



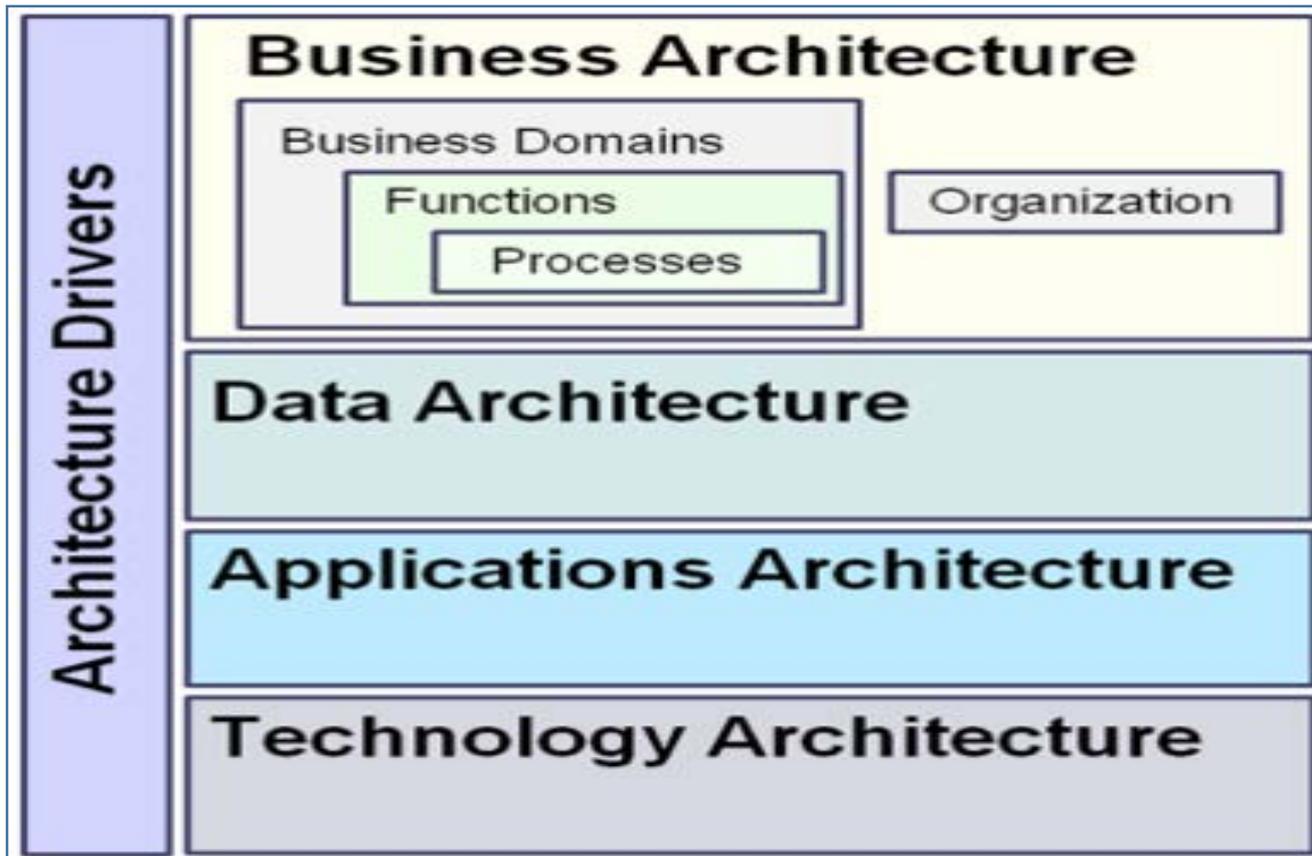
W E L C O M E



U.S. Department of Transportation  
Office of the Assistant Secretary for  
Research and Technology

# Module 16

## An Introduction to Transit Enterprise Architecture and its Benefits



# Instructor



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Consensus Systems  
Technologies**

# Learning Objectives

Define an **Enterprise Architecture (EA)**

Review the **benefits** to a transit organization of having an Enterprise Architecture

Describe the general **process for creating** a transit Enterprise Architecture

Articulate how use of **EA principles** can benefit a transit agency

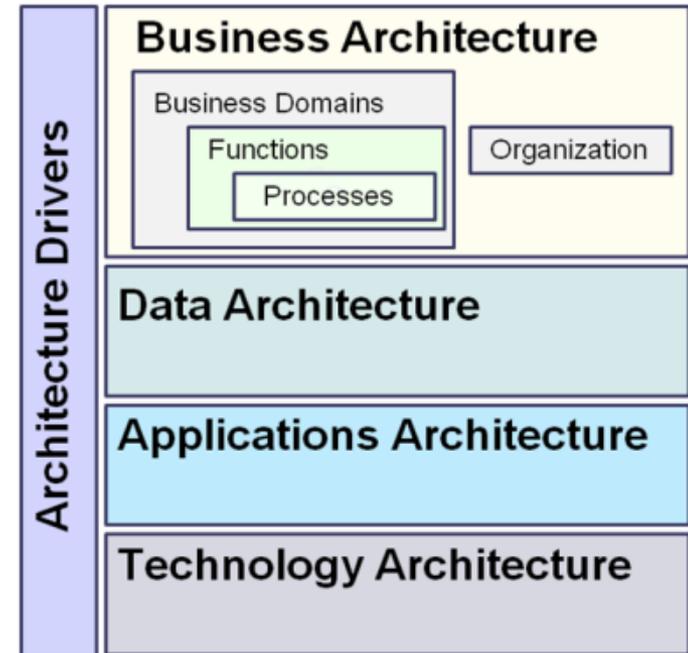
# Learning Objective 1

Define an Enterprise Architecture (EA)

# View from 10,000 feet

## What does a Transit Enterprise Architecture (EA) do?

- Creates efficiencies by providing managers and staff visibility into the overall relationships among their enterprise's
  - People and processes
  - Data
  - Applications
  - Technologies
  - Performance
  
- An EA can be designed to answer a wide range of questions that often stress transit managers and staff



# View from 10,000 feet

## What is an enterprise?

- “Any collection of organizations that has a common set of goals”
  - *The Open Group*
- It is a transit agency for this presentation

## What is architecture?

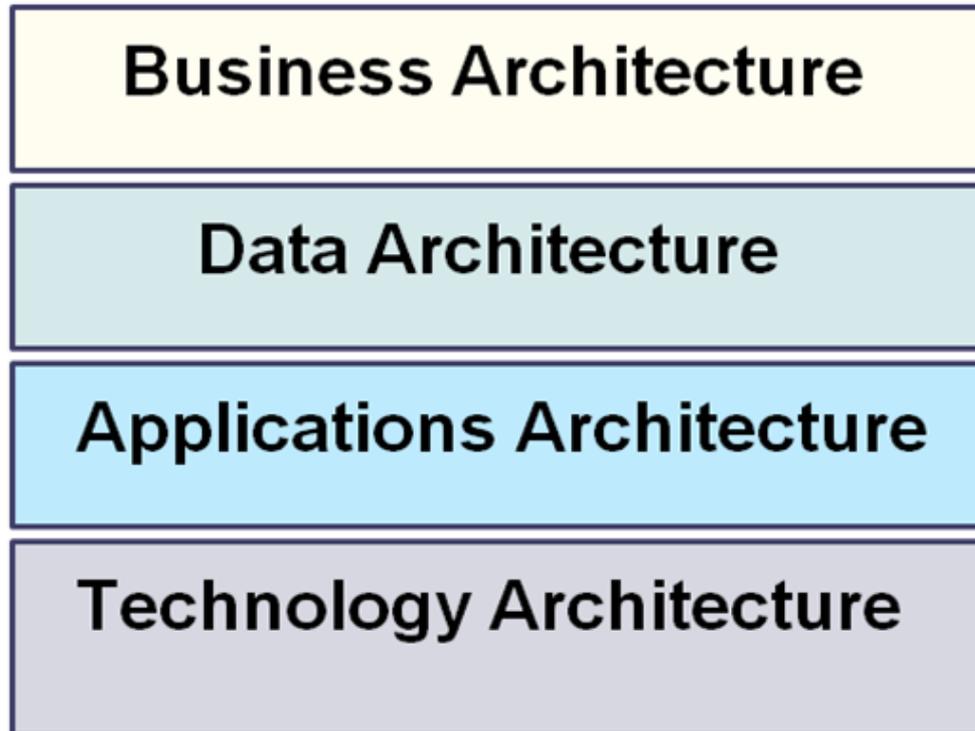
- “The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.”
  - *ISO/IEC 42010:2007*

## How is better visibility into transit achieved?

- By storing information about the enterprise in an architecture repository software tool that has analysis and display capabilities

# EA Layers

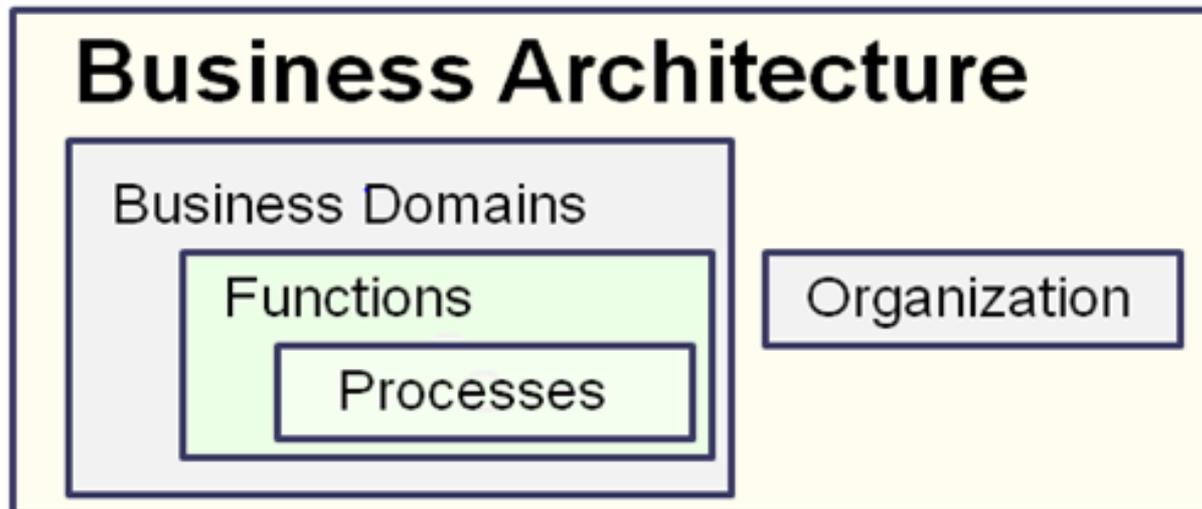
## Architecture Layers Commonly Seen in Transit EAs



# EA Layers

## Business Architecture (BA)

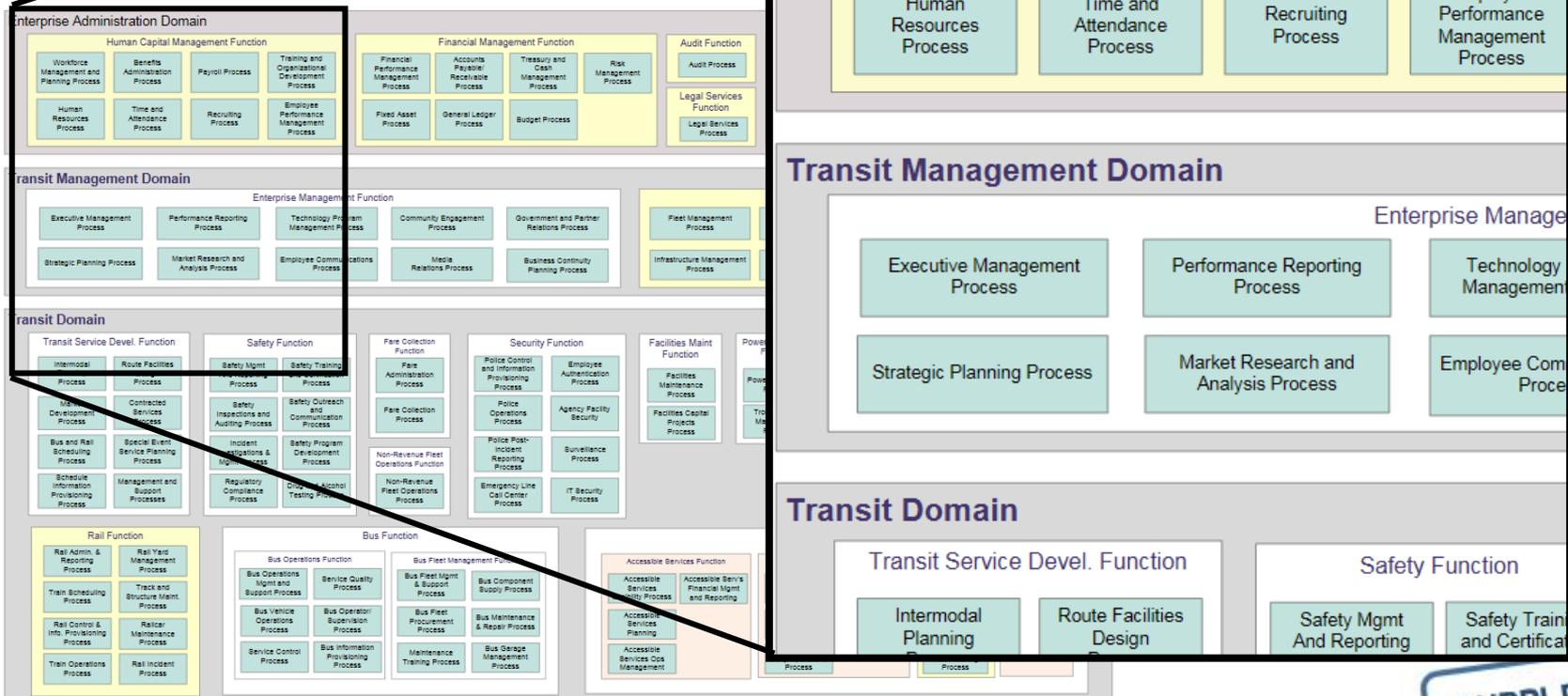
- The BA is an organized view of the business, usually including:
  - A hierarchical and mutually exclusive representation of the business functions and processes
  - A representation of the organizational structure
  - Connections and work flows
  - Roles and responsibilities that control the business



# EA Layers

## Partial Business Architecture Summary of Functions View

KCM Business Architecture: Summary of Functions View (Version 2.1)



SUPPLEMENT

# EA Layers

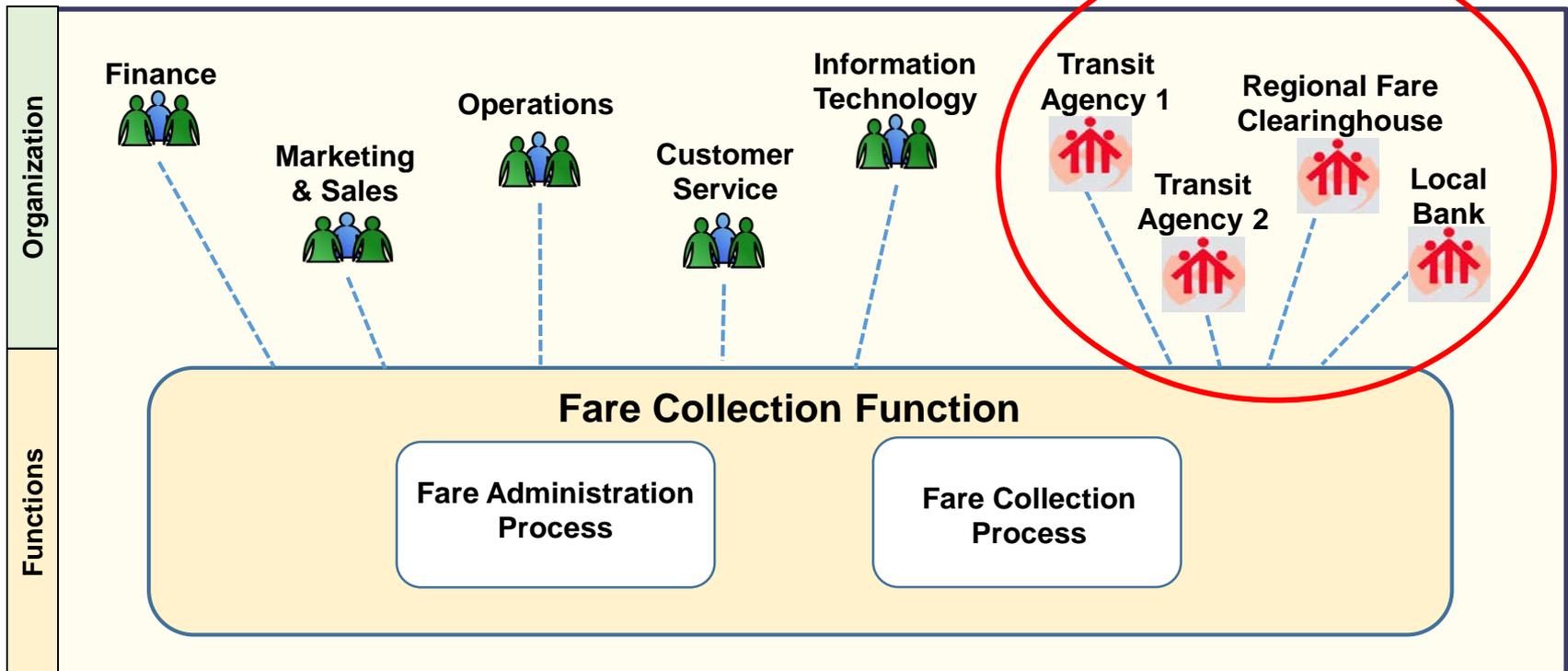
## Transit Business Architecture Can Be Extended



# EA Layers

## Extended BA: External Stakeholders

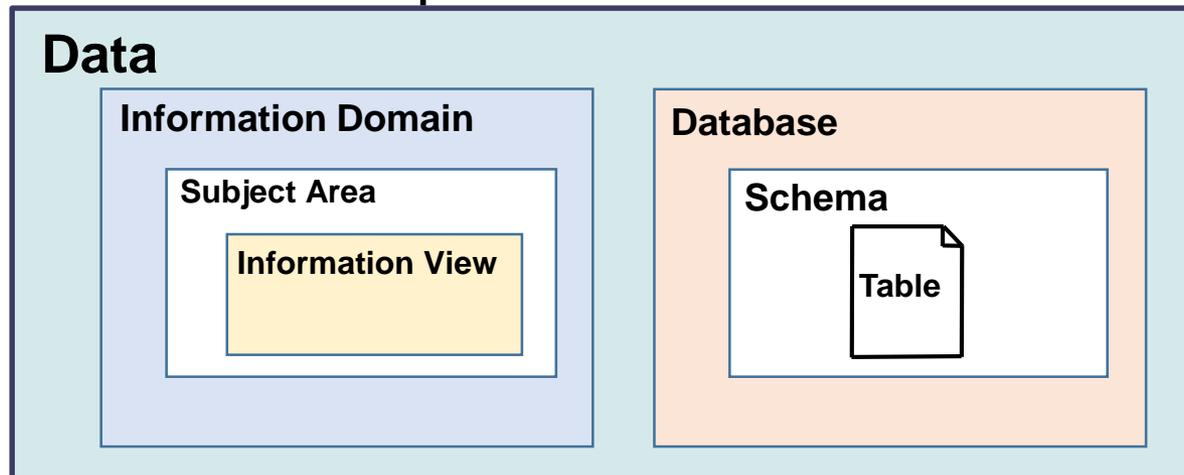
### Business Architecture



# EA Layers

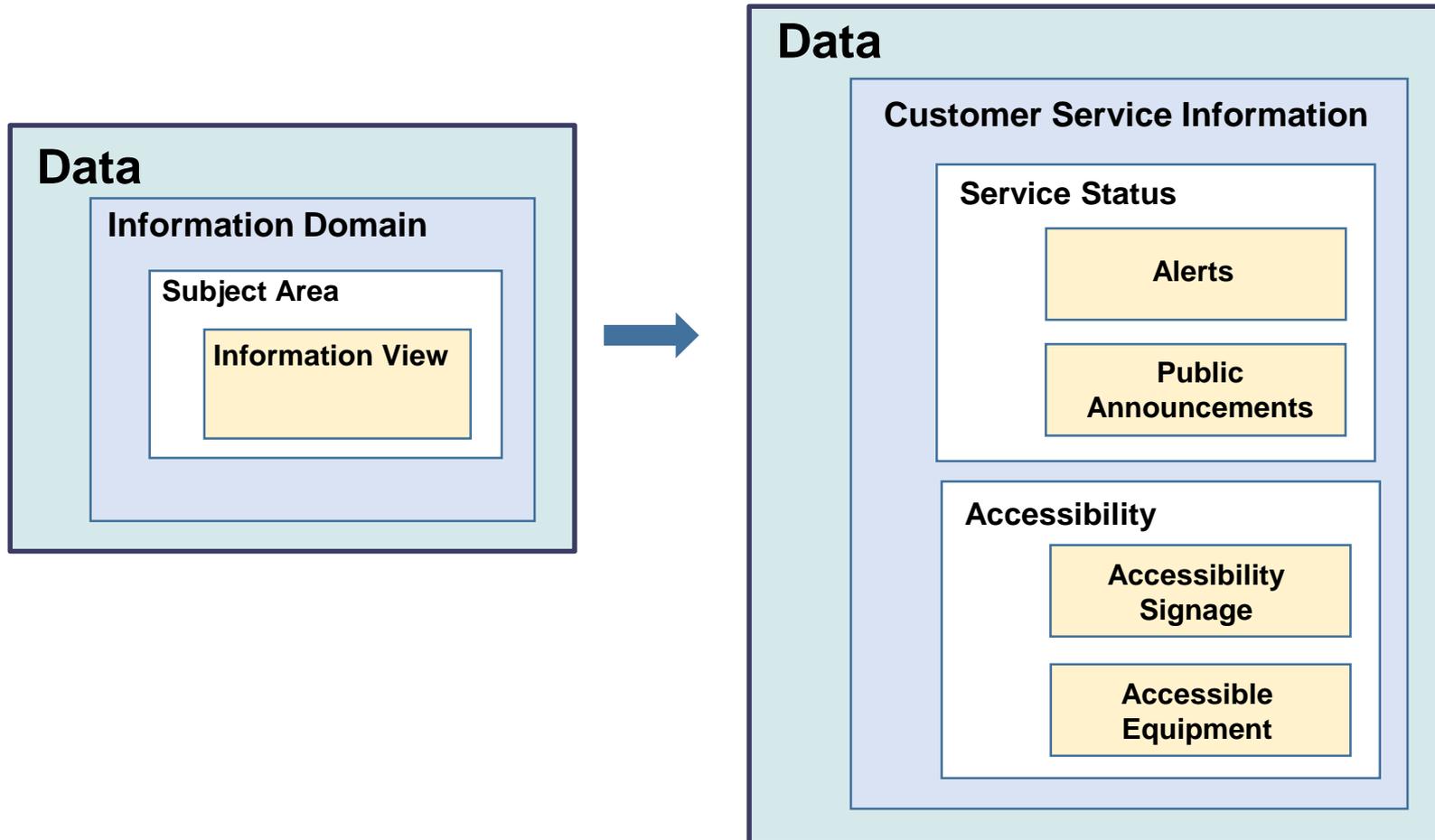
## Data or Information Architecture

- The Data Architecture (DA) describes the data and data structures used by a business and its applications. It may include:
  - The meaning and relationships of information categories
  - Answers related to how the data is stored and managed
  - Information on data integration within the organization
  - Supporting information about interfaces
- Common DA Components



# EA Layers

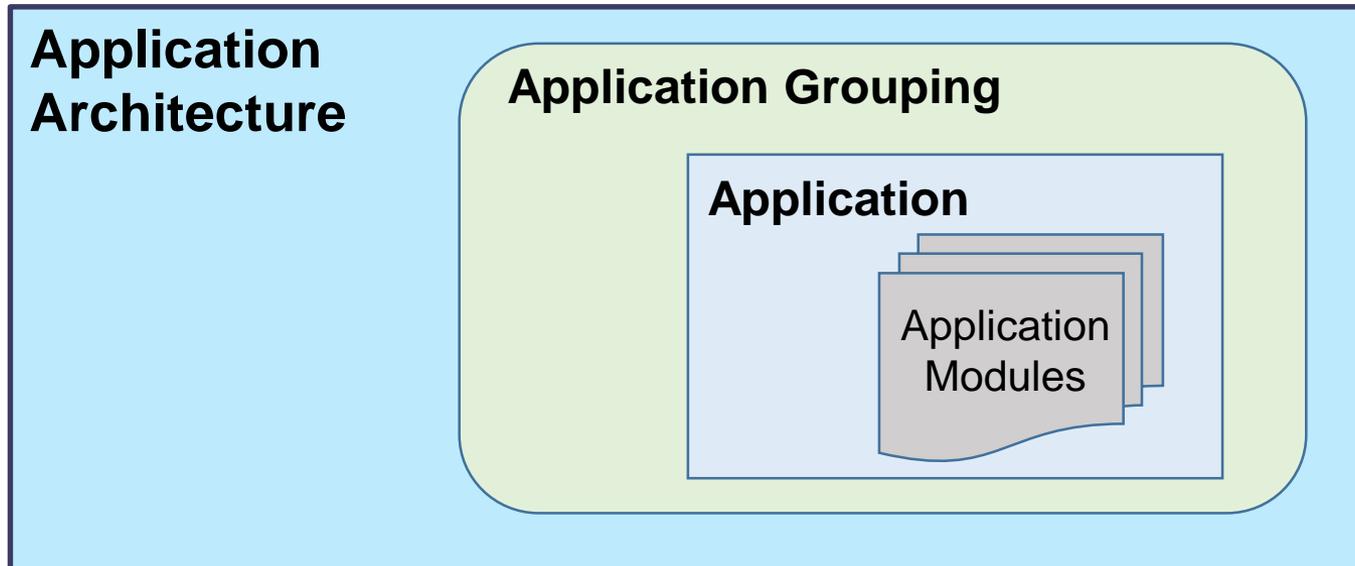
## Examples of Components in a Data Architecture



# EA Layers

## Applications Architecture (AA)

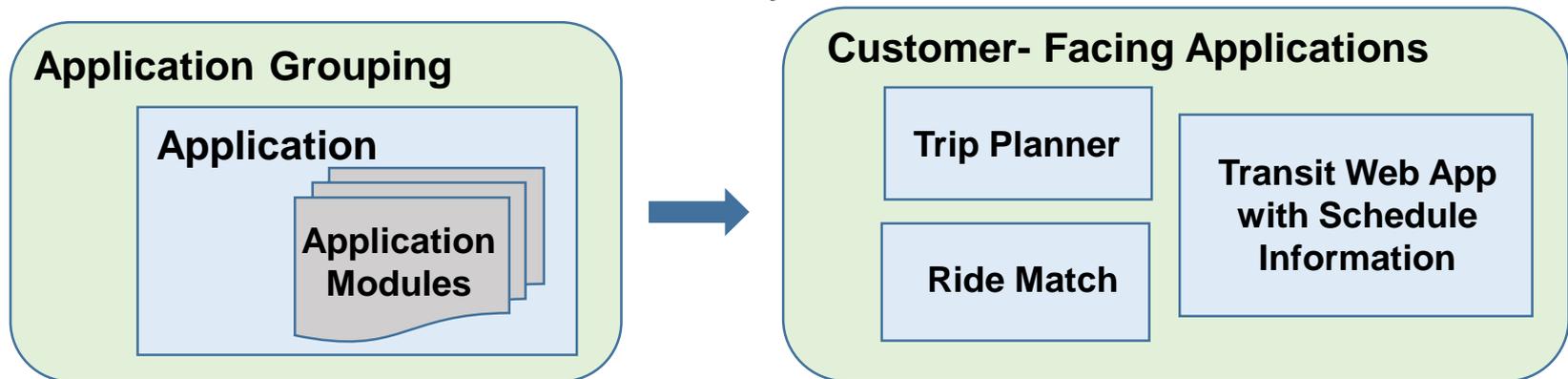
- The Application Architecture describes the applications and software services needed to support the operation of an enterprise such as transit.
- Common components of the AA



# EA Layers

## AA Components and Summary Views

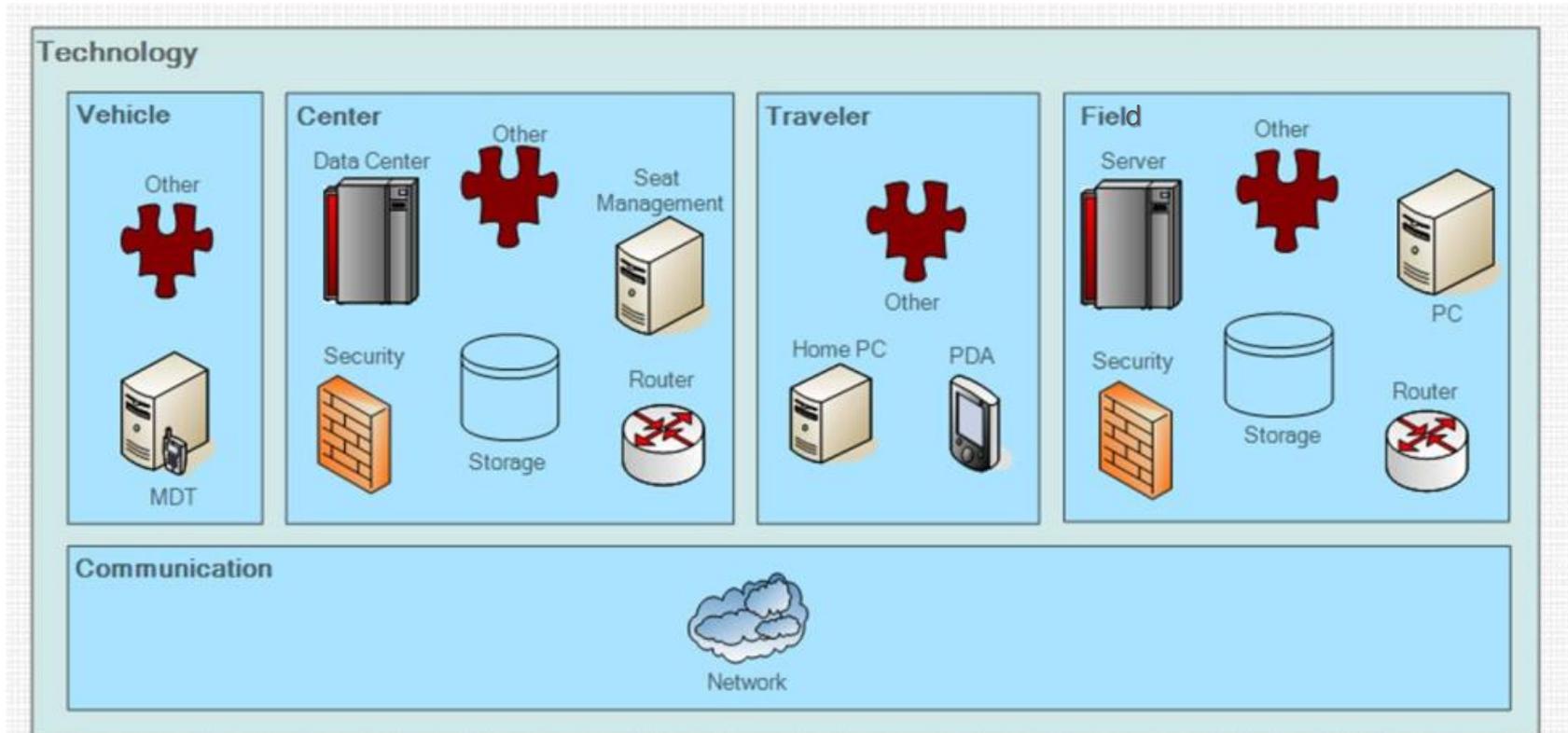
- Application Groupings support analysis and visualization
  - Can show redundancies
  - Need for standardization
- Examples of groupings that help transit with common issues
  - Customer-facing application
  - Reporting tools
  - On-board vehicle functionality



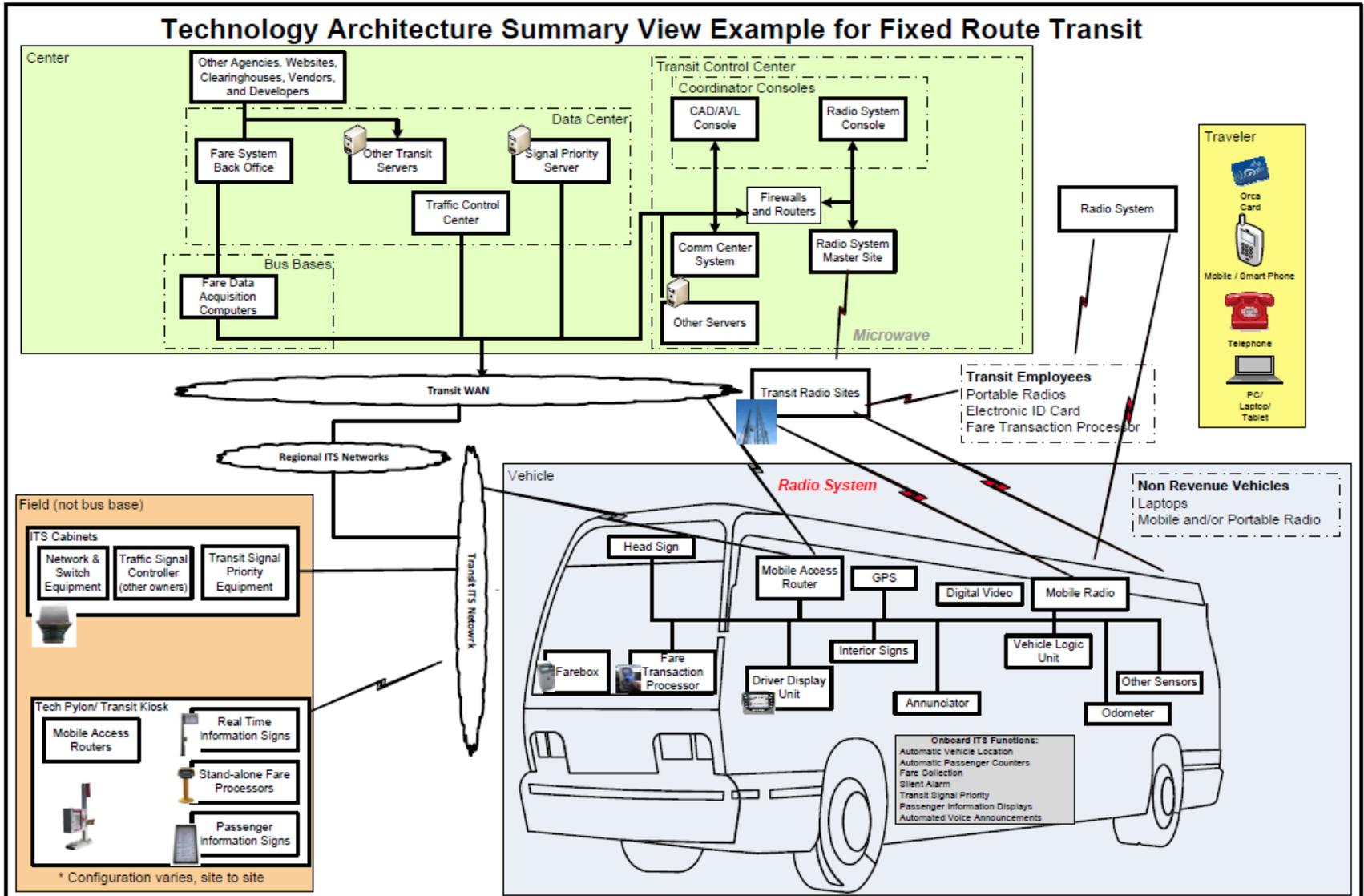
# EA Layers

## Technology Architecture (TA)

- The transit Technology Architecture captures, at a high level, the technology infrastructure components that are required to support the data and applications of an organization



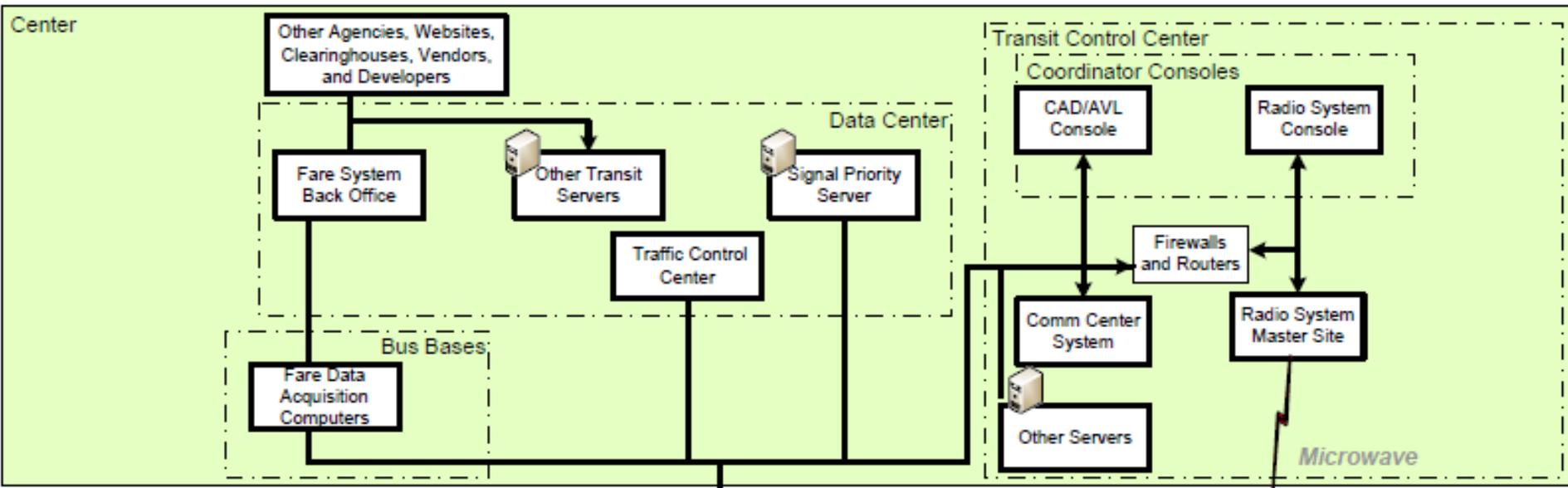
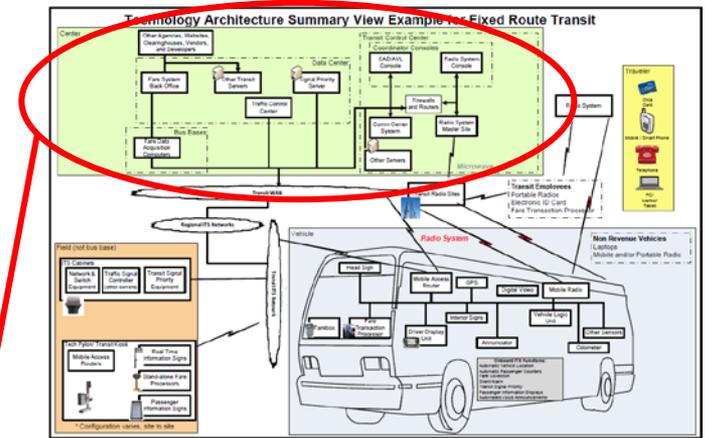
# EA Layers



# EA Layers

## TA Summary View - Center

Can show significant technology component categories at each Center location

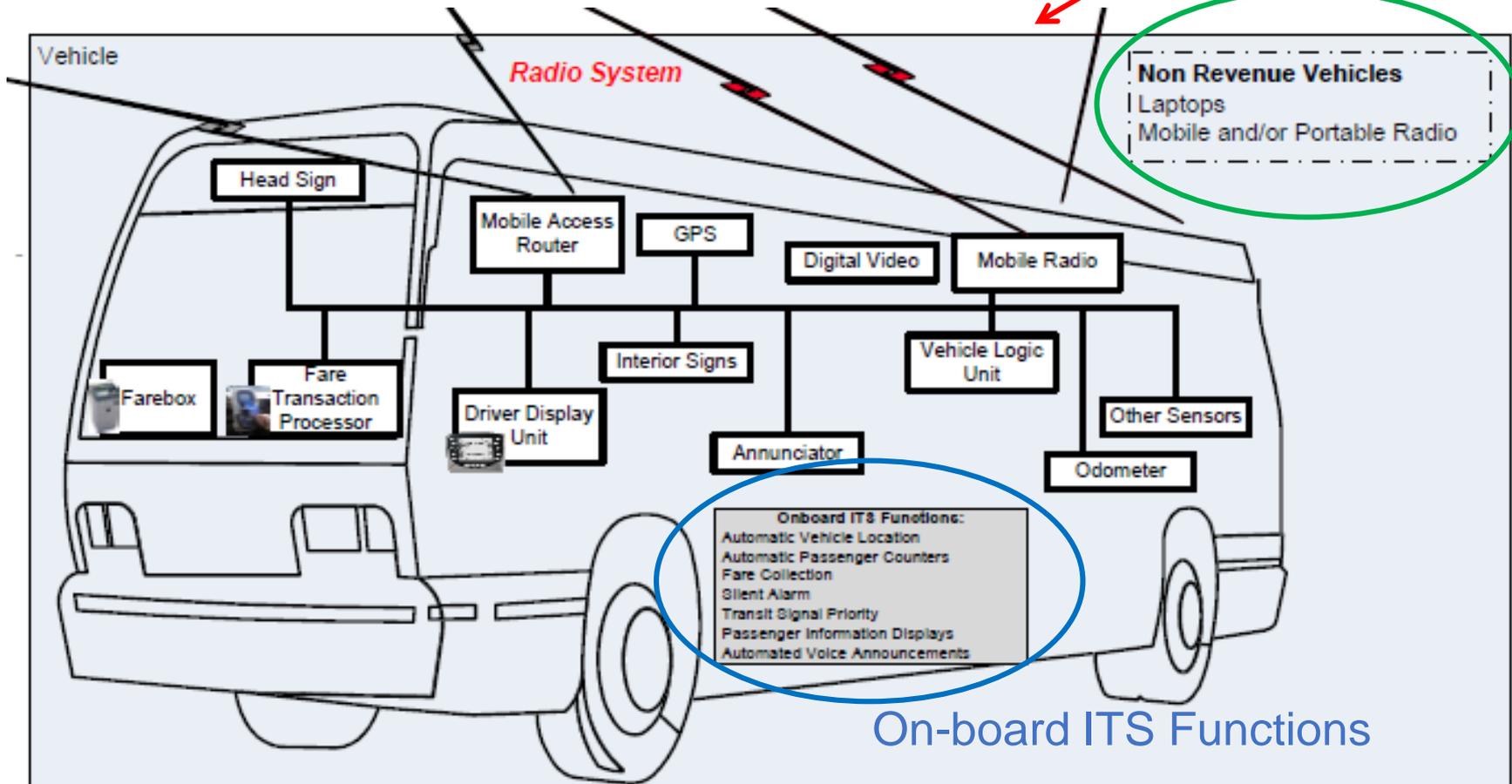
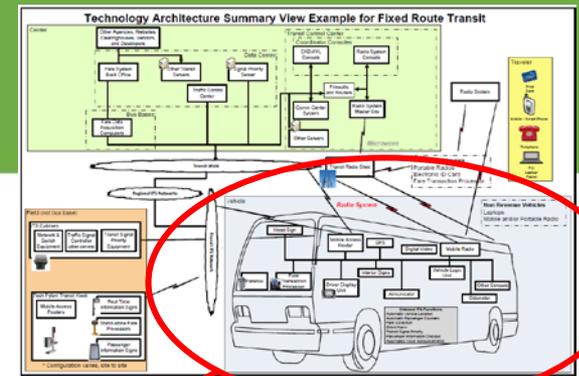




# EA Layers

## TA Summary View - Vehicle

Significant TA component categories located on vehicles



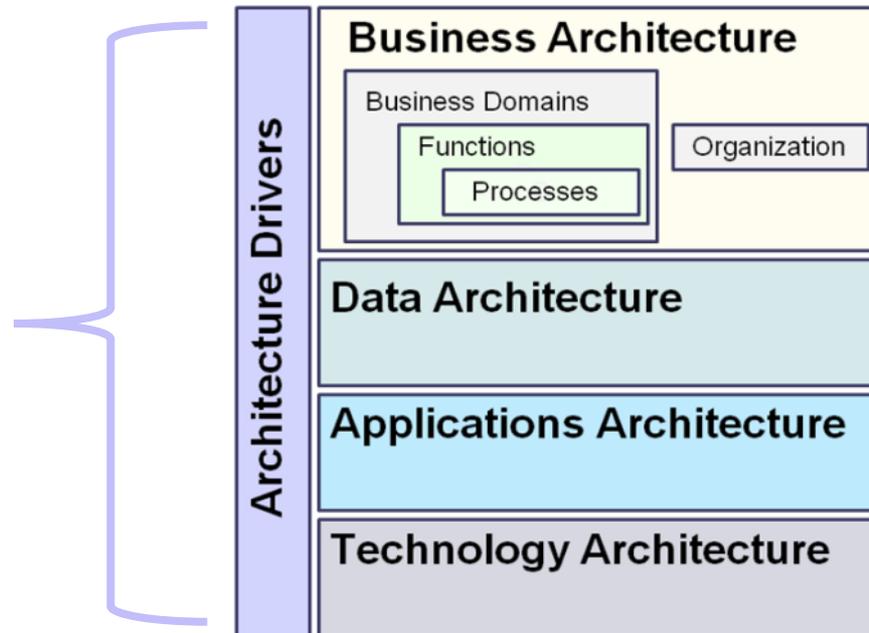


# EA Drivers

## Enterprise Architecture Drivers



Architecture Drivers influences the development, construction, and assessment of the EA



## Enterprise Architecture



- Linking drivers to components of the EA highlights priorities, biases and weaknesses
- Vision, Mission, Goals and Objectives
  - Can improve alignment with investments
- Transitional processes (e.g., new projects)
  - Can assess the impacts of new projects
- Standards
  - Can be linked to applications and other EA components

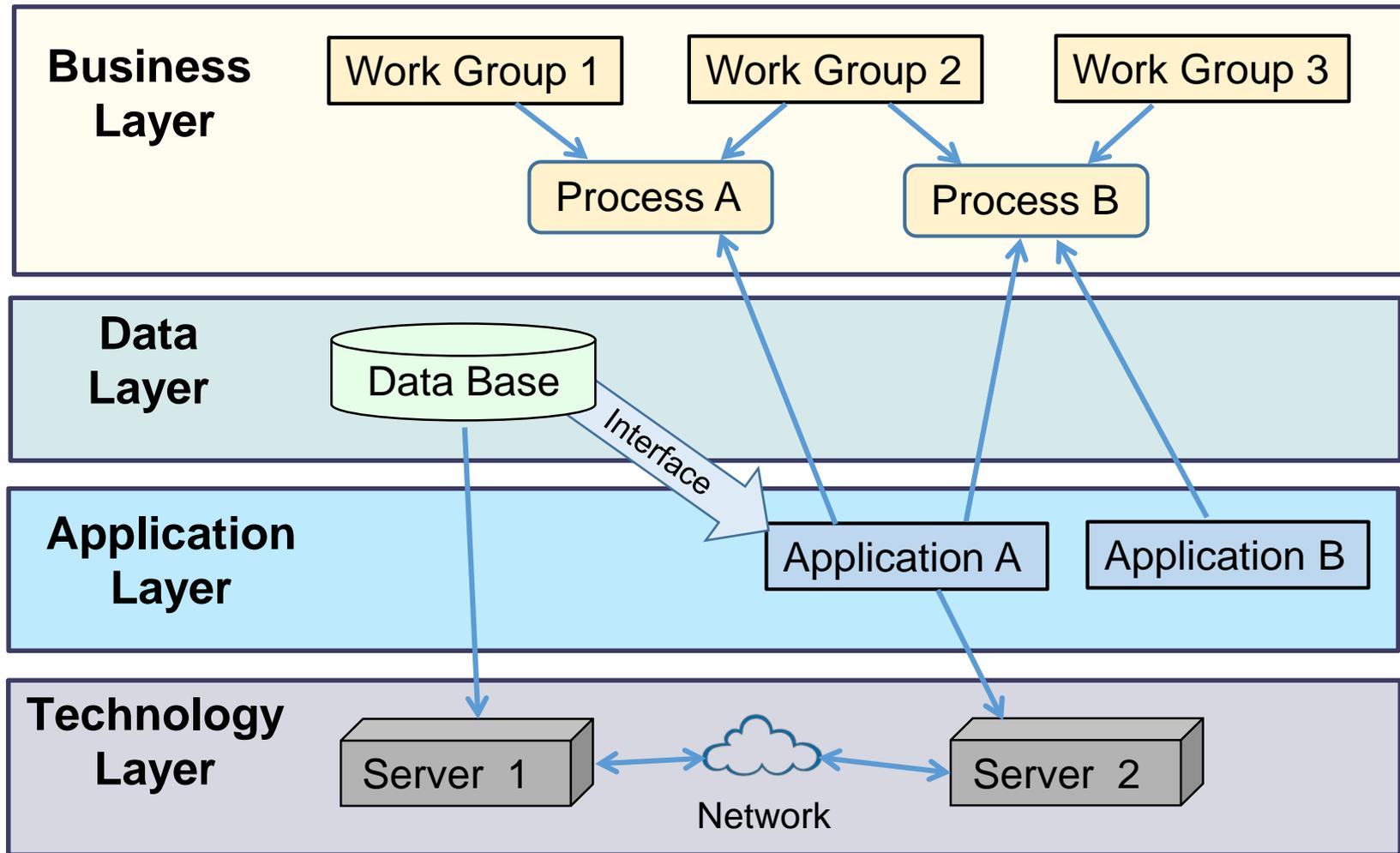
# EA Connections

## How are EA Connections Valuable?

- Defined Connections are a key part of the value of an EA
  - Define relationships
  - Can have Properties
- Parent-child Connections simplify the description of an EA
- Connections between Components in different EA layers inform about relationships
- A diversity of Connections between Components can be defined:
  - Business Functions "are supported by" Applications
  - Applications "are hosted on" Servers
  - A "sequence flow" can occur between processes

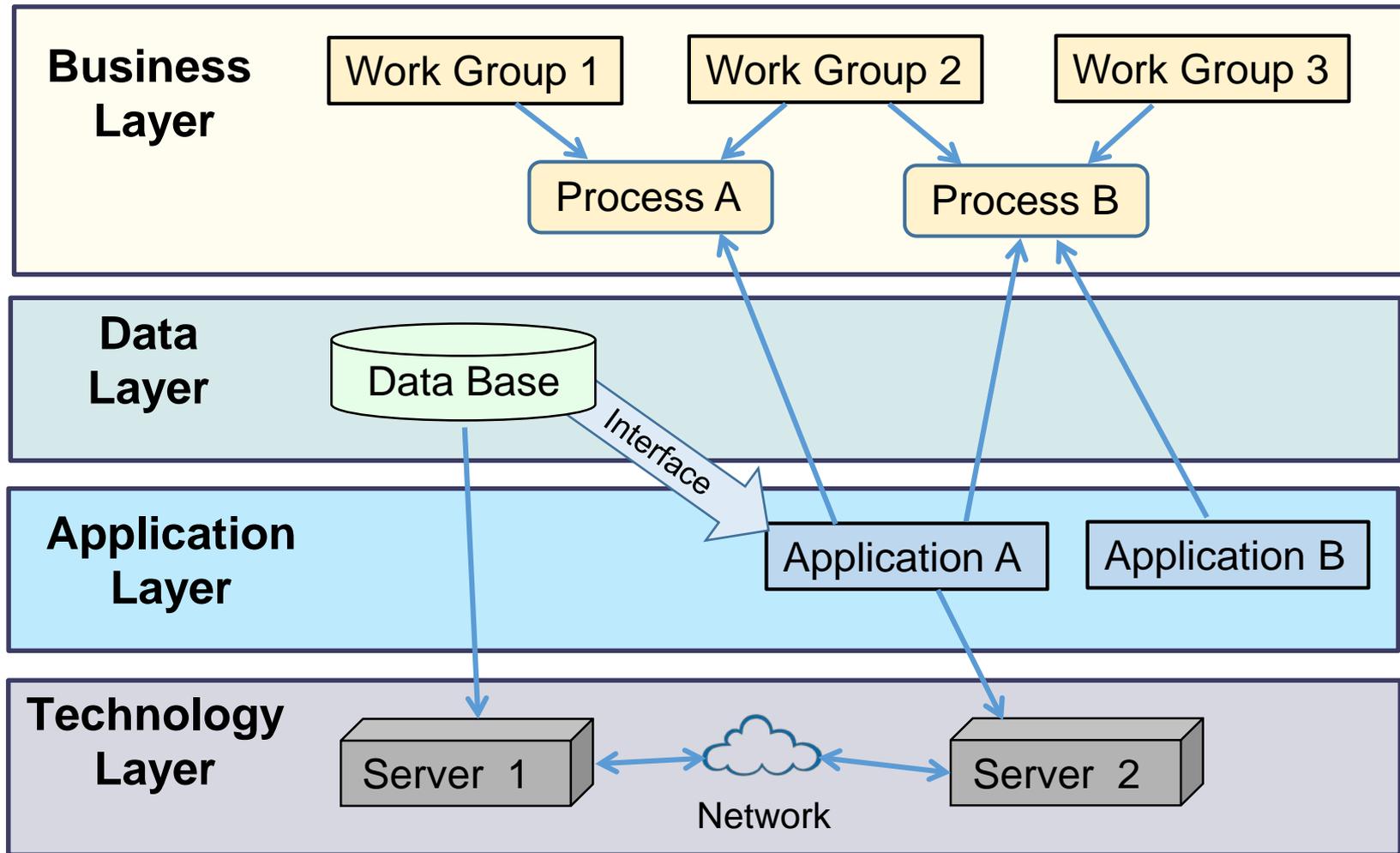
# EA Connections

## Connections – BA Perspective



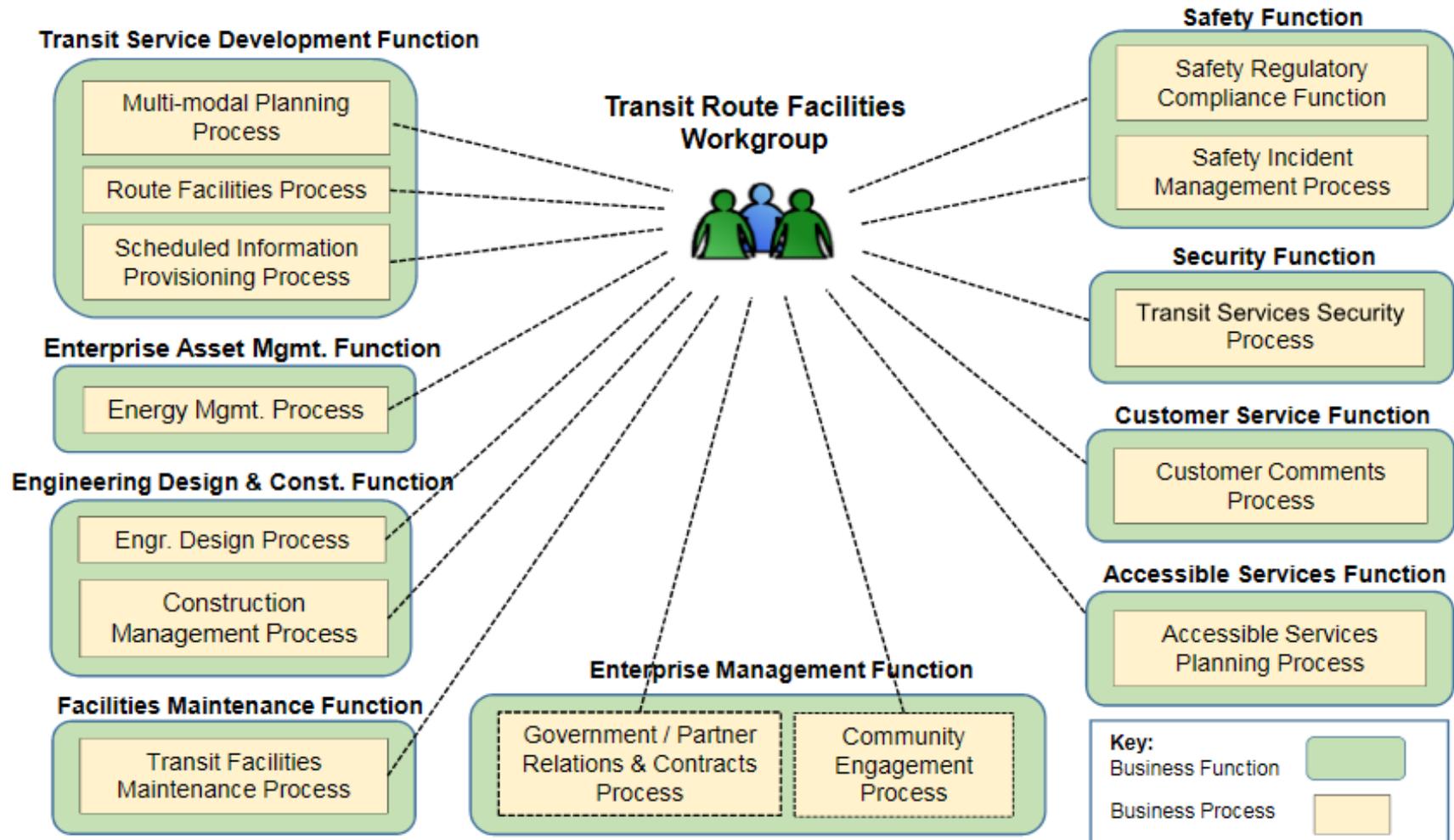
# EA Connections

## Connections – Technology Perspective



# EA Connections

## Transit Route Facilities Work Group Example



# EA Connections

## EA: Putting the Pieces Together

- An EA can present different perspectives
  - Different perspectives on the definition of an EA exist
- Revisiting the definition of an EA for transit, a preferred version:

*“A strategic information asset base, which defines the business, the information necessary to operate the business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing business needs. It is a representation or blueprint.”*

(Definition from the Federal Enterprise Architecture Framework)

Source: Congressional Research Service, Federal Enterprise Architecture and E-Government: Issues for Information Technology Management, April 10, 2008.  
<https://www.fas.org/sgp/crs/secrecy/RL33417.pdf>



# ACTIVITY



# Question

**Which of the following is NOT a typical name of a layer in a Transit Enterprise Architecture?**

## **Answer Choices**

- a) Business
- b) Software
- c) Technology
- d) Data

# Review of Answers



a) Business

*Incorrect. Business layer shows functions, processes, and organizational information.*



b) Software

***Correct! Software is a part of the Application layer, but is not a typical EA layer name as it can reside in hardware.***



c) Technology

*Incorrect. Technology layers shows EA components such as servers, networks, and ITS devices.*



d) Data

*Incorrect. Data layer typically shows databases and key datasets.*

## Learning Objective 2

Review the benefits to a transit organization of having an Enterprise Architecture (EA)

# Benefits to Transit

## Wide Range of Potential EA Benefits

- Provides better **visibility** into the agency
- Improves **understanding** of the enterprise
- Reduces **risk** by increasing awareness of dependencies
- Increases understanding of the impacts of potential **changes** on people, systems, and data
- Enables **quicker** response to change through better information



# Benefits to Transit

## Wide Range of Potential EA Benefits (continued)

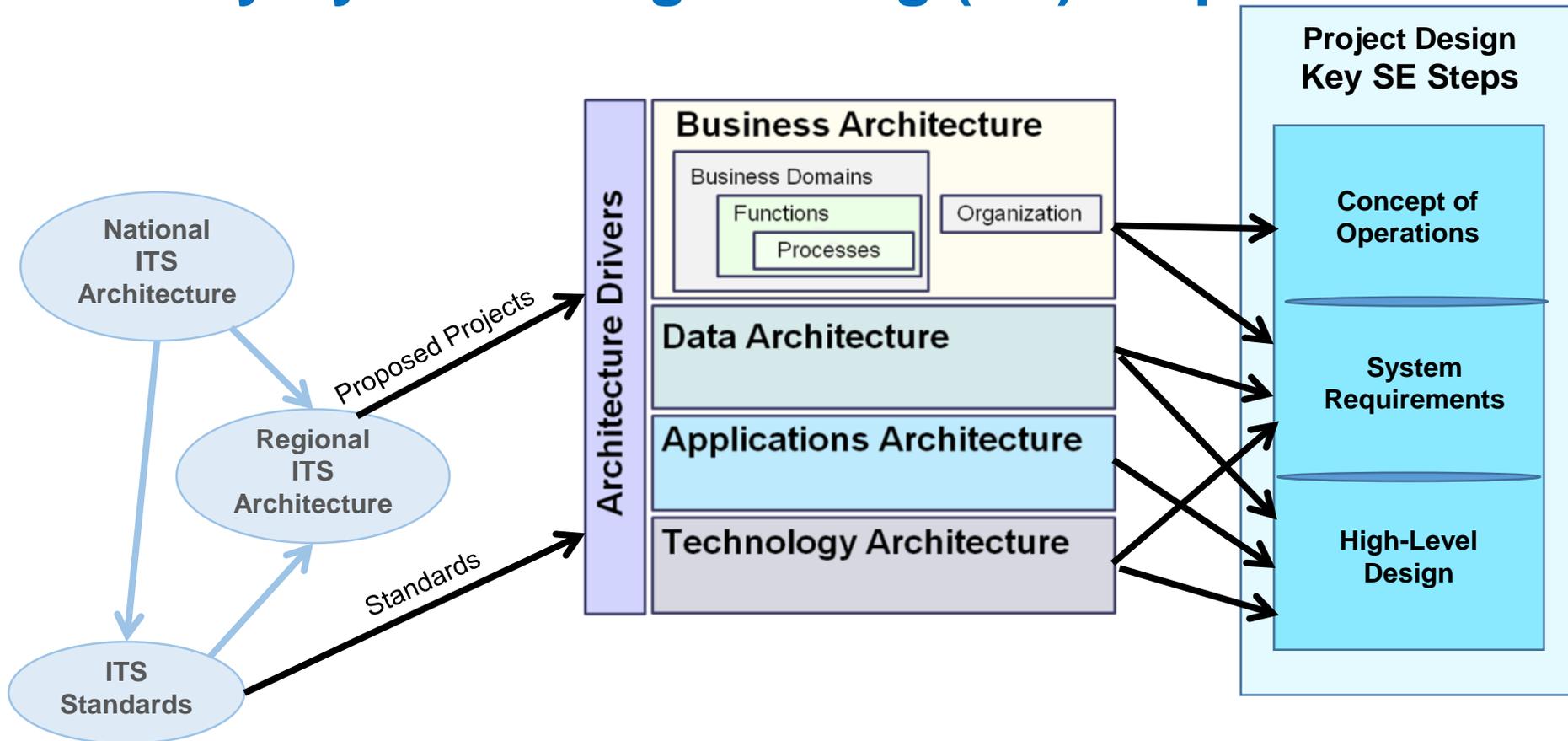
- Improves **alignment** between the goals of the organization and its
  - business processes
  - technology investments
- Finds duplicate and **ineffective** business processes and systems
- Identifies **gaps**
- Enables **efficiencies** through standards and standardization

## Transit EA Can Support ITS Initiatives

- An EA can support transit ITS efforts through the stages of a project's life cycle
  - Inform whether an existing or potential project may be part of the ITS Architecture
  - Identify standards required or used
  - Improve the quality and timeliness of Systems Engineering efforts
  - Provide context for a project or solution architecture

# ITS Related

## Some Transit EA Relationships to ITS Standards and Key Systems Engineering (SE) Steps



# Benefits Evolve

## Benefits of an EA Can Evolve

- Transit organizations operate in a state of constant change
- Some changes can drive the EA to a more mature state (better information and analysis capabilities) that provides the organization more benefits
- The EA provides the greatest benefits when the model and data improvements help the agency **solve a business problem**



# ACTIVITY



# Question

**Which of the following is NOT a common benefit of a transit EA?**

## **Answer Choices**

- a) Better visibility into transit's people, processes and technologies
- b) Improved standardization
- c) Solving employee problems
- d) Understanding dependencies

# Review of Answers



a) Better visibility into transit

*Incorrect. EA benefits transit by better showing components of transit such as processes, applications, data and technology.*



b) Improved standardization

*Incorrect. EA improves standardization by listing standards for use and by detecting inconsistencies.*



c) Solving employee problems

***Correct! EA is not commonly used to resolve conflicts between individuals.***



d) Understanding dependencies

*Incorrect. An EA documents and displays dependencies.*

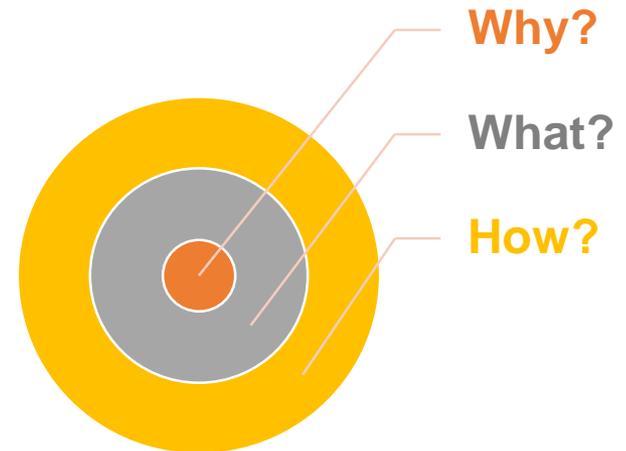
## Learning Objective 3

Describe the general process for creating a transit Enterprise Architecture (EA)

# Goals

## Key Steps in the EA Development Process

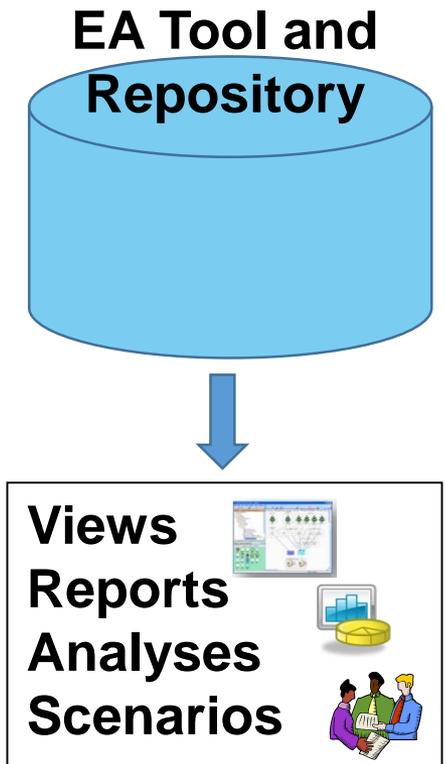
- **Educate** stakeholders about EA and research needs
- Determine intended use, goals and **objectives**
- Identify **scope** and depth of EA
- Identify needed **Components and Connections**
- Evaluate, then select an EA **Framework**
- Target an EA **development path** and identify staff resources



# Goals

## Key Steps in the EA Development Process (continued)

- Evaluate and select an EA software modeling **tool** and support model
- Collect **Information**
- Populate the **EA repository**
- Develop a test plan to improve **quality**
- Develop common **analyses** and visualizations
- Provide documentation and **training**



# Goals

## Approach for Determining Goals and Objectives

- Research what problems transit is having that can be helped or solved by an EA
- Conceptualize what reports and analysis that transit needs from the EA
  - This will drive what data needs to be collected and what relationships need to be defined
- Develop preliminary goals and objectives for the EA based on:
  - Your research and analysis
  - Perceived management and staff interest

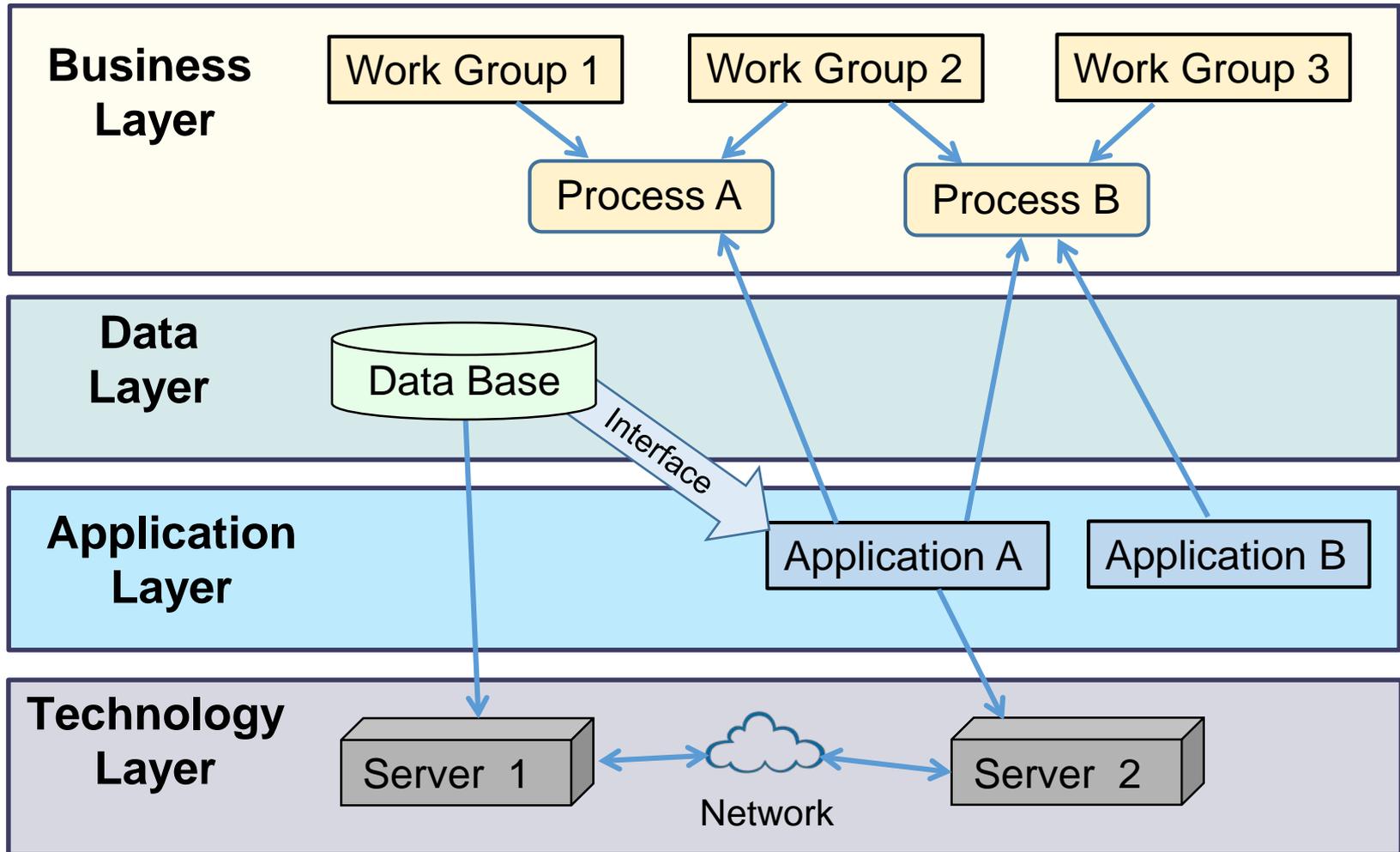
# ID Components

## Identify Needed Components and Linkages

- Build off the EA goals and objectives
- Select top priority Components and Connections to develop
- Create and implement a data gathering and data definition process to support the needed analyses
- Modify the EA Framework to assist with developing the EA

# ID Components

## Assess which Components and Linkages to Add



# Roles

## Key Staff and Roles for a Transit EA

- Key Stakeholders
  - Management Sponsor
  - “Enterprise Architect”
  - Project Manager
- Staff Groups
  - Supervisors and Budget Analysts
  - Key IT Staff
  - ITS Staff
- Vendor Support
- Contract/Consultant Support



# Scalable

## Scalability of EA

- Size of the Enterprise
- Number of Components to define and inventory
- Number of hierarchical levels used to define Components
- Number of Attributes used to describe Components and Connections
- Complexity of the relationships that are being analyzed
- Number of charts and graphics that are customized



# Challenges

## Common Challenges for an EA

- **Inadequate tools** available in agencies for managing EA data storage and analysis
- **Cost** of some EA Modeling tools
- Learning curve for **modeling** the EA to be represented in the EA Modeling tool
- **Learning curve** for using an EA Modeling tool



# Challenges

## Common Challenges for an EA (continued)

- **Model Complexity**
- **Staffing Issues**
  - Lack of a dedicated Enterprise Architect
  - Too few people knowing how to use the EA Modeling tool
  - Failing to distribute the task of updating inventories
  - Staff turnover and changing management priorities



# ACTIVITY



# Question

**Which of these statements about an EA is NOT correct?**

## **Answer Choices**

- a) Many groups help build an EA
- b) An EA needs a maintenance plan
- c) An EA must solve a business need
- d) Only a fully developed EA is useful

# Review of Answers



a) Many groups help build an EA

*Incorrect. Staff from many groups are needed to provide the knowledge stored in the EA repository.*



b) An EA needs a maintenance plan

*Incorrect. An EA needs ongoing maintenance, just as inventories do. Responsibilities and update approaches must be defined.*



c) An EA must solve a business need

*Incorrect. An EA must solve transit business need(s) to be useful and inspire a desire to maintain it.*



d) Only a fully developed EA is useful

***Correct! Statement is false, as an EA can be scalable and useful from the beginning.***

## Learning Objective 4

Articulate how use of EA principles  
can benefit a transit agency

# EA Principles

## What are EA Principles?

- EA Principles are general rules or guidelines that inform how an organization sets about fulfilling its mission

*(definition derived from The Open Group)*

- Often designed to maximize the value of technology investments
- Described clearly by a:
  - Name
  - Statement
  - Rationale
  - Implications

# EA Principles

## Benefits from Implementing EA Principles

- Four **general** EA principles
  - Enterprise-wide perspective
  - Foster integration
  - Leverage resources
  - Business results focused
- General **IT/ITS focused** EA principles
  - Alignment of IT/ITS strategies with business vision and goals
  - Interoperability
  - Requirements-based change



# EA Principles

## Benefits from Implementing EA Principles (continued)

- **Data Architecture specific EA principles**
  - Data is an asset
  - Data is shared
  - Data is accessible
  - Common vocabulary and data definitions



# EA Principles

## Example of an EA Principle Description *(summarized from The Open Group)*

- **Name: Interoperability**
- **Statement:** Software and hardware should conform to defined standards that promote interoperability for data, applications, and technology.
- **Rationale:** Standards help ensure consistency... help ensure support from multiple vendors... and facilitate supply chain integration.
- **Implications:**
  - Interoperability standards will be followed unless there is a compelling business reason not to do so.
  - A process for setting standards, periodically reviewing them, and granting exceptions must be established.



# EA Principles

## Applying EA Principles

- Communicate the principles widely
  - Rationale and implications should be understood
- EA Principles should influence
  - Assessment of the current architecture
  - Decisions and approaches for moving forward
  - Development of evaluation criteria for new products



## EA Principles improve integration and standardization of ITS initiatives

- Examples of EA Principles that directly support more successful, better integrated ITS initiatives
  - Foster partnerships
  - Data is shared
  - Common vocabulary and Data Definitions
  - Interoperability
  - Leverage the ITS Environment

# ACTIVITY



# Question

**Which of the following would be the poorest EA Principle for supporting efficiencies in transit?**

## **Answer Choices**

- a) Be focused on creating business results
- b) Buy the most advanced, complex software
- c) Control technical diversity
- d) Have an enterprise-wide perspective

# Review of Answers



a) Be focused on creating business results

*Incorrect. A business results focus supports efficiencies.*



b) Buy the most advanced, complex software

***Correct! For example, the most advanced software application may create inefficiencies because it's difficult to use and maintain.***



c) Control technical diversity

*Incorrect. Controlling technical diversity, such as through the use of standards, creates efficiencies.*



d) Have an enterprise-wide perspective

*Incorrect. An enterprise-wide perspective promotes efficiencies, as it helps find redundancies and other issues.*

# Module Summary

## What We Have Learned about EA

1. Define an Enterprise Architecture (EA)
2. Review the benefits to a transit organization of having an EA
3. Describe the general process for creating a transit Enterprise Architecture
4. Articulate how the use of EA principles can benefit a transit agency

From an ITS perspective, EA allows for more integration of ITS technologies and applications within an existing and/or planned transit agency network.

**Thank you for completing this module.**

## **Feedback**

Please use the Feedback link below to provide us with your thoughts and comments about the value of the training.

Thank you