Appendix C

Example of the Use of the ITS Architecture and Tools

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1. Defining an ITS Project Architecture using the Turbo Architecture

The purpose of this appendix is to illustrate the types of inputs that the regional and national ITS architectures provide for the systems engineering process (SEP) described in this document. This appendix presents an example of how the ITS architectures and tools can be used to assist in determining the system boundary; interfaces and standards; and functional requirements. As described in previous sections of the document, the information obtained from the regional architecture should be used as a starting point to define the project architecture and requirements. Additions, subtractions, and/or changes will be needed to meet the defined needs and constraints identified as part of the SEP.

The market packages applicable to the project, either fully or partially, should be identified first. This is done by reviewing the market packages presented on the *Florida Statewide ITS Architecture (SITSA) and Standards* Web site[77] and selecting those packages that appear to be applicable to the project. Then, the architecture elements and interconnections should be further identified by opening the relevant statewide or regional ITS architecture database or, if the ITS project engineer is familiar with the Turbo Architecture software application, it could be used to update the project architecture details as appropriate from the regional ITS architecture (RITSA).

1.1 Define Customer Expectations

The *SITSA* and, thus, any derived project architecture based on the *SITSA* do not explicitly list regional stakeholder requirements and constraints. However, these requirements and constraints are implicitly considered in the selection and customization of the market packages. In addition, the *SITSA* database includes the identification of legacy and planned systems; organizational responsibilities; and existing and planned external interfaces that can be considered as constraints in project development and deployment. The *SITSA* development team identifies this information based on existing regional and corridor deployments; existing ITS architectural documentation; and articulation of stakeholder needs in the regional workshops. This information needs to be verified as part of project development, and can be used as part of identifying the project's requirements and constraints. Completing this task will also satisfy the requirements of *Parts 655* and *940* of *Title 23* of the *Code of Federal Regulations* (*CFR*) for the identification of participating agencies' roles and responsibilities.

As mentioned above, there is a need to identify customer or stakeholder requirements and constraints associated with the ITS deployment. In this regard, it will be useful to create a tool that maps various user requirements and constraints to the ITS architecture elements. No off-the-shelf tool currently exists for this purpose, although some of the privately developed tools have some of the desired capabilities.

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[77] The *SITSA* Web site is available online at http://www.consystec.com/html/florida/.

1.2 Define External Constraints

According to the *IEEE 1220* standard, the enterprise should identify and define external constraints that impact design solutions or the implementation of SEP activities. These constraints include:

- Public and international laws and regulations
- The technology base
- Industry, international, and other general specifications, standards, and guidelines
- Human-related specifications, standards, and guidelines
- Human availability, recruitment, and selection
- Competitor product capabilities

Technical Memorandum No. 3.2: Technology Review prepared as part of the ITS Corridor Master Plans for Florida's five Florida Intrastate Highway System (FIHS) limited-access corridors addresses various implementation, operations, and maintenance issues associated with market packages, and could assist in this task. The *NITSA* documents also address some of the constraints, issues, and risks associated with ITS deployments. Again, it would be more efficient to have a tool that maps these constraints to ITS architecture elements.

1.3 Define Operational Scenarios

The SEP requirements analysis presented in the *IEEE 1220* standard requires the enterprise to identify and define the operational scenarios that describe the range of the anticipated uses of the system product(s). For each operational scenario, the enterprise defines expected interactions with the environment and other systems; human tasks and task sequences; and physical interconnections with interfacing systems, platforms, or products.

The *SITSA* does not document a concept of operations (ConOps) for ITS in Florida. However, the *SITSA Final Report*[78] states, "Market Packages, customized for the specific consensus requirements of each region, represent the information that will be exchanged between specific stakeholder elements to effect specific sets of user services. As such, they collectively represent the concept of operations for a district." Note, however, that federal *Rule 940* requires that a ConOps document be developed for each ITS deployment. (Refer to *Section 3.1.2.2* of *Florida's Statewide SEMP*.)

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[78] Available online at http://www.dot.state.fl.us/trafficoperations/its/its_default.htm under the ITS Architectures, Standards and Modeling link and the ITS Architectures sublink.

Defining operational scenarios can be viewed as describing how the architecture elements and interfaces will be utilized. This description needs to be explicitly expressed in the SEMP. The customized market packages can assist with identifying agency roles and responsibilities; providing input on how the architecture elements will operate under different scenarios; and serve as a starting point for a more detailed definition of the ConOps.

1.4 Define Project and Enterprise Constraints

In addition to the constraints listed above, the *IEEE 1220* standard requires that the enterprise identify and define project and enterprise constraints that impact design solutions.

Project constraints may include:

- Approved specifications and baselines developed from prior applications of the SEP
- Updated engineering and technical plans
- Team assignments and structure
- Automated tools availability or approval for use
- Control mechanisms
- Required metrics for measuring technical progress

Enterprise constraints may include:

- Management decisions from a preceding technical review
- Enterprise general specifications, standards, or guidelines
- Policies and procedures
- Domain technologies
- Established life-cycle process capabilities
- Physical, financial, and human resource allocations to the technical effort

As with user requirements and constraints, it would be efficient to use tools that map these constraints to the project ITS architecture elements.

1.5 Define Measures of Effectiveness

The *IEEE 1220* standard specifies that the enterprise needs to define system effectiveness measures that reflects overall customer expectations and satisfactions. The measures shall be related to project stakeholder goals and objectives. There are a number of sources that can assist in this regard.

The *ITS Performance and Benefit Study* presents qualitative and quantitative performance measures mapped to the national ITS goals for ITS development and deployment. These goals include improvements in operational efficiency, mobility, safety, emergency consumption environment, economic productivity, and environment.

Florida's ITS Strategic Plan outlines the recommended development of an ITS plan; deployment priorities for ITS goals and objectives; and performance measures to be reported. These performance measures can be categorized as:

- Safety measures
- Protection of public investment measures
- Interconnected transportation system measures
- Travel choices measures

Performance measures were also recommended in *Technical Memorandum No. 3.3*, which was developed as a part of the ITS Corridor Master Plans project. These performance measures include mobility- and safety-related performance measures, and agency performance measures. Each of these measures was derived from the goal and objective statements used to summarize the needs, issues, problems, and objectives for ITS deployments on the FIHS corridors, or to support a hierarchy of national performance measures.

1.6 Define System Boundaries

According to the *IEEE 1220* standard, the enterprise needs to define system boundaries including:

- Which system elements are under the enterprise's design control and which are not

- The expected interactions among system elements under design control, and external and/or higher-level and interacting systems outside the system boundary

- The ITS architecture will help in this effort by:

- Identifying the elements provided as part of the project

- Identifying other existing or future elements that will interact with the elements provided as part of this project

This can be obtained using the customized project architecture market package diagrams and the Turbo Architecture project database. All elements included in the project market packages need to be identified as either existing, future, or to be provided as part of the project. The elements could be subsystems (or equipment packages within the subsystems) or terminators.

1.7 Define Interfaces

According to the *IEEE 1220* standard, the enterprise needs to define the functional and design interfaces to external and/or higher-level and interacting systems, platforms, humans, and/or products in quantitative terms. Mechanical, electrical, thermal, data, communication-procedural, human-machine, and other interactions are included. The project ITS architecture includes information that allows the enterprise to identify information flows between the project functions and subsystems.

There are two types of interfaces in an ITS architecture:

- **Architecture Flows** – These represent information exchanged between architecture elements (i.e., subsystems and terminators) in the physical architecture view of the ITS architecture. Architecture flows are the primary tool that is used to define the regional and project ITS architecture interfaces.

- **Data Flows** – Modeled in the logical architecture view of the *NITSA*, data flows represent data flowing between processes, or between a process and a terminator. A data flow is shown as an arrow on a data flow diagram and is defined in a data dictionary entry in the logical architecture. Data flows are aggregated to form high-level architecture flows in the *NITSA* physical architecture view.

As discussed above, the *SITSA* was developed using the Turbo Architecture software that deals with the flows at the physical level, or the architecture flow level. For detailed project development tasks, these flows need to be traced to their components' data flows to provide a higher level of detail of the flows between the subsystems. The physical architecture flows can be traced to the logical data architecture flows using the *NITSA* database view or the *NITSA* hypertext view.[79]

The United States Department of Transportation (USDOT) has been leading an effort to develop standards for the interfaces between ITS subsystems. The Turbo Architecture database can assist in the identification of applicable ITS standards for the project. The database contains a mapping of each architecture flow to ITS standards that support the flow. With the ITS architecture created as described above, an output available from Turbo Architecture is a set of applicable standards for each flow. This set serves as a starting point for the specification of ITS standards as part of the project specifications. Documenting the set of applicable standards and testing procedures, along with the rationale for the standards selected for the project, will satisfy the *Rule 940* requirement for "identification of applicable ITS standards and testing procedures."

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[79] The hypertext view provides immediate, interconnected access to all the elements of the architecture definition. The document view presents the complete set of architecture documentation as it exists in printed format. The database view provides developers direct access to the source material for the *NITSA* in several connected relational databases.

It should be recognized that the Turbo Architecture software produces a list of ITS interface standards that are being developed by the ITS community and include data dictionary, message sets, and communication protocol standards. The ITS systems use additional enabling standards. These standards include off-the-shelf communications media and applicable general purpose data communication standards such as standards for fiber optic technology, TCP/IP, and cellular radio. These standards are also applicable to the corridor ITS deployment, although not included in the list.

1.8 Define Utilization Environments

The *IEEE 1220* standard recommends that the enterprise define the utilization environments for each operational scenario. All environmental factors, natural or induced, that may affect system performance should be identified and defined. This is done to ensure that the system minimizes the potential for human or machine errors or failures that cause injurious accidents or death; and that the system poses minimal risk of death, injury, or acute chronic illness, disability, and/or reduced job performance of the humans who support the system life cycle.

As applied to ITS, defining utilization environments could include, for example, operating a traffic management system during normal, incident, and emergency conditions, or operating a transit system during weekdays, weekends, and special events.

1.9 Define Life-Cycle Process Concepts

In this task, the enterprise analyzes the output of the subprocess tasks to define life-cycle process requirements necessary to develop, produce, test, distribute, operate, support, train, and dispose of system products under development. This includes identification of manpower, personnel requirements, training requirements, human interfaces, and safety/security issues.

2. Define Requirements

2.1 Functional Requirements

The next task in the *IEEE 1220* standard SEP is to perform functional analysis based on the information gathered in previous tasks to determine what the system should be able to do. The functional analysis requires detailed identification of system functions, the decomposition of system functions to lower-level functions to be satisfied by system design, and the establishment of a functional architecture from which the design solutions will be determined. This will satisfy the functional requirement part of the federal *Rule 940* requirement for a requirements definition. The developed ITS architectures can assist in this effort.

As described above, any derived project architecture based on the *SITSA* is based on the identification of customized market packages to be implemented as a part of the project. Although the market packages defined by the ITS architecture are parts of the physical architecture, the physical components in these market packages can be traced to the functional components of the *NITSA* logical (i.e., functional) architecture. They can also be traced to user service requirements that were used as the basis for developing the *NITSA*.

It is possible to trace the *SITSA* physical components to the logical *NITSA* architecture functional specifications and the ITS user services from the *SITSA* database or from the *SITSA* Web version. This traceability cannot be done using the Turbo Architecture software, although it can be done using the Turbo Architecture extension developed as part of *SITSA*.

Using the Web-based version of the *SITSA*, the Web page of the ITS subsystem under consideration needs to be accessed. Once on the page, selecting the Functionality Details link will lead to a list of equipment packages that provide high-level definitions of the possible functions of the selected subsystem. An additional level of requirements detail can be accessed by selecting the Details link on the Equipment Package page. In addition to the equipment package definition, the details page contains a listing of the titles of process specifications (PSpecs) from the *NITSA* that may be applicable to the selected equipment package. The complete description of these PSpecs or functions are not given on the page but can be obtained from the *NITSA* CD-ROM or Web site using the hypertext view, logical view, or database view of the ITS logical architecture. The details page also includes a list of user service requirements that may be applicable to the deployment. These user service requirements are the functional requirements used to define the *NITSA*. The requirement details can be found on the *NITSA* CD-ROM or in the Web version.

The PSpecs applicable to the equipment package can be used to create an initial version of the equipment packages' functional requirements. These will need to be verified and modified, as required and explained in the next section.

2.2 Performance Requirements

The *IEEE 1220* standard SEP states that the enterprise must define the performance requirements for each system function. Performance requirements describe how well the functional requirements must be performed to satisfy the measures of effectiveness (MOEs). Performance requirements are not in the scope of the ITS architectures and, thus, identifying these requirements should be done as an additional step after defining the project functions based on the ITS architectures.

2.3 Define Modes of Operation

The next SEP task is for the enterprise to define the various modes of operation (e.g., embedded training capability, fully operational, etc.) for the system product(s) under development. The conditions (e.g., environmental, configuration, operational, etc.) that determine the modes of operation are defined. As an example, a signal control system may work at different modes during the daytime, nighttime, and weekends.

2.4 Define Technical Performance Measures

In this SEP task, the enterprise identifies the technical performance measures (TPMs), which are key indicators of system performance. The selection of these TPMs should be limited to critical measures of performance (MOPs) that, if not met, put the project at cost, schedule, or performance risk. Specific TPM activities are integrated into the SEMP to periodically determine achievement to date and to measure progress against a planned value profile.

2.5 Define Design Characteristics

In this SEP task, the enterprise identifies and defines required design characteristics (e.g., size, environmental limitations, weight, communication requirements, and calibration requirements) for the system product(s) under development. The enterprise identifies which design characteristics are constraints and which can be changed based on trade-off analyses. As an example, an agency might decide the existing microwave communication subsystem should be used for communication between the TMC and field devices, or the agency might decide that the microwave subsystem should be considered as an alternative in the trade-off analysis between different communication subsystem alternatives.

2.6 Define Human Factors

In this task, the enterprise identifies and defines human-factor considerations (e.g., design space limits, climatic limits, line-of-sight, reach, cognitive limits, and usability, etc.) that affect operation of the system under development. The enterprise identifies which human factors are constraints and which can be changed based on trade-off analyses. As an example, when designing a DMS system, the design needs to be based on human ability to recognize the existence of a message on the sign, read the message, and react to the message.

2.7 Establish a Requirements Baseline

According to the *IEEE 1220* standard, the output of tasks 1.2 through 1.13 is recorded in three views (i.e., operational, functional, and design) to form a requirements baseline that establishes the system problem that the enterprise must solve. The operational view describes how the system products serve their users. It establishes who operates and supports the system and its life-cycle processes, and how well and under what conditions the system products are to be used. The functional view describes what the system products do to produce the desired behavior described in the operational view and provides a description of the methodology used to develop the view and decision rationale. The design view describes the design considerations of the system products development and establishes requirements for technologies and for design interfaces among equipment, and among humans and equipment. The content of these views may include the following.

2.7.1 Operational View

The operational view consists of:

- An operational need description
- Results of system operational analyses
- Operational sequences/scenarios (best portrayed in pictures) that include utilization environments, MOEs, and how the system products should be used
- Conditions/Events to which system products should respond
- Operational constraints, including MOEs
- Identified human roles, including job tasks and skill requirements
- Training requirements, including how humans will be trained to be a part of the system and support system life-cycle processes through formal, informal, embedded, on-the-job, or other forms of training
- Identification of what operations are required to ensure safety
- Life-cycle process concepts to include MOEs; critical MOPs; and existing products and services
- Operational interfaces with other systems, platforms, humans, and/or products
- System boundaries

2.7.2 Functional View

The functional view consists of:

- Functional requirements that describe what system products and life-cycle processes must do or accomplish
- Performance requirements, including qualitative (i.e., how well); quantitative (i.e., how much, capacity); and timelines or periodicity (i.e., how long, how often) requirements
- Functional sequences for accomplishing system objectives
- Technical performance measure criteria
- Functional interface requirements with external, higher-level, or interacting systems, platforms, humans, and/or products
- Modes of operations
- Functional capabilities for planned evolutionary growth

2.7.3 Design View

The design view consists of:

- Previously approved specifications and baselines
- Design interfaces with other systems, platforms, humans, and/or products
- Human systems engineering elements, including the safety, training, knowledge, skills, and abilities required to accomplish functions of the system, and characteristics of information displays and operator controls
- Characterization of operator(s) and support personnel, including special design requirements and applicable movement, or visual or workload limitations
- Characterization of information displays and operator controls
- System characteristics, including design limitations (i.e., capacity, power, size, weight); technology imitations (i.e., precision, data rates, frequency, language); inherent human limitations (i.e., physical and cognitive workload; perceptual abilities; and reach and anthropometrical limitations); and standardized end items, nondevelopmental items, and reusability requirements

- Design constraints, including project, enterprise, and external constraints that limit design solutions and/or development procedures
- Design capabilities and capacities for planned evolutionary growth.

2.8 Example

The example presented in this appendix assumes that the project scope is to upgrade emergency management/public safety systems in Broward County to perform advanced emergency response and emergency vehicle routing functions. By examining the *SITSA* Web site, it can be concluded that two of the FDOT District 4 regional market packages should be used as a basis for this project: EM1 (Emergency Management) and EM2 (Emergency Routing).

Figures C.1 through C.3 show the diagrams of these two market packages as presented on the *SITSA* Web site. An initial project architecture can be developed based on these two market packages by deciding on the market package subsystems, terminators, and interfaces that should be included as part of this project. This needs to be accomplished as described earlier in this document. It is recommended that both the *SITSA* Web site and the Turbo Architecture regional architecture database be used in this effort.

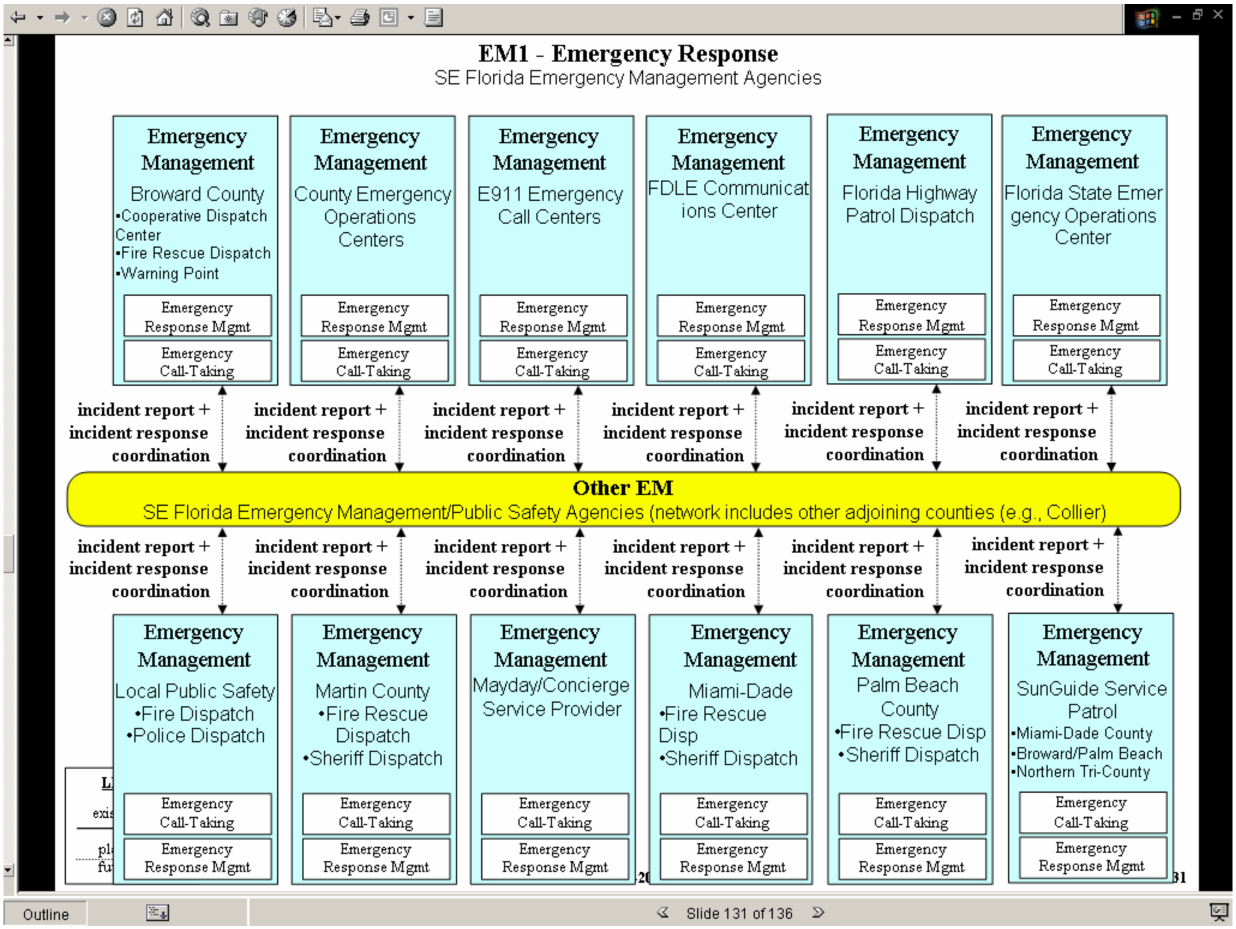
The above selection of market packages, subsystems, terminators, equipment packages, and interfaces allows the identification of system boundaries as specified previously. In this example, it is assumed that the equipment provided as part of this project will be that required at the emergency management centers and in emergency management vehicles. In addition, as indicated in Figures C.1 through C.3, the emergency management centers need to interface with weather services, the media, and TMCs. The emergency vehicles need to interface with roadside signal preemption devices.

The ITS architecture allows the identification of the interfaces between the project subsystems (i.e., the emergency management centers and vehicles), and other subsystems and terminators (i.e., weather services, TMCs, roadside signal preemption devices, and the media) as specified previously in this document. These interfaces can be determined based on Figures C.1 and C.3, and from the Turbo Architecture database. For example, the following architecture flows are identified between different emergency management centers in the region. (Flow descriptions can be obtained from the *SITSA* Web site or *NITSA* materials):

- Incident Report: Report of an identified incident including its location, type, severity, and other information necessary to initiate an appropriate incident response.

- Incident Response Coordination: Procedures, resource coordination, and current incident response status that are shared between allied response agencies to support a coordinated response to incidents. This flow also coordinates a positive hand-off of responsibility for all or part of an incident response between agencies.

Figure C.1 – FDOT District 4 EM1 Market Package Detailed Interfaces



EM1 - Emergency Response
SE Florida Emergency Management Agencies

Emergency Management
Broward County
- Cooperative Dispatch Center
- Fire Rescue Dispatch
- Warning Point

Emergency Response Mgmt
Emergency Call-Taking

Emergency Management
County Emergency Operations Centers
Emergency Response Mgmt
Emergency Call-Taking

Emergency Management
E911 Emergency Call Centers
Emergency Response Mgmt
Emergency Call-Taking

Emergency Management
FDLE Communications Center
Emergency Response Mgmt
Emergency Call-Taking

Emergency Management
Florida Highway Patrol Dispatch
Emergency Response Mgmt
Emergency Call-Taking

Emergency Management
Florida State Emergency Operations Center
Emergency Response Mgmt
Emergency Call-Taking

incident report + incident response coordination

Other EM
SE Florida Emergency Management/Public Safety Agencies (network includes other adjoining counties (e.g., Collier)

incident report + incident response coordination

Emergency Management
Local Public Safety
- Fire Dispatch
- Police Dispatch

Emergency Call-Taking
Emergency Response Mgmt

Emergency Management
Martin County
- Fire Rescue Dispatch
- Sheriff Dispatch

Emergency Call-Taking
Emergency Response Mgmt

Emergency Management
Mayday/Concierge Service Provider
Emergency Call-Taking
Emergency Response Mgmt

Emergency Management
Miami-Dade
- Fire Rescue Disp
- Sheriff Dispatch

Emergency Call-Taking
Emergency Response Mgmt

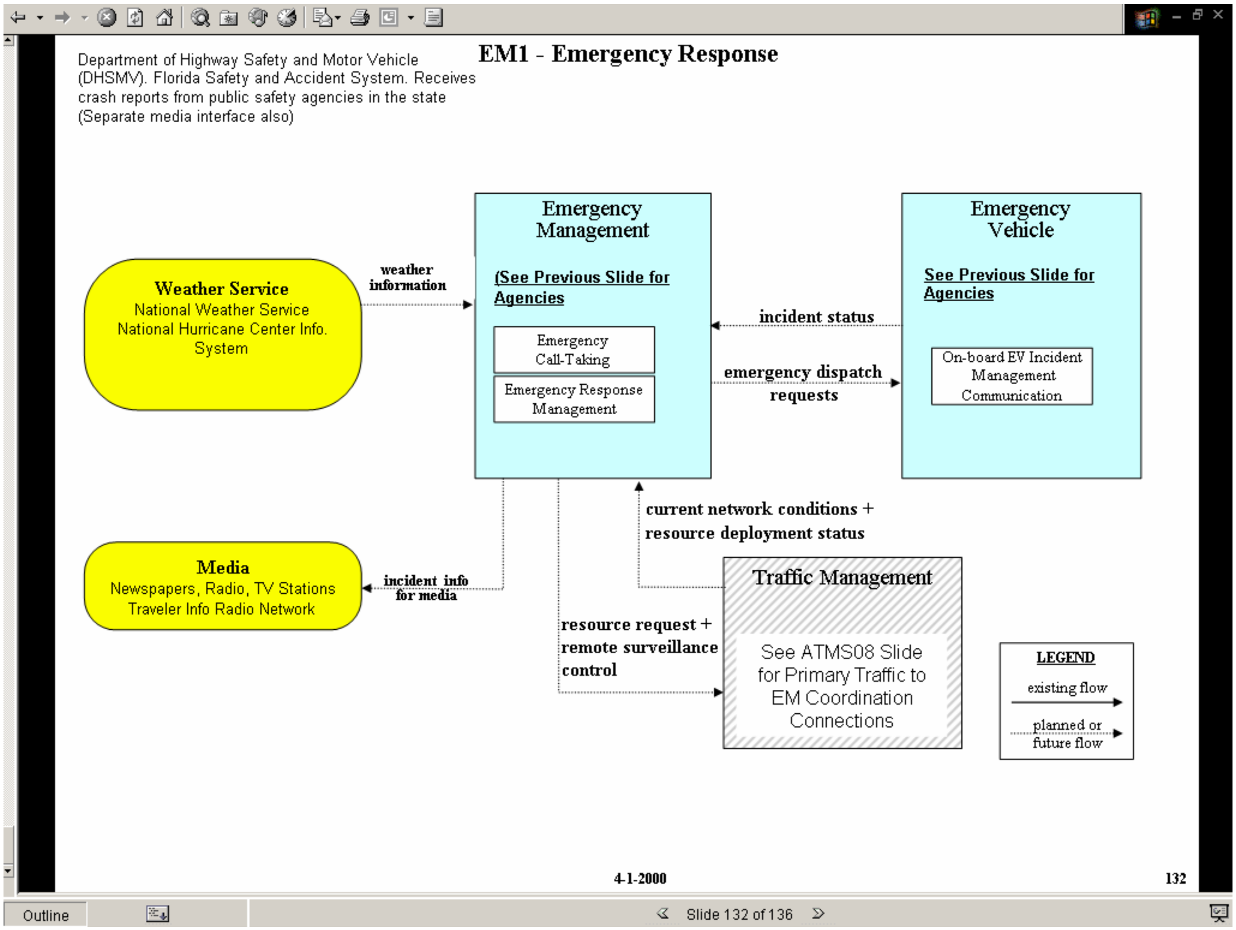
Emergency Management
Palm Beach County
- Fire Rescue Disp
- Sheriff Dispatch

Emergency Call-Taking
Emergency Response Mgmt

Emergency Management
SunGuide Service Patrol
- Miami-Dade County
- Broward/Palm Beach
- Northern Tri-County

Emergency Call-Taking
Emergency Response Mgmt

Figure C.2 – FDOT District 4 EM1 Market Package



EM1 - Emergency Response

Department of Highway Safety and Motor Vehicle (DHSMV). Florida Safety and Accident System. Receives crash reports from public safety agencies in the state (Separate media interface also)

Weather Service
National Weather Service
National Hurricane Center Info. System

Media
Newspapers, Radio, TV Stations
Traveler Info Radio Network

Emergency Management
(See Previous Slide for Agencies
Emergency Call-Taking
Emergency Response Management

Emergency Vehicle
See Previous Slide for Agencies
On-board EV Incident Management Communication

Traffic Management
See ATMS08 Slide for Primary Traffic to EM Coordination Connections

weather information
incident status
emergency dispatch requests
current network conditions + resource deployment status
incident info for media
resource request + remote surveillance control

LEGEND
existing flow
planned or future flow

4-1-2000

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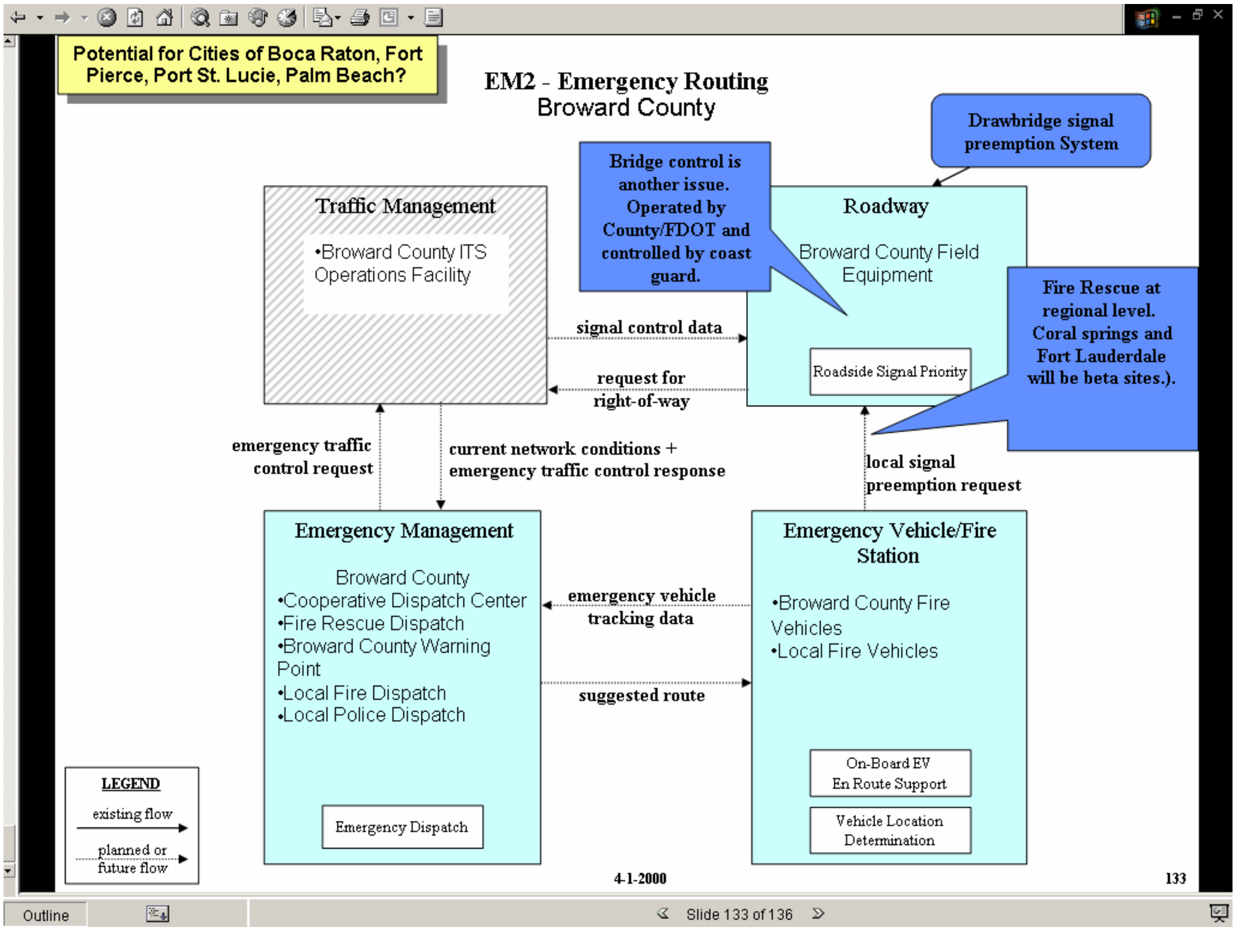
Figure C.3 – FDOT District 4 EM2 Market Package



Potential for Cities of Boca Raton, Fort Pierce, Port St. Lucie, Palm Beach?

EM2 - Emergency Routing
Broward County

Drawbridge signal preemption System

Bridge control is another issue. Operated by County/FDOT and controlled by coast guard.

Fire Rescue at regional level. Coral springs and Fort Lauderdale will be beta sites.).

Traffic Management
- Broward County ITS Operations Facility

Roadway
Broward County Field Equipment
Roadside Signal Priority

signal control data

request for right-of-way

emergency traffic control request

current network conditions + emergency traffic control response

local signal preemption request

Emergency Management
Broward County
- Cooperative Dispatch Center
- Fire Rescue Dispatch
- Broward County Warning Point
- Local Fire Dispatch
- Local Police Dispatch

Emergency Dispatch

emergency vehicle tracking data

suggested route

Emergency Vehicle/Fire Station
- Broward County Fire Vehicles
- Local Fire Vehicles

On-Board EV En Route Support

Vehicle Location Determination

LEGEND
existing flow
planned or future flow

4-1-2000

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In addition, by examining the *SISTA* Web site, *NITSA* materials (i.e., Web site, documents, or CD-ROM), or Turbo Architecture database, an initial list of the ITS standards that support the architecture interfaces can be identified as discussed in prior sections of this document. For example, the following standards are found to be applicable to the above two architecture flows:

- *IEEE P1512.2 – Standard for Public Safety Incident Management Message Sets (IMMS) for use by EMCs*
- *IEEE P1512.3 – Standard for Hazardous Material IMMS for use by EMCs*
- *IEEE P1512.a – Standard for Emergency Management Data Dictionary*
- *IEEE P1512-2000 – Standard for Common IMMS for use by EMCs*
- *NTCIP 1102 – Base Standard: Octet Encoding Rules (OER)*
- *NTCIP 1104 – Common Object Request Broker Architecture (CORBA) Naming Convention*
- *NTCIP 1105 – CORBA Security Service*
- *NTCIP 1106 – CORBA Near-Real Time Data Service*
- *NTCIP 2104 – Subnet Profile for Ethernet*
- *NTCIP 2202 – Internet (TCP/IP and UDP/IP) Transport Profile*
- *NTCIP 2303 – Application Profile for File Transfer Protocol (FTP)*
- *NTCIP 2304 – Application Profile for Data Exchange ASN.1 (DATEX)*
- *NTCIP 2305 – Application Profile for CORBA*
- *NTCIP 2501 – Information Profile for DATEX*
- *NTCIP 2502 – Information Profile for CORBA*

The above list of standards needs to be examined to see if additions or deletions to the list are necessary for the application under consideration. For example, the user should determine if the C2C communications will use the DATEX communication protocol standards or the CORBA standards. Although both CORBA and DATEX standards are included in the above list, only the selected standards should be kept in the list.

As indicated previously, the *SITSA* deals with the interfaces between subsystems at the architecture flow level. Information available on the *NITSA* Web site, CD-ROM, and in the documentation allows the identification of data flows that constitute these architecture flows, providing the additional level of details required for the project design. Table C.1 presents the data flows that constitute the two architecture flows listed above for the interfaces between the emergency management centers in the region and descriptions of these flows. As mentioned in these descriptions, these data flows are also composed of data items that are listed in the descriptions. These data items are described in the *NITSA*, but these additional descriptions are not included in Table C.1. Notice also that the format of these data items has been standardized as part of the data dictionary and message set ITS standard development effort.

To determine the project functional requirements, it is necessary to identify the equipment packages to include in the project and the PSpecs that constitute these equipment packages. As indicated in Figures C.1 through C.3, the following equipment packages are needed at the emergency management centers. (The description of these packages could be obtained from the *SITSA* Web site.)

- **Emergency Call-Taking –** This equipment package supports the emergency call-taker, collecting available information about the caller and the reported emergency, and forwarding this information to other equipment packages that formulate and manage the emergency response. This equipment package receives 911; seven-digit local access; and motorist aid call-box calls and interfaces to other agencies to assist in the verification and assessment of the emergency, and to forward the emergency information to the appropriate response agency.

- **Emergency Dispatch** – This equipment package supports efficient dispatch of emergency vehicles. It tracks emergency vehicles; dispatches them to an incident; and provides safe and efficient routes based on real-time traffic information.

- **Emergency Response Management –** This equipment package develops and stores emergency response plans and manages overall coordinated response to emergencies. It tracks the availability of resources and assists in the appropriate allocation of these resources for a particular emergency response. This equipment package provides coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident. It provides vital communications links that provide real-time information to emergency response personnel in the field.

In addition, the following equipment packages are needed in the emergency vehicles:

- **On-board Emergency Vehicle Incident Management Communication –** This equipment package provides a direct interface between the emergency vehicle and incident management personnel.

- **On-Board Emergency Vehicle En-Route Support –** This equipment package provides capabilities that support safe and expedient arrival at and departure from the incident scene. This package provides dispatch and routing information; tracks the vehicle; and preempts signals by way of short-range communication directly with roadside traffic control equipment.

- **Vehicle Location Determination –** This equipment package determines current vehicle location and provides this information to other equipment packages that use the information to provide various ITS services.

For each of the above equipment packages, a list of the PSpecs that support the package are presented on the *SITSA* website. For example, for the emergency dispatch equipment package required for vehicle routing, the following list of PSpecs is provided:

- Provide Operator Interface for Emergency Data
- Dispatch Vehicle
- Maintain Vehicle Status
- Provide Emergency Vehicle Route
- Update Emergency Display Map Data

A description of each of these PSpecs can be obtained from the *NITSA* Web site, CD-ROM, or documents. Table C.2 presents the descriptions of the above PSpecs. These PSpec descriptions should be used as starting points for defining the technical requirements for the project.

Table C.1 – Architecture Flow Traceability to Data Flows

Architecture Flow	Data Flow	Description
Incident Report	toec_mayday_emergency_data	This data flow is sent to the other emergency centers by the Manage Emergency Services function. It contains information about an emergency that was reported by a Mayday system; verified by the Mayday service provider; and determined to require a response from a public safety agency or another authorized responder. It consists of the following data items, each of which is contained in its own DDE: emergency_request_driver_details + emergency_request_vehicle_details + mayday_agency_ID + driver_status_update + vehicle_status_update
	toec_incident_details	This data flow is sent to the other emergency centers by the Manage Emergency Services function and contains data about an incident that has been reported beyond the area served by the local function and, therefore, outside their area of operation. It consists of the following data items, each of which is defined in its own DDE: incident_confidence_level + incident_location + incident_number + incident_report_source + incident_reported_time + incident_description + incident_start_time + incident_duration + incident_severity + incident_status + incident_traffic_impact + incident_type

Table C.1

(CONTINUED)

Architecture Flow	Data Flow	Description
Incident Report (Continued)	toec_emergency_center_identity	This data flow is sent to the other emergency centers by the Manage Emergency Services function and contains the identity of the center that is providing the local function. The details of this incident are contained in a parallel data flow. This data flow consists of the following data item which is defined in its own DDE: emergency_center_identity
Incident Response Coordination	toec_incident_response_coordination	This data flow supports coordination of an incident response between allied response agencies. It supports the coordination of response procedures, status, and resources between agencies. It also supports the coordinated hand-off of responsibility for all or part of an emergency response. It consists of the following data items, which are defined in their own DDEs: incident_response_status + agency_incident_response_procedures + incident_resource_coordination + hand_off_coordination + staging_area Sub Data Flows: agency_incident_response_procedures hand_off_coordination incident_resource_coordination incident_response_status staging_area

Table C.2 – Process Specification Descriptions

PSpec	Description
5.2 – Provide Operator Interface for Emergency Data	This process shall provide the emergency services operator with an interface to the other processes in the Manage Emergency Services function. The process shall enable the operator to review and update the data used to allocate emergency services to incidents, applying temporary overrides to current emergency service allocations to suit the special needs of a current incident and requesting output of the log of emergency service actions. This process shall support remote security monitoring of areas where travelers may be vulnerable. It shall also enable the output of a message showing the failure of an emergency vehicle dispatched in response to an incident. This output shall override all other outputs. The process shall support inputs from the emergency services operator in both manual and audio form, and shall provide its outputs in audible and visual forms. The visual output may appear in either hardcopy or as a display, or both, and an audible output shall accompany the emergency vehicle dispatch failure message.
5.3.2 – Dispatch Vehicle	This process shall direct selected emergency vehicles and drivers to respond to an incident, receive acknowledgment that they will in fact respond; and provide them with the incident location and details that were precalculated and sent to this process. If called for, the process shall send details to the Manage Traffic function to request a traffic control preemption be provided for the vehicle(s) if that mode of preemption is available and chosen. The data for the emergency vehicle driver shall be sent to the driver interface process.
5.3.6 – Maintain Vehicle Status	This process shall maintain a data store of the current status of all emergency vehicles available for dispatch and that have been dispatched. It shall provide data from the store on request from other processes and shall update the contents of the store with new data received from other processes. This process shall output probe data, either traffic information or environmental readings, to the Manage Traffic function. The process shall output the status of a vehicle to the process responsible for vehicle tracking for as long as it is on its way to an incident to update estimated time of arrival (ETA) estimates and enable local vehicle preemption to be given at intersections, if that mode of preemption is chosen and granted.

Table C.2

(CONTINUED)

PSpec	Description
5.3.7 – Provide Emergency Vehicle Route	This process shall calculate and assign emergency vehicle routes for incident assistance upon request. This process shall provide an interface to the care facilities to which emergency vehicles may be routed. This care facility interface shall be used to decide which care facility is open and ready to receive patients. This process shall interface with a map update provider to maintain an accurate digital map for routing purposes. Once the route is calculated it is provided to the dispatch function and a record of the assigned route is provided to the assessment function
5.5 – Update Emergency Display Map Data	This process shall provide updates to the store of digitized map data used as the background for displays of incidents and emergencies produced by processes in the Manage Emergency Services function. The process shall obtain the new data from a specialist data supplier, or some other appropriate data source, on receiving an update request from the emergency system operator interface process within the Manage Emergency Services function.

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