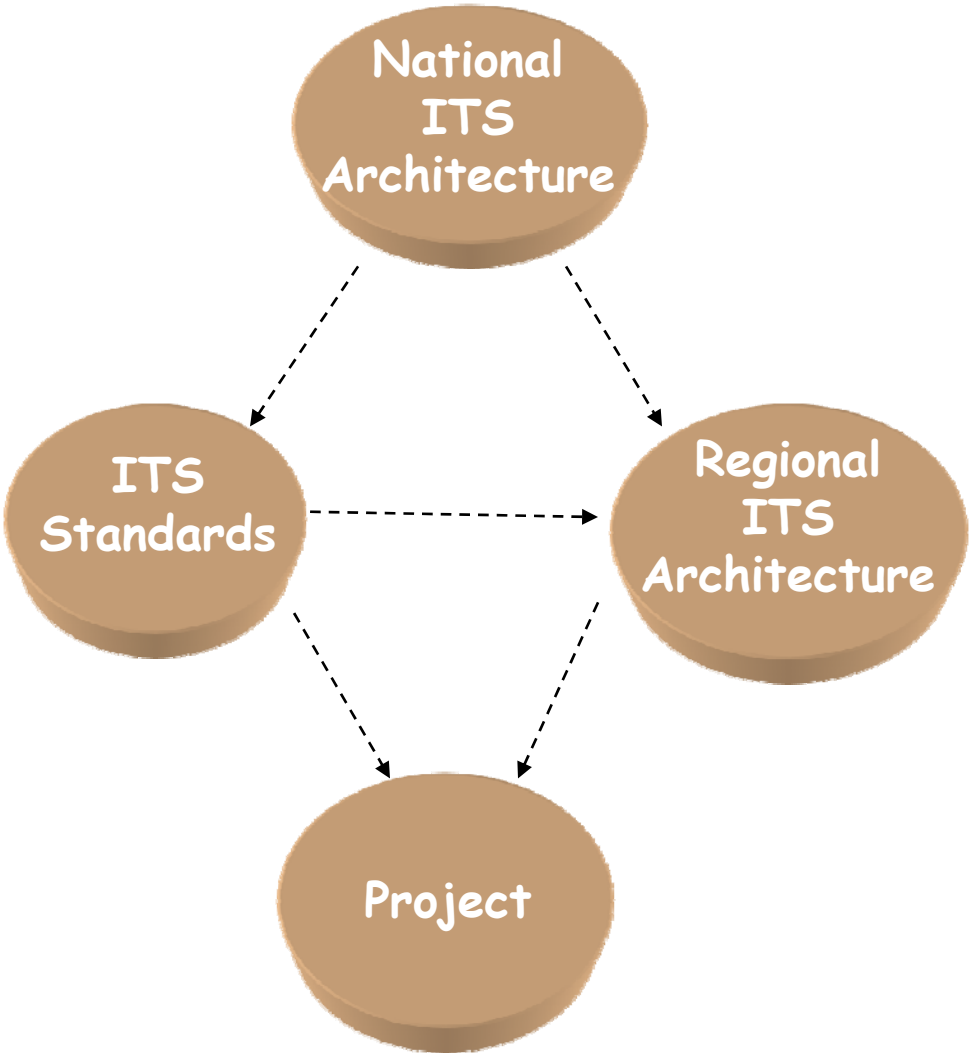
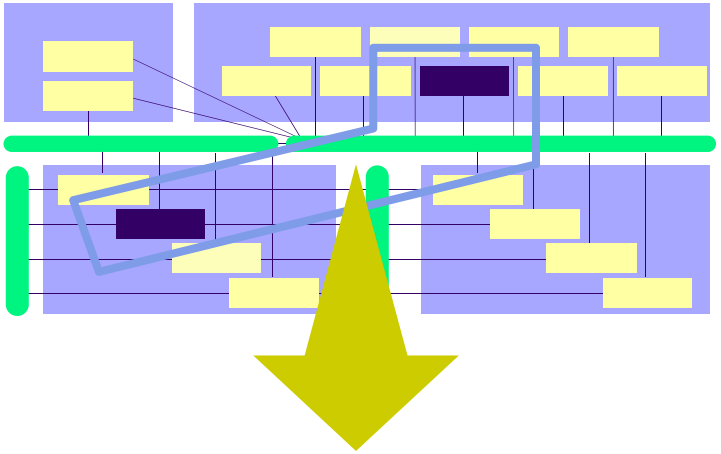
# ITS Architecture and Standards Relationships

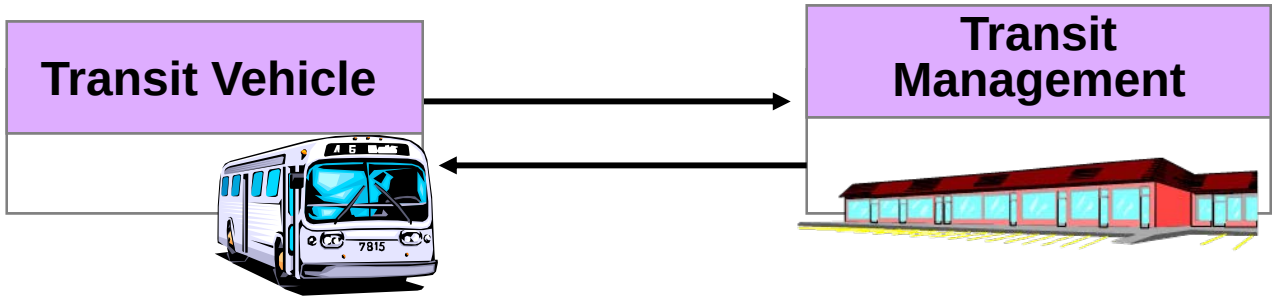


# Market Packages



## Architecture

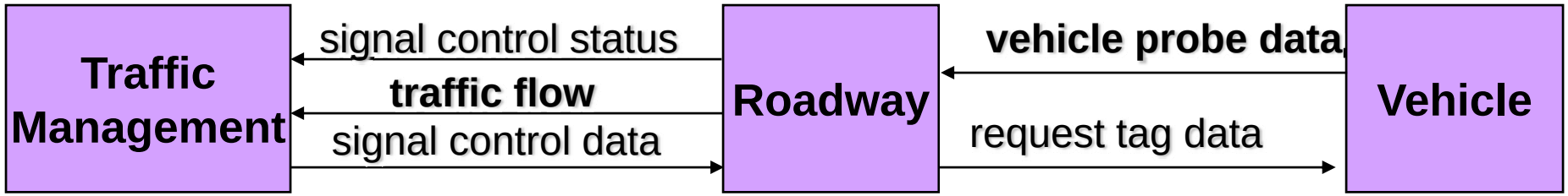
***Framework spanning all of ITS***




## Market Packages

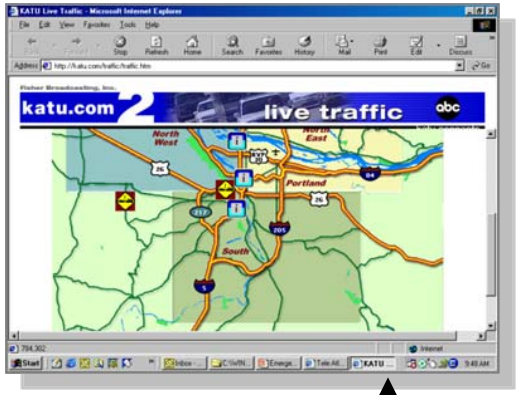
***Pieces of the architecture that provide a particular transportation service.***

# Moving Standardized Information between ITS Elements: *Architecture Flows*



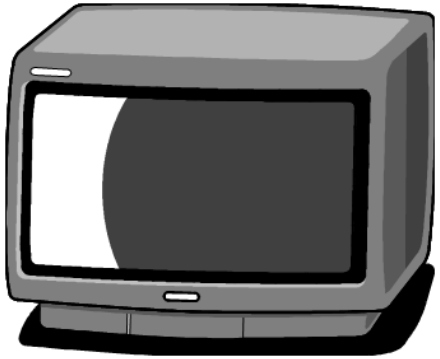

- *Architecture Flows*
  - Identify the expected types of information messages that flow between ITS elements
  - Provide a <u>high-level mapping to ITS standards</u>

# Traffic Information Dissemination

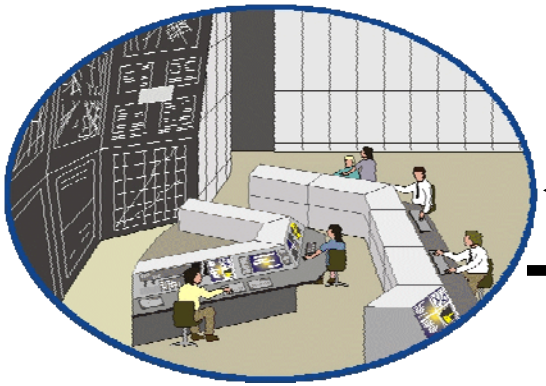



Web Site

Motorist



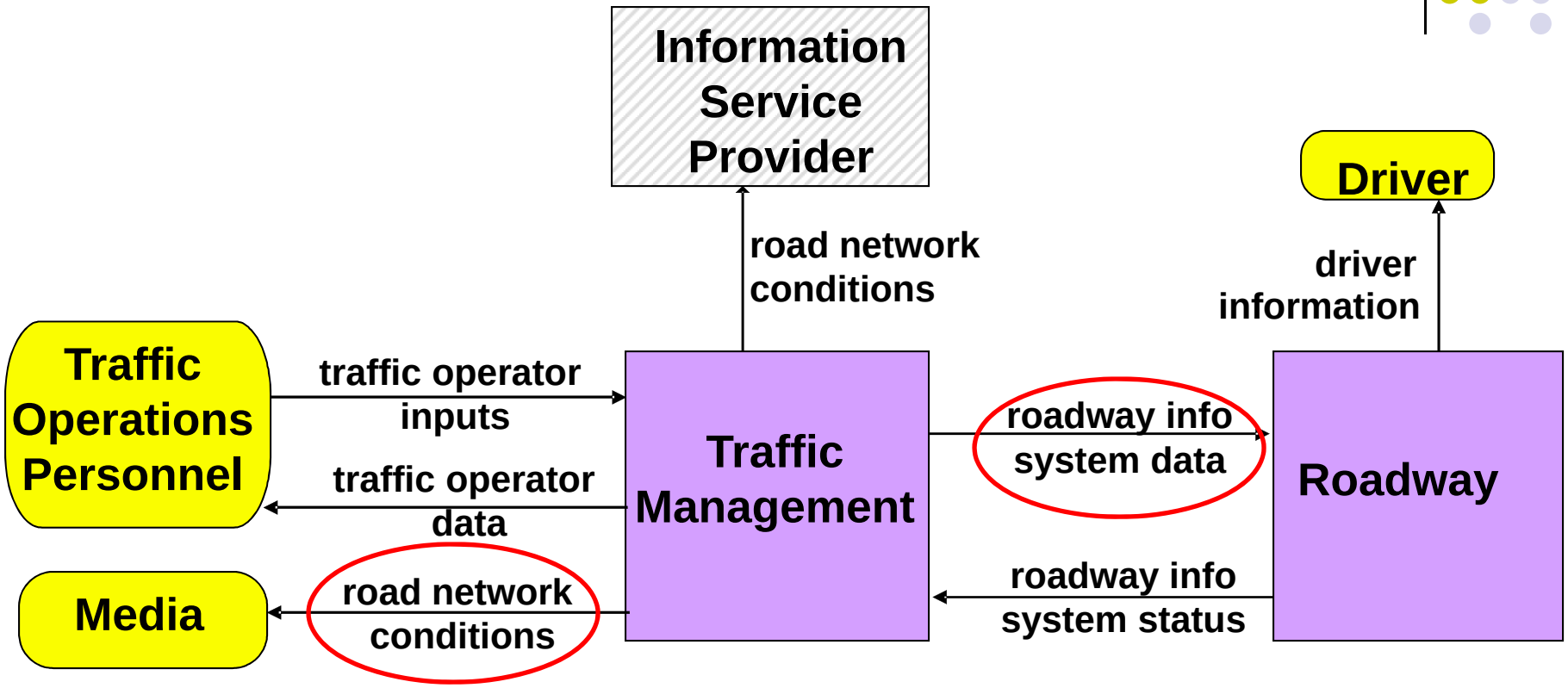
Television Station



Traffic Management Center

Dynamic Message Signs

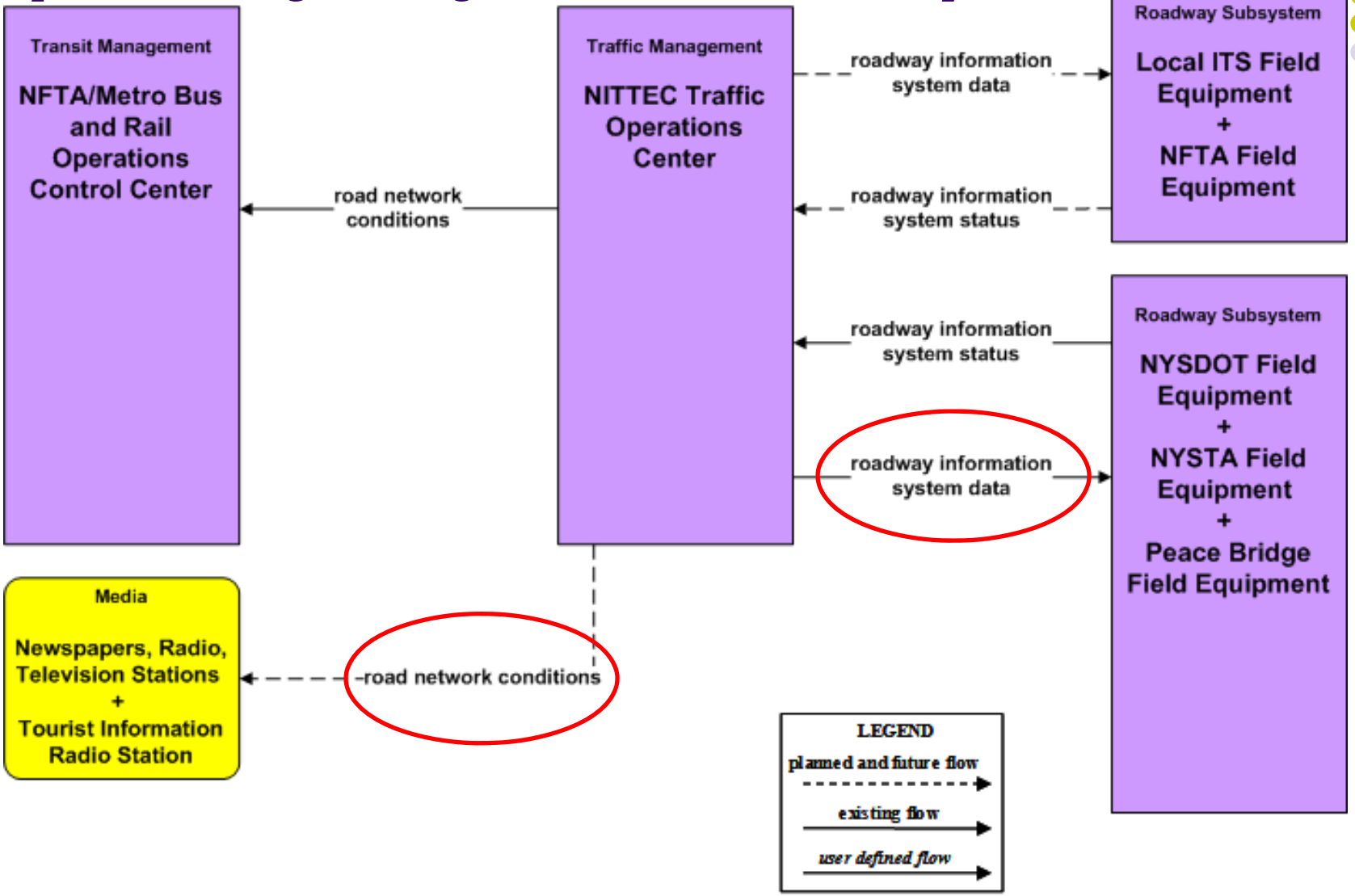
# ATMS06 – Traffic Information Dissemination *[National ITS Architecture]*




**We'll track <u>road network conditions</u> and <u>roadway information system data</u> from National ITS Architecture to Regional ITS Architecture and applicable ITS standards**

# ATMS06 - Traffic Information Dissemination
# NITTEC

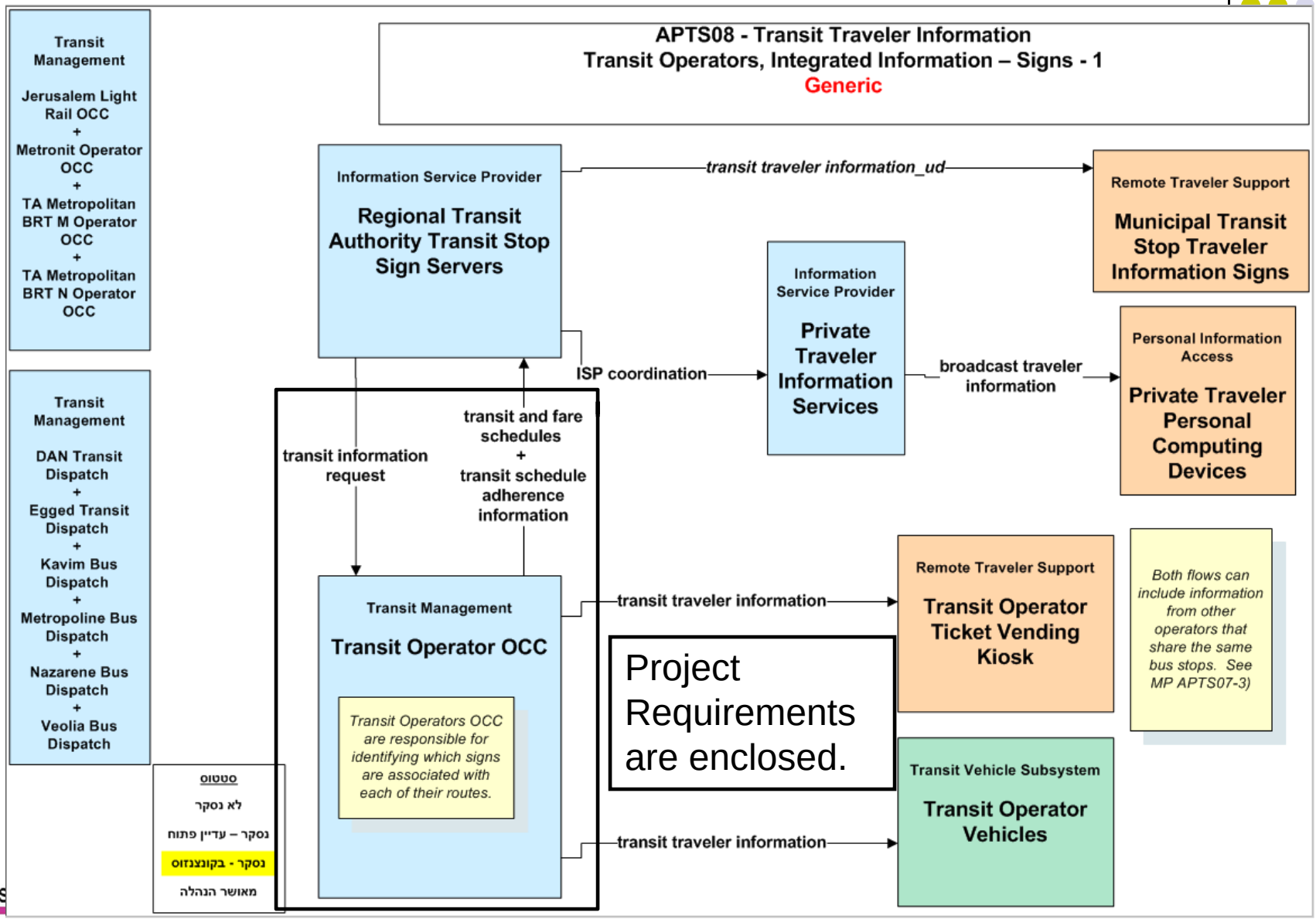
## *[Buffalo/Niagara Regional ITS Architecture]*



# Example ITS Architecture Flow Mapping to ITS Standards

- road network conditions
  - NTCIP C2C: NTCIP Center-to-Center Standards Group
  - ITE TMDD 3.0: Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD and MS/ETMCC)
- roadway information system data
  - NTCIP C2F: NTCIP Center-to-Field Standards Group
  - NTCIP 1201: Global Object Definitions
  - NTCIP 1203: Object Definitions for Dynamic Message Signs (DMS)

# Example MPs: Transit Operator Tender – Bus Stop Real-Time Arrival Sign



# Summary:
# Needs and ITS Architecture Benefits

| Needs related to Planning and Development of ITS Systems | Benefits |
|---|---|
| 1). Early definition of integration opportunities between ITS systems, particularly where the interfaces cross institutional boundaries. | Reduced time to develop projects involving institutional integration. The architecture will enable institutional agreements to be developed in advance of ITS project development. |
| 2). Definition of open standards that can be used to implement key interfaces of ITS projects. | Reduced time to select and agree to interface standards crossing institutional boundaries when ITS projects are developed. |
| 3). Definition of stakeholder's ITS services, ITS elements roles and responsibilities, and high-level functional requirements allocated to stakeholder ITS elements. | Reduced time to perform project preliminary engineering for each ITS service, including accelerating development of a Concept of Operations that stakeholders can agree to quickly |
| 4). Identification of cooperative opportunities between different stakeholder projects. | Achieve better efficiency for future investments, e.g. avoid redundant surveillance by multiple Traffic Operations Centers (TOCs) that can now share transportation monitoring information. |

# Thank-You!

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