ARC-IT – The Architecture Reference for Cooperative and Intelligent Transportation

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National ITS Architecture Team

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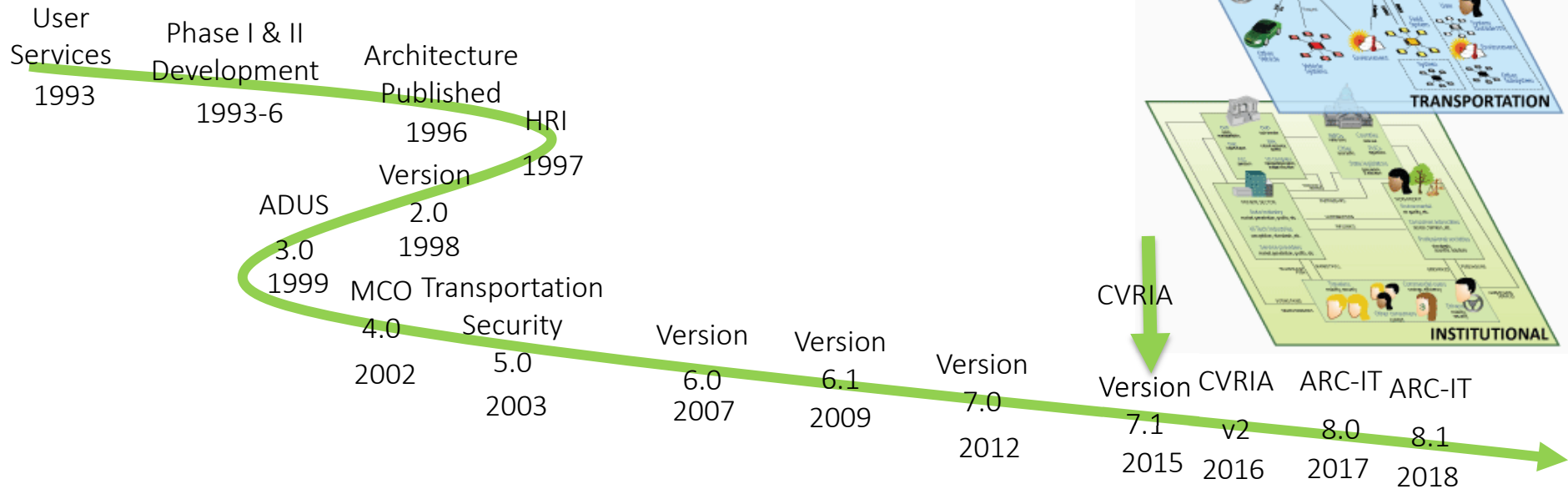
ARC-IT Version **8.1**
The National ITS Architecture

Architecture and US DOT

- USDOT's ITS Join Program Office (JPO) supports ITS deployment across US Department of Transportation surface modes

  □ Strategic goal: Enable efficient, interoperable, secure and cost-effective ITS infrastructure, connected vehicle and automated vehicle deployments across North America.

  □ Legislative mandate to (1) maintain an ITS National reference architecture and (2) to cooperate with standards organizations to develop standards in support of ITS deployment.

- Various forms of international cooperation seek to leverage global resources and expertise

  □ Maximize commonality of ITS deployments

  □ Share labor resources

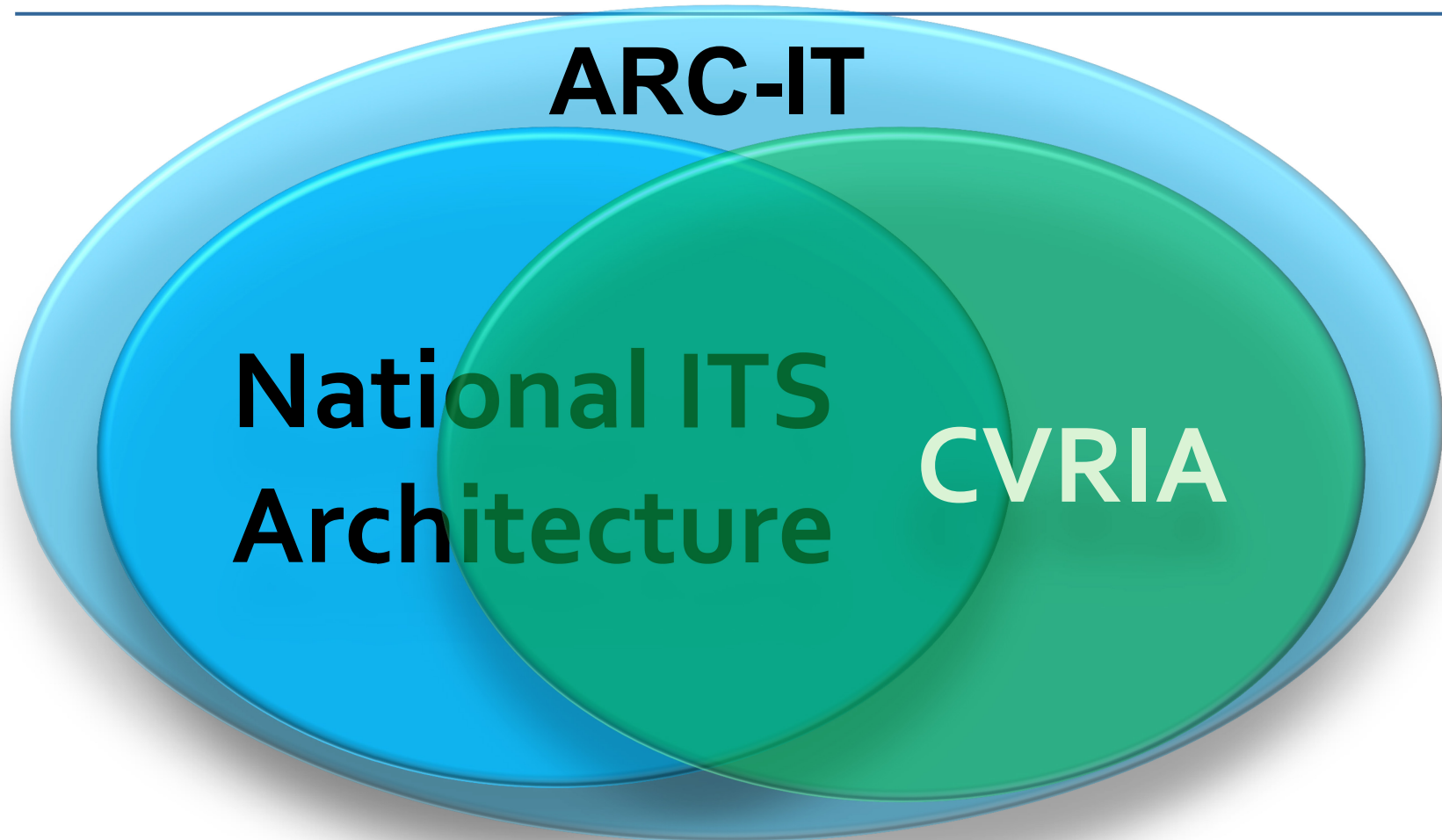 □ Access best-available expertise in order to facilitate ITS deployment and open markets

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National ITS Architecture is a "Living Document"

▪ Continuing evolution of the architecture over 20 years

User Services 1993

Phase I & II Development 1993-6

Architecture Published 1996

HRI 1997

Version 2.0 1998

ADUS 3.0 1999

MCO 4.0 2002

Transportation Security 5.0 2003

Version 6.0 2007

Version 6.1 2009

Version 7.0 2012

CVRIA

Version 7.1 2015

CVRIA v2 2016

ARC-IT 8.0 2017

ARC-IT 8.1 2018

ARC-IT Scope

ARC-IT

National ITS Architecture

CVRIA
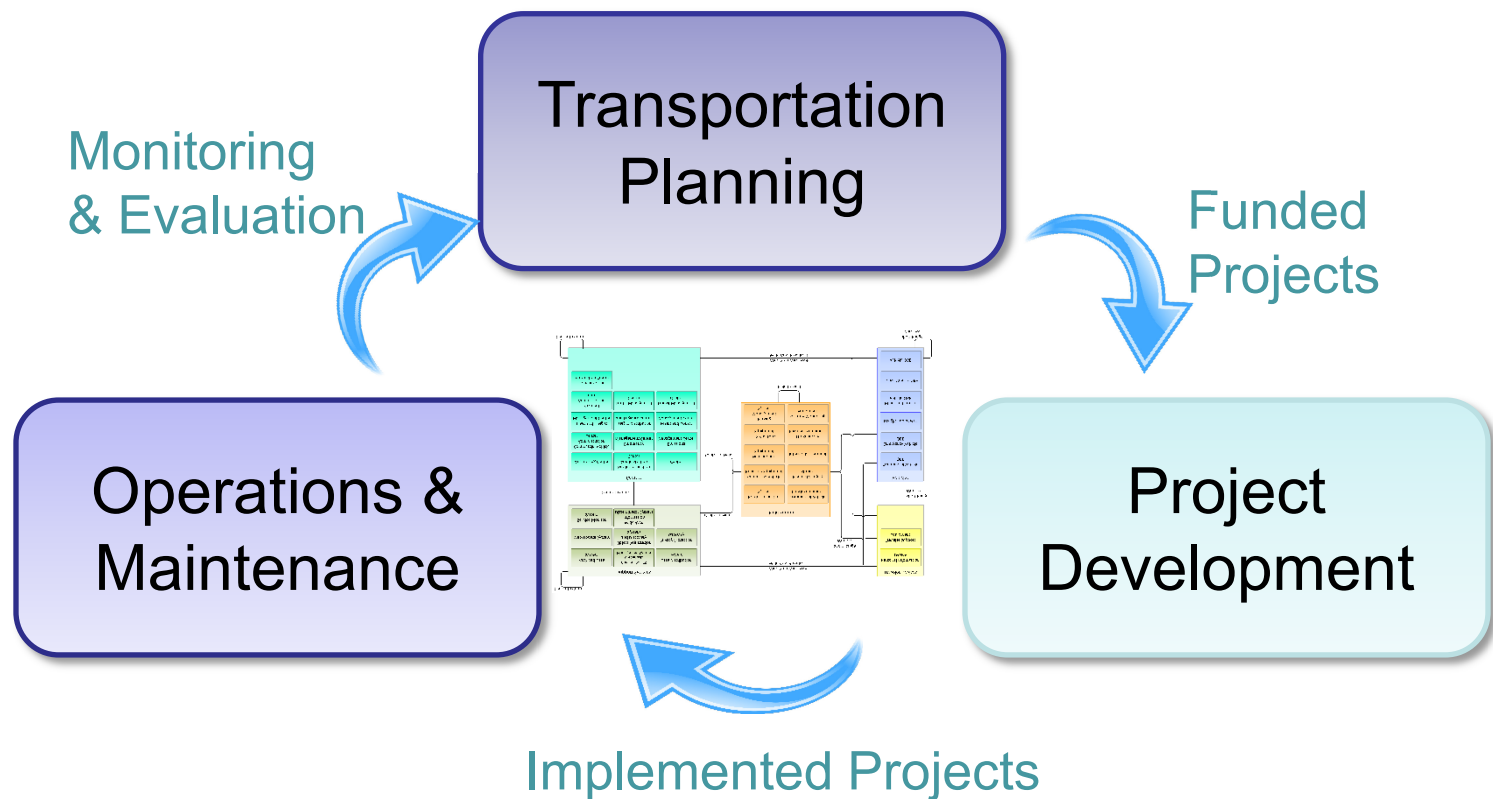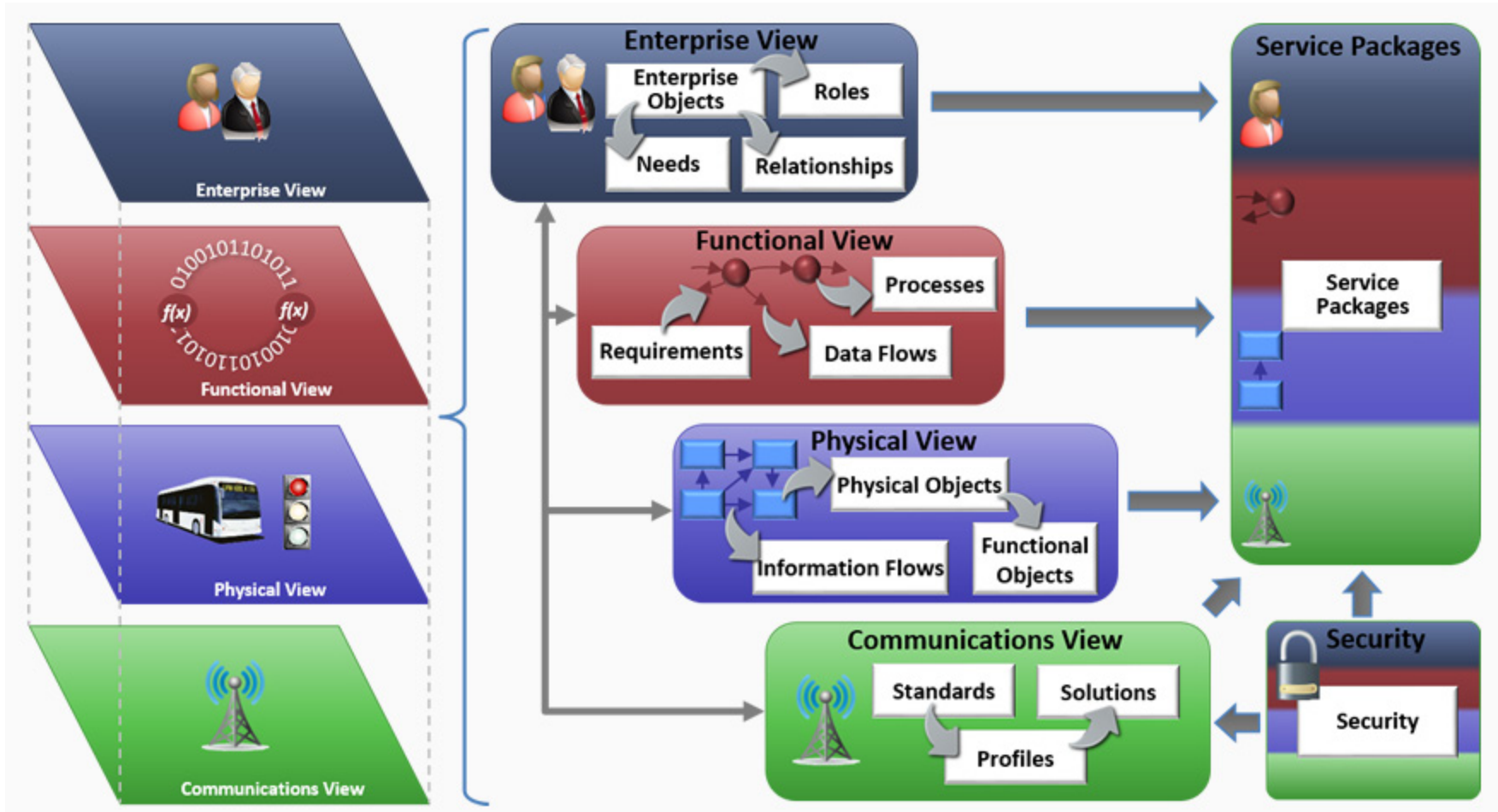
- ARC-IT combines services of National ITS Arch with connected vehicle content of CVRIA

Combined/Merged Architecture

- Continue to support regional planning and project implementation

Monitoring & Evaluation

Transportation Planning

Funded Projects

Operations & Maintenance

Project Development

Implemented Projects

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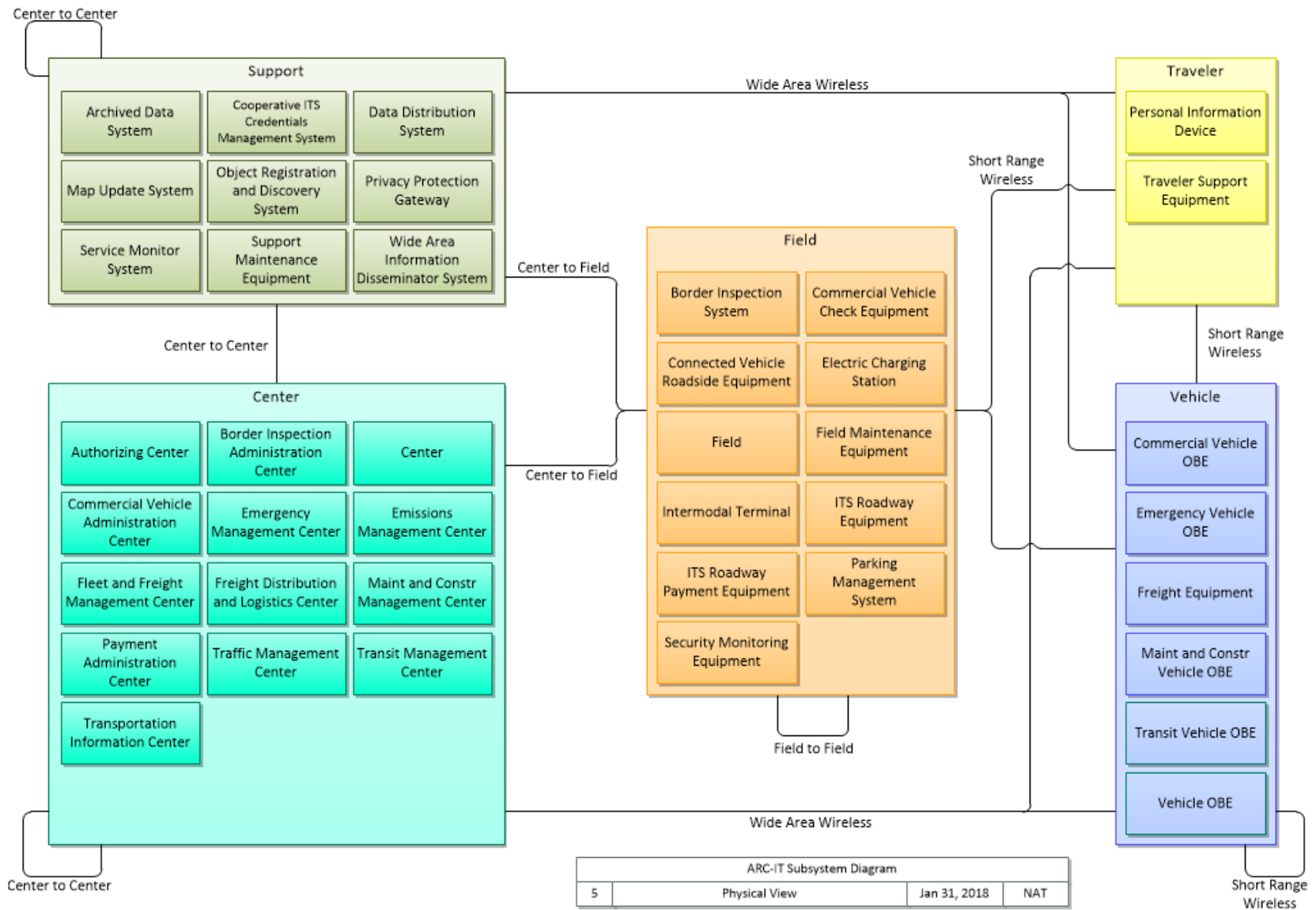
ARC-IT Structure and Organization

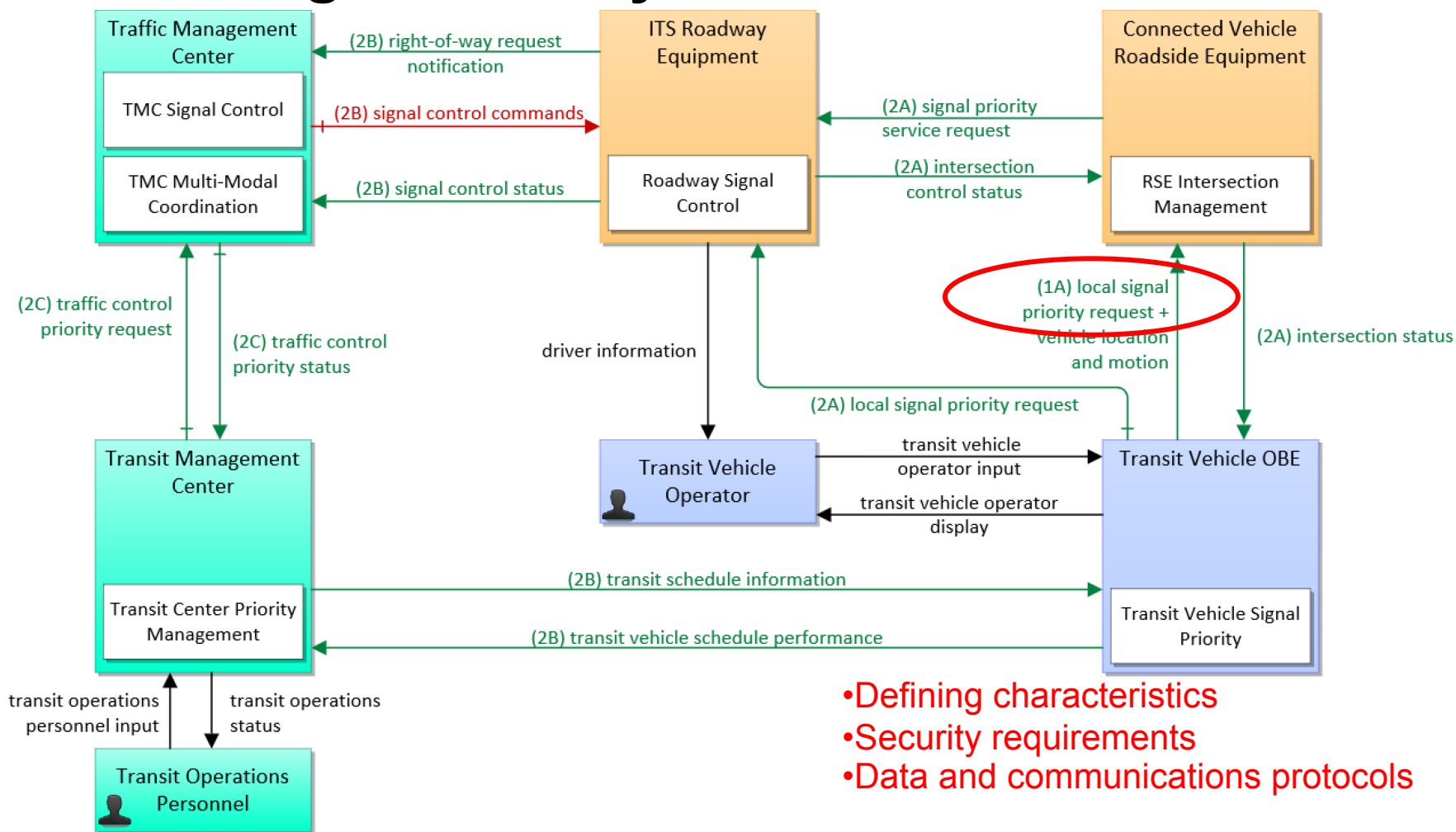# Correspondence between Views

Correspondence rules define how artifacts in one viewpoint are related to artifacts in another.
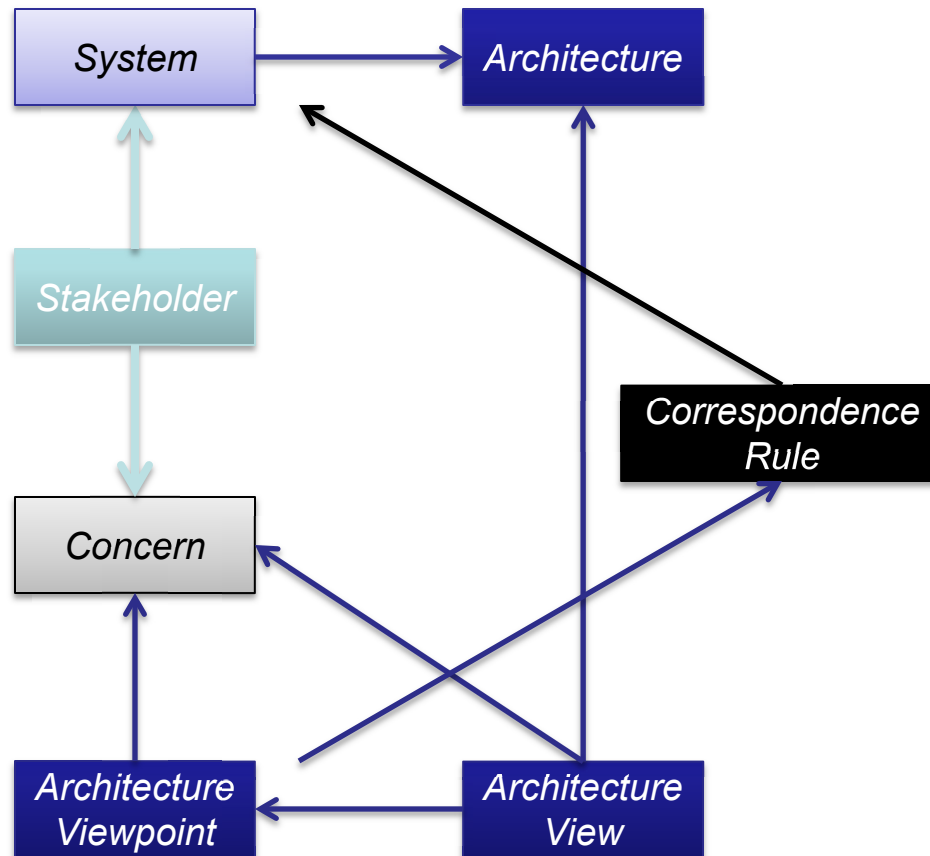
Physical View- Interconnect Diagram

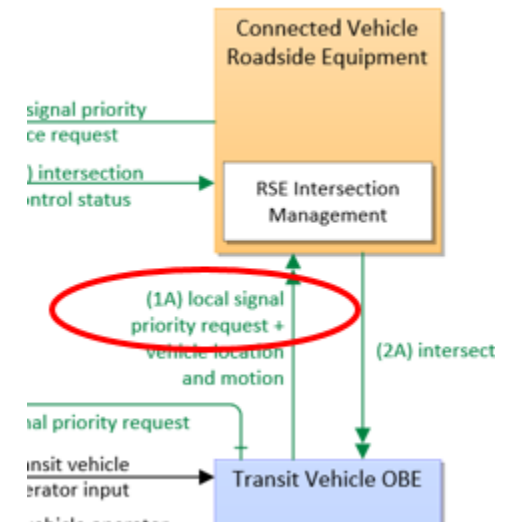# Service Package Example – Transit Signal Priority

Flow Characteristics

- For every flow… (> 1700)
  - Description of underlying data
  - Data time context (relevance)
  - Data spatial relevance
  - Communications requirements
    - Initiator
    - Acknowledgement
    - Cardinality
    - Range
    - Latency

Transit Vehicle OBE --> Connected Vehicle Roadsi
local signal priority request

| Definition | Included In | Communication Diagrams | Characteristics | Security |

Characteristics

Characteristic	Value
Time Context	Recent
Spatial Context	Adjacent
Acknowledgement	False
Cardinality	Broadcast
Initiator	Source
Authenticable	True
Encrypt	False

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Security Requirements

- Security requirements based on standardized methodology: FIPS-199
- Provides a basis for deployers' security requirements

Transit Vehicle OBE --> **Connected Vehicle Roadside Equipment**:
local signal priority request

Link Type: Short Ran Wireless

| Definition | Included In | Communication Diagrams | Characteristics | Security |

Security

Information Flow Security

	Confidentiality	Integrity	Availability
Rating	Not Applicable	Moderate	Low
Basis	This information can be observed.	Only approved vehicles should be allowed to make these requests to the RSE. A corrupted request may lead to a transit vehicle not receiving a green light after requesting it. In this case, this may lead to traffic delays. If an unapproved vehicle is able to forge these requests, they may cause larger scale traffic delays.	If the RSE does not receive any requests, the vehicle may not receive the priority it requested. In the worst case scenario the transit vehicle would be forced to wait at some lights until they turned green. It would be more useful for a device to support this application, and only have some messages received, than to not support this application at all.

Security Characteristics	Value
Authenticable	True
Encrypt	False

Data and Communications Protocols

- Similar in structure to OSI, ITS-S
- Basis for international harmonization and standards gap identification activities
- Provides a basis for deployers' interface control documents

DSRC-WSMP		
local signal priority request -->		
Transit Vehicle OBE		**Connected Vehicle Roadside Equipment**
ITS Application Information Layer SAE J2735	Security Plane IEEE 1609.2	ITS Application Information Layer SAE J2735
Application Layer Undefined		Application Layer Undefined
Presentation Layer ISO ASN.1 UPER		Presentation Layer ISO ASN.1 UPER
Session Layer Undefined		Session Layer Undefined
Transport Layer IEEE 1609.3 WSMP	Security Plane Undefined	Transport Layer IEEE 1609.3 WSMP
Network Layer IEEE 1609.3 WSMP		Network Layer IEEE 1609.3 WSMP
Data Link Layer IEEE 1609.4, IEEE 802.11		Data Link Layer IEEE 1609.4, IEEE 802.11
Physical Layer IEEE 802.11		Physical Layer IEEE 802.11

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Physical Device Requirements

- Analysis of information flows leads to "rollup" requirements for devices implementing those flows
  - Sum of requirements for inputs and outputs
  - Generally, "worst case" for each requirement must be met
- Aggregation of requirements and logical grouping suggests five levels of device security requirements

Physical Device Requirements

| Enterprise | Functional | Physical | Goals and Objectives | Needs and Requirements | Sources | Security |

Security

In order to participate in this service package, each physical object should meet or exceed the following security levels.

Physical Object Security				
Physical Object	**Confidentiality**	**Integrity**	**Availability**	**Security Class**
Connected Vehicle Roadside Equipment	Low	Moderate	Moderate	Class 1
ITS Roadway Equipment	Moderate	High	Moderate	Class 3
Traffic Management Center	Moderate	High	Moderate	Class 3
Transit Management Center	Low	Moderate	Moderate	Class 1
Transit Vehicle OBE	Low	Moderate	Moderate	Class 1

In order to participate in this service package, each information flow triple should meet or exceed the following security levels.

| Information Flow Security					
Source	**Destination**	**Information Flow**	**Confidentiality** Basis	**Integrity** Basis	**Availability** Basis
Connected Vehicle Roadside Equipment	ITS Roadway Equipment	signal priority service request	Not Applicable — There is no sensitive or confidential information within this messages. Additionally, it could be inferred by observing either the presence of a transit vehicle near an intersection, or the effect on the timing of the intersection. This is also transmitted as a result of	Moderate — The RSE is transmitting a request to the ITS RE on behalf of a transit vehicle. It should only be making requests on behalf of an approved vehicle. A corrupted request may lead to a transit vehicle not receiving a green light after requesting it. In this case, this may lead to traffic delays. If an unapproved vehicle is able to forge these requests, they may cause larger scale traffic delays.	Low — If the ITS RE does not receive any requests, the vehicle may not receive the priority it requested. In the worst case scenario the transit vehicle would be forced to wait at some lights until they turned green. It would be more useful for a device to support this application, and only have some messages received, than to not

ARC-IT Information Access

- ARC-IT is a publicly available product
  - All content is published at arc-it.org/
  - Content relevant for planning, deployment and systems engineering is included in the companion toolset
    - Regional Architecture Development for Intelligent Transportation (RAD-IT)
    - Systems Engineering Tool for Intelligent Transportation (SET-IT)
- Training in architecture methodology and tool use is also published

Tool Use
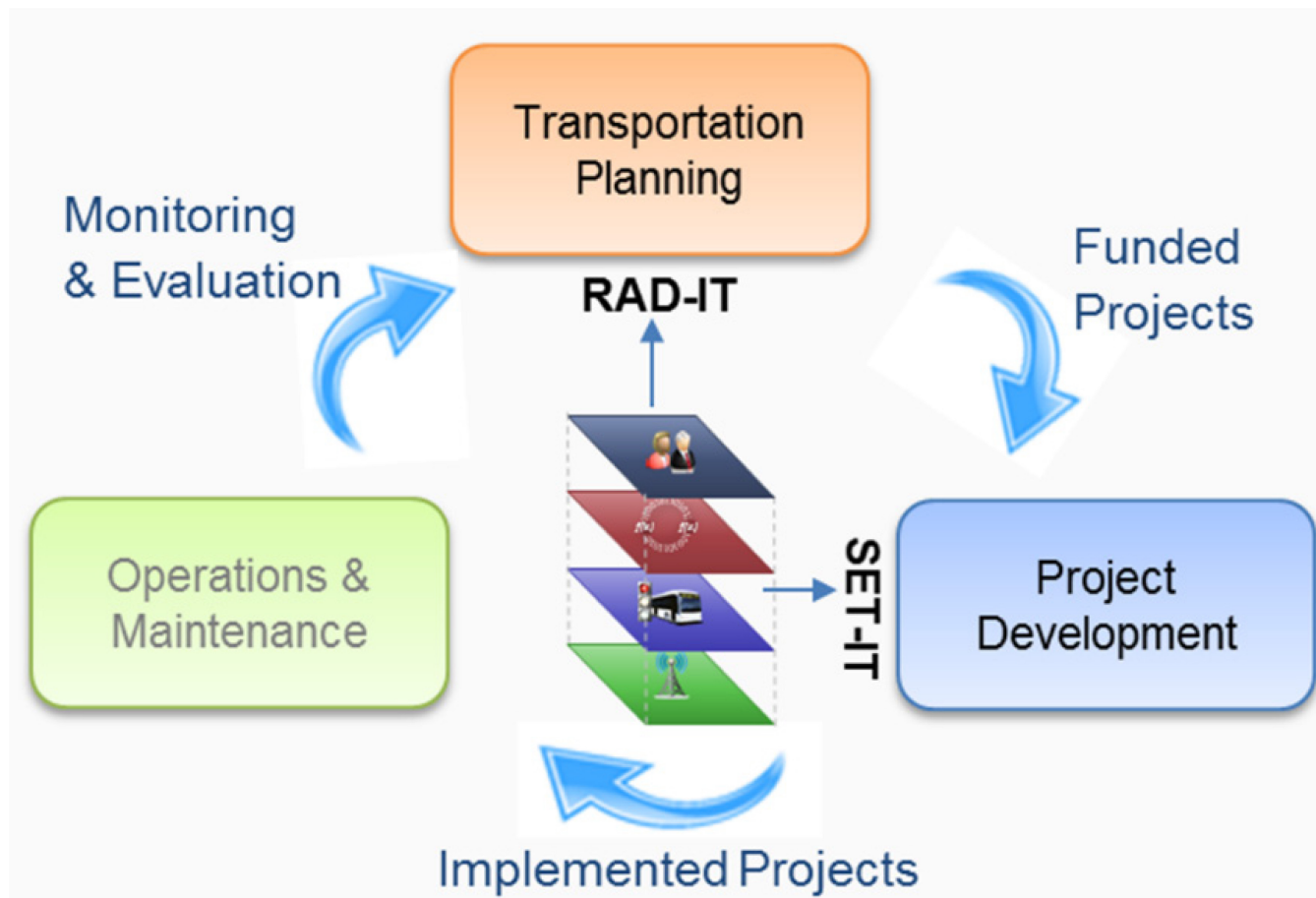
Scope of Tools

- RAD-IT focuses on regional planning and the development of Operations Concepts,
  - Stakeholders, Physical Objects, Service Packages, Interfaces for the region
- SET-IT is project-focused
  - scope specified in the regional architecture
  - graphical tool,
    - providing visual feedback and tools to manipulate service package diagrams
    - develop communications stack templates, specify standards at all protocol layers,
  - Outputs – documents, diagrams, tables
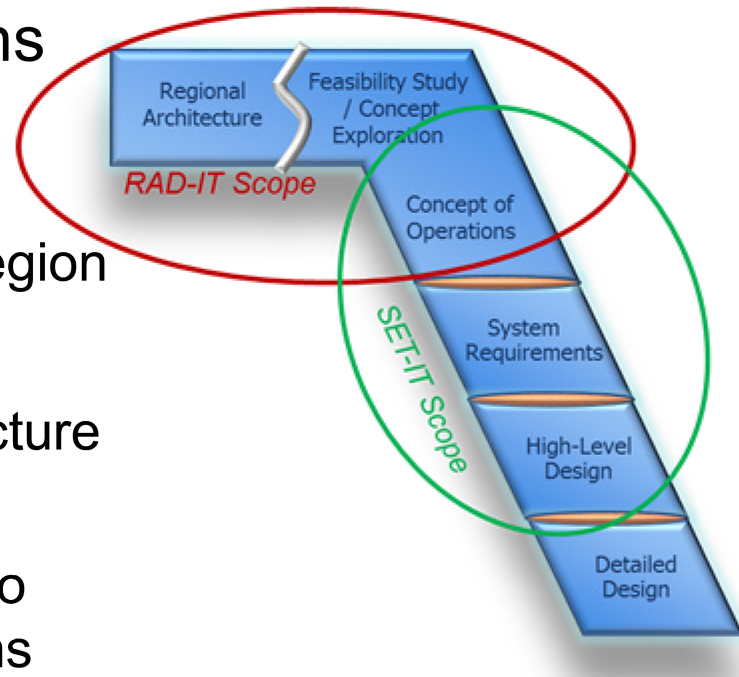
Using ARC-IT: Framework for ITS Standards

- Interfaces defined in ARC-IT identify what to standardize
  - Many ITS standards documents contain a section mapping their outputs to the interfaces of ARC-IT
  - Foundation for expandability and interoperability
- Use of Architecture as a framework for standardization continued with CVRIA and connected vehicle standards
- ARC-IT pulls all of these standardization efforts into one common framework
- ARC-IT is compatible with current international standards harmonization efforts

Contact Info

- Questions/Discussion?

- Contacts:
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