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Task 02: Northern Virginia Task Support

Deliverable Task C.1.3.3

NOVA ITS Architecture Version 2.0 FINAL REPORT

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1.0 Introduction

This report documents the work performed on Task C.1 - *Update Northern Virginia Architecture for Compliance with FHWA Requirements,* for the Virginia Department of Transportation (VDOT) from January 10, 2005 to April 6, 2005. This report is organized as follows:

- Project Scope – Describes the work performed in Task C-1.
- Deliverables – Describes the project deliverables for Task C-1.
- 2005 Changes – Describes the changes that were made to the NOVA ITS Architecture for Task C-1.
- Regional ITS Architecture Assessment – Documents how the NOVA ITS Architecture is compliant with FHWA Rule and FTA Policy on ITS Architecture and Standards Conformity.
- Ongoing and Future Activities – Discusses the activities that are ongoing or planned (Task C-2 and Task D) and their implications to the architecture.

2.0 Scope and Deliverables

The Northern Virginia District ITS Architecture identifies interfaces among VDOT Systems and non-VDOT systems in the Northern Virginia District. The architecture was developed using Turbo Architecture (Version 3.0) and is based on the National ITS Architecture definition. The purpose of the NOVA ITS Architecture is to guide the planning and deployment of ITS systems within VDOT and those systems that interface with VDOT to facilitate integration across the region's transportation system.

VDOT is committed to leveraging this architecture to deploy ITS more efficiently. The NOVA ITS Architecture has been defined and documented and is available on the web at **www.vdot-itsarch.com**. The website includes the latest **hyperlinked version (Version 2.0)** of the architecture enabling a user to explore the various interfaces and subsystems defined in the architecture. In addition, the documentation and Turbo Architecture database are available for download.

2.1 Subtask 1: Definition Update in cooperation with Metropolitan Washington Council of Governments (MWCOG)

2.1.1 NOVA Architecture and MWCOG Architecture Comparison

One of the major subtasks involved coordination with Metropolitan Washington Council of Governments (MWCOG)'s architecture development. MWCOG was updating their regional architecture to conform to the FHWA rule and it was essential that both architectures be consistent in terms of stakeholders, elements, and services especially for overlapping areas. The following sections describe the work performed by the NOVA team in reviewing, comparing, and ensuring that both the architectures are consistent for all elements.

2.1.1.1 Stakeholder Comparison

The stakeholder lists for both the NOVA architecture and the MWCOG architecture were compared using documentation provided by the MWCOG architecture team and the MWCOG and NOVA turbo databases. The comparison included the naming of stakeholders, their descriptions, and use of stakeholder groups for city and local agencies & private ISPs.

Task C.1.1.4 report documents the comparison. The report was extensively discussed with MWCOG in a two hour telephone conversation (01/28/05) and a consensus was reached on the stakeholder list. Section 3.1 discusses the changes made to VDOT NOVA architecture as a result of the comparison.

2.1.1.2 Inventory Comparison

The system inventory lists for both the NOVA architecture and the MWCOG architecture were compared in the Task C.1.1.5 report using documentation provided by the MWCOG architecture team and the MWCOG and NOVA turbo databases. The detailed comparison included the naming of elements (ITS systems), their descriptions, associated stakeholders, and entity mapping (functions).

The comparison was essential to ensure consistency between the architectures. System inventory including the element names and the mapped entities determine the nature of the information flows between systems.

Task C.1.1.5 report compared the elements in a tabular format. Common elements in both architectures were listed along with any discrepancies (naming, entity mapping). Elements in one of the architectures were also highlighted.

The report was extensively discussed with MWCOG in a two hour telephone conversation (01/28/05) and a consensus was reached on the stakeholder list. Major additions to the architecture included new elements for CapCOM, RITIS, VTIP, VDOT NOVA ITS MCO and WMATA. WMATA was grouped earlier under local transit agencies but has now been called out as a separate element in the MWCOG architecture. Section 3.2 discusses all the changes made to VDOT NOVA architecture as a result of the comparison.

2.1.1.3 Operational Concept and Functional Requirements Comparison

MWCOG developed the operational concept through roles and responsibility statements for selected stakeholders. The list was reviewed and provided to MWCOG on 2/10/05 as part of the Task C.1.1.6 report using documentation provided by the MWCOG architecture team. A follow-up teleconference between ITS PPA manager, MWCOG representatives and the NOVA architecture team resulted in clarification of the roles and responsibilities for the selected stakeholders.

It was decided that the NOVA team would use MWCOG's operational concept definitions for regional and non-VDOT NOVA stakeholders and develop separate roles and responsibilities statements for non-overlapping stakeholders in the NOVA architecture.

Functional requirements were reviewed in the same manner. Also, the NOVA architecture turbo file was provided to MWCOG to ensure consistency with the selection of the functional areas.

2.1.1.4 Information Flow Comparison

On March 7th, 2005, the MWCOG interconnect diagrams were reviewed against NOVA Architecture TURBO database to check for consistency in flows. Due to the size of the

MWCOG architecture (about 600 diagrams), only diagrams which are relevant to the NOVA architecture were reviewed (i.e. diagrams which contain at least one NOVA specific element). The comparison was presented in a PowerPoint slideshow. In each slide, the main body of the slide is the architecture diagram from the regional architecture. The comments/recommendations and NOVA flow information are provided in the notes section of each slide. The slideshow was also discussed with the ITS PPA manager to address discrepancies such as missing flows, missing interfaces etc. Task C.1.1.11 report presents these power point slides and the NOVA specific comments on the interconnect diagrams.

2.1.1.5 Regional Stakeholder Meetings

The architecture team had extensive information exchanges with MWCOG including attending the MOITS meeting on March 8th. The meeting highlighted MWCOG's architecture development efforts to regional stakeholders including DCDOT, MDSHA, WMATA, and representatives for local jurisdictions. The VDOT NOVA architecture team provided the Task C.1.1.11 report on the information flow diagrams comparison to MWCOG, DDOT and representatives from Maryland during the meeting. Another meeting is planned on April 12th to discuss the next version of MWCOG architecture.

2.1.2 Interviews

To gather additional information on specific stakeholders, the NOVA team conducted five telephone interviews. The stakeholders were selected by the NOVA ITSPPA Task Manager with input from the NOVA Architecture team. Interviews were conducted with stakeholders that were outside the overlap area between MWCOG regional architecture and NOVA. These included stakeholders from Fairfax County Public Safety Transportation Operations Center (PSTOC), Virginia Transportation Information Portal (VTIP), VDOT Traffic and Emergency Operations Center (TEOC), VDOT Maintenance and Construction Operations and Statewide 511. The notes from the interviews are summarized below.

1. David Evans PSTOC – 703-383-2102

Interviewed David Evans to gather information on PSTOC and to identify how PSTOC will be represented in version 2.0 of the NOVA Architecture. David mentioned that for the current version of the architecture (due April 7th, 2005), PSTOC should be mentioned, in the description field, as a new facility (future) that will be shared by Fairfax County Public Safety Communications Center (PSCC) and the Fairfax County Office of Emergency Management (OEM) and the VDOT STC, STSS and VSP State Police dispatch. PSTOC will include the following entities:

Fairfax County Public Safety Communication Center (PSCC)

- 911 Call Takers
- Fire and Police Dispatch
- Emergency Management

VDOT

- STSS – Signal Controllers
- STC
- State Police Dispatch Unit

Mr. Evans mentioned that PSTOC will start sharing information in the near future, but detailed information necessary for the architecture is uncertain at this time. He also mentioned that information will change after tasks A and B are completed for NOVA. He recommended that we get in touch with Chris Landis of VDOT Information Sharing group.

In discussions with Chris Landis and he concurred with David Evans that we should wait and update PSTOC information into the architecture after Tasks A and B are completed and in the interim continue to review materials generated by the PSTOC team. He also mentioned that Ms. McElwain is on the e-mail list to receive all the PSTOC generated material.

For version 2.0 of the NOVA architecture, PSTOC will be added to the description fields for Fairfax County, VDOT NOVA STC, STSS, and VSP dispatch.

2. <u>David Sutton, Virginia Transportation Information Portal (VTIP) – 804-786-0460</u>

The NOVA Task C team spoke to Dave Sutton to gather information on VTIP and ensure that the element is portrayed correctly in the NOVA Architecture. VTIP will be added as a new element in version 2.0 of the architecture. Mr. Sutton mentioned that VTIP is a pilot application deployment on the I-81 Corridor. He also mentioned that VTIP will not have any interaction with NOVA. VTIP is envisioned to be a multi-layered multi functional transportation management system that will include traffic management, weather, GIS, freeway management, and emergency plume analysis including chemical spills, evacuation zones, etc. It is being tested and implemented in a very small geographic area and has no relationships with other VDOT districts. If it does become operational, it will interface with VDOT Statewide 511.

Even though VTIP does not connect to any specific element in the NOVA architecture, the NOVA architecture team has included it in version 2.0 as the potential future statewide transportation information sharing portal.

3. <u>Perry Cogburn, VDOT TEOC, 804-786-2848</u>

VDOT TEOC inventory element currently exists in the NOVA Architecture. The interview with Perry was conducted to ensure that the interfaces and the information flows listed in the architecture, relevant to TEOC are still the same, and also to gather any new/updated interfaces. The updates to TEOC include:

- **New Description:** Transportation Emergency Operations Center in Richmond is responsible for emergency transportation management statewide and responding to incidents in Richmond and major incidents statewide.

- **Systems Interconnected** – Add Statewide 511 and VOIS
- **Interconnect Diagram**
    i. Change the "planned" flow from TEOC to NOVA Public Safety Centers to "existing". The TEOC currently interfaces with Fairfax and Prince William emergency centers.
    ii. In the future, TEOC will not be responsible for maintaining the RWIS system. This will be maintained by the Asset Management Division of the VDOT Central Office. This will be updated in Task C2 once confirmation is obtained.

4. Jim Gray, 703-383-2761, james.gray@vdot.virginia.gov, VDOT NOVA Maintenance and Construction Operations

The NOVA Task C team spoke to Jim Gray to gather information on some of the maintenance and construction activities and ensure that the element is portrayed correctly in the NOVA Architecture.

Jim Gray mentioned that their office is responsible for Technical Construction. Technical construction is responsible for administration of most ITS construction projects throughout the district. This includes two ongoing traffic signal contracts that constructs on average of 2-3 intersections per month Administration includes all activities from the time contracts are awarded to project closeout and final acceptance.

There are three other project managers within the maintenance organization that administers maintenance construction projects (formerly Transport, now Site Manager) throughout the district. Types of projects include but not limited to paving, sidewalk and curb/gutter replacement. Administration includes all activities from the time contacts are awarded to project closeout and final acceptance.

Snow operations involve four maintenance sections, Fairfax, Manassas, Leesburg and Interstate. Electronic Snow Reporting, a NOVA district product, is used during weather events for reporting of weather/road conditions, equipment status, materials status, chemical route assignments, and status of work in subdivisions. Data is entered at the respective area headquarters and can be viewed from any NOVA district desktop.

In terms of the architecture, work was performed to:

- Created a VDOT NOVA Maintenance and Construction Operations element which includes the routine maintenance and snow operations for all the NOVA sections.
- Added VDOT NOVA Maintenance Vehicle element to VDOT NOVA Maintenance to represent communications between snow plows/other maintenance vehicles back to the district or residency centers.
- Added a VDOT ITS MCO element which accounts for the technical construction

5. Todd Kell, PBS&J (consultant), Statewide 511 System

The NOVA Task C team spoke to Todd Kell about the Virginia Statewide 511 System. The Statewide 511 system is currently operational in two forms – a telephone service as well as a website (www.511virginia.org). The telephone system provides traffic information, incident information, construction and maintenance information and some travel service information for interstates, and most U.S routes. The website provides the same information as the telephone service in addition to trip planning services, connections to local transit agencies (in some areas).

Currently, VTTI serves as the 511 clearinghouse for the entire state. Statewide Travel Information Clearinghouse maintained by VTTI in Blacksburg that contains, information on traffic and road conditions is updated continuously using data provided by VDOT and the State Police. Weather information is provided by Meteorlogix and drawn from the National Weather Service. Travel services data are provided by NavTeq (for the website only) and supplemented by the sale of targeted advertising and promotions on the 511Virginia service. From the clearinghouse, the information is relayed to the user via TeleAtlas and Westwood One to the website and phone system. The website is maintained by Maptuit. The phone system is maintained by Logictree.

The 511 system uses VOIS as the primary source for VDOT STCs and other VDOT districts related data, VSP CAD for incident data and information from some other travel service providers. While this is the current scenario, VOIS is not designed for easy input into the 511 system. There are several steps which are handled by VTTI to take VOIS data and make it acceptable to the necessary database structure to support the concatenated recordings, as well as the text to speech format required for 511. In addition to VOIS, some major construction information is also provided through weekly updates from the VDOT public affairs offices

A statewide ATIS information clearinghouse in lieu of VOIS has been discussed by VDOT but no approved plans exist as of the printing of this document. The statewide clearinghouse would take over most of the VTTI's current roles as a 511 clearinghouse. The statewide clearinghouse could technically be a virtual clearinghouse with no interface between VDOT and the 511 system..

In terms of coordination with other 511 providers, Virginia 511 coordinates with North Carolina and Kentucky 511 services. Planning efforts are underway to develop a regional 511 system for the metropolitan Washington area. CapCOM, if realized completely, will be the driving force for information to this 511 service with RITIS serving as the data collection and fusion engine.

Future plans include expanding the coverage to all the U.S routes as well as adding some major VA routes. Local road information is not expected in the near future but there is some thought of obtaining information from major local public safety agencies (Arlington county, etc.)

Currently, there is no specific information about toll roads like Dulles Greenway Virtually all, if not all, toll roads in the state will be added this summer. However, VDOT does not operate all of these roads, plus automatic detection devices and CCTV cameras are limited. Therefore, VDOT will often get information second or third-hand either from the VSP, local law enforcement, or the local operating authority.

2.1.3 Deliverables

- Comparison of Inventory and Stakeholders (Task C.1.4 and Task C.1.5 reports)
- Comments on Regional Operational Concept and Functional Requirements (Task C.1.6 report)
- Comments on DC Regional Strawman Architecture – Interconnect Diagrams (Task C.1.1.11 report)
- Telephone Interview Summary (Task C.1.1.7 -Provided in Section 2.1.2)
- List of Recommended Changes (Section 3.0)
- Strawman ITS Architecture (Task C.1.1.10 report – Powerpoint presentation, also on website)

2.2 Subtask 2 Fulfill Other FHWA Rule Requirements

Section 2.1 focused on the updates to the NOVA Architecture to ensure consistency with the Metropolitan Washington Area Regional Architecture and included certain requirements of the FHWA Rule on ITS Architecture and Standards. This section focuses on the work performed to fulfill the remaining requirements of the FHWA Rule. The deliverables under this task are:

- List of Agreements
- Planning Process Memorandum to define and implement the use of Architecture from the Planning Perspective
- Project Development Memorandum to define and implement the use of Architecture for Project Development

2.2.1 Needed Agreements

The NOVA Architecture team and the ITS PPA Task Manager worked together to identify stakeholders in the NOVA area that may have existing agreements and/or new agreements. Using the Regional ITS Architecture Guidance document (USDOT, October 2001) on the level of detail required for the agreements, the NOVA Architecture team contacted the NOVA staff from the NOVA STC, NOVA STSS, VDOT Central Office, NOVA local agreements, PSTOC, Incident Management Team, VDOT Planning, CapWIN, RITIS, and VDOT TEOC to gather information and copies of the agreements. The list of agreements and their detailed information is provided in Task C.1.2.1 report and also provided in Appendix A. The NOVA team will also include agreements (if a NOVA stakeholder is part of the agreement) that are identified by the MWCOG architecture team (once they are identified). This list will be available in the Turbo Database and will include details on:

- Title of Agreement
- Status (Existing or Planned)
- Type of Agreement (Interagency, MOU, Intergovernmental, etc)
- Description
- Lead Stakeholder/Agency
- Selected Stakeholder/Agency

2.2.2 Planning Process Memorandum

The NOVA Architecture team updated the planning process documentation (Task C.1.2.2 report) to reflect the changes to the NOVA organization and to fulfill the FHWA rule requirements. The goal of the planning processes is not to impose more work upon the NOVA Staff managing the ITS project development, but to ensure that the projects are defined with integration in mind. FHWA policy requires the definition of ITS projects that are consistent with a regional plan or architecture to better support integration. Projects defined without considering integration opportunities have been found to be more costly in the long run due to the cost of redesign. The planning process document details information on project sequencing and elaborates on the process that NOVA project managers need to follow during the life cycle of a project, from the planning perspective. These tools allow VDOT to better plan ITS financial investments and assist VDOT managers in understanding the priorities of ITS deployment in the NOVA District. VDOT transportation planning is a process that involves project definition, review, prioritization, approval, funding allocation, and incorporation into the transportation plan. The path a project follows in the planning process is dependent on the funding source being sought for the project. The planning process documents the process that NOVA Project Managers should follow when implementing projects using Six Year Improvement Funds (SYIP), ITS Earmark funds and Special Grant funds. It also discusses how and where the NOVA ITS Architecture and other pertinent documents like the strategic plan and the concept of operations could be used as a reference in the pursuit of integration opportunities. This document is included in Appendix B.

2.2.3 Project Development Memorandum

The NOVA Architecture team updated the project development documentation (Task C.1.2.3) to meet the FHWA rule 940 requirements. The NOVA ITS Architecture Version 2.0 describes subsystems, interconnects, and information flows necessary to deploy an integrated transportation system in NOVA. The architecture is used by VDOT project managers to define ITS projects that implement portions of the architecture in a phased manner. The project development documentation assists NOVA project managers in identifying when to develop project architectures (from the funding perspective) and what the essential components that constitute a project architecture required by the FHWA rule. The document discusses the benefits attained in developing project architectures during three phases of a project:

- Development of a High Level Project Architecture -Prior to Securing Funds for a Project
- Development of a Detailed Project Architecture - Project Implementation with Secured Funds

- Submit Project Architecture after Project Implementation

The document highlights the process required by project managers to develop project architectures using systems engineering analysis steps and the use of the NOVA Architecture Turbo Database to comply with FHWA Rule. Defining a project using the systems engineering (SE) process and the NOVA ITS Architecture maximizes the integration opportunities available by examining the interfaces that the project should accommodate.

The last part of the document highlights the need and the process for submitting project architectures to the NOVA ITS PPA Manager following project completion. This will ensure that the NOVA ITS Architecture is updated to reflect the establishment of interconnects and/or information flows or new subsystems in the architecture. If portions of the project architecture were not implemented as planned, they should not be reflected in the updated architecture to avoid consideration in another project in the future.

The project development also discusses the approach and process for maintenance of the architecture beyond the FHWA rule conformity and to ensure that the NOVA ITS Architecture be kept current so that the project managers using the architecture to define projects in the NOVA District have the most accurate information available. The NOVA architecture will also be maintained and updated when additional tasks are performed to ensure that the results of the activities are accurately reflected and are consistent with the ITS Architecture. This document is included in Appendix C.

2.3 Document FHWA Rule Conformity

Section 3.0 and Section 4.0 document the conformity with the FHWA 940 rule. The deliverables for this subtask are the

- Updated Turbo Database (Version 2.0)
- Updated Website
- Task Report (This document)

3.0 2005 Architecture Changes

The following describe the changes to the VDOT NOVA ITS Architecture based on the comparison with MWCOG architectures and discussions with VDOT ITS PPA Project Manager.

3.1 Updates to Stakeholder List

- Deleted DC/MD
- Deleted District of Columbia
- Renamed District of Columbia Public Safety Agencies to District of Columbia Public Safety and Emergency Agencies
- Deleted EZ Pass Administration
- Under Federal Agencies – added federal installations and FEMA (renamed National Advisory Warning system as FEMA)
- Deleted FEMA
- IMMP – Removed as a stakeholder – and added as an element under VDOT Central office and renamed it to Asset Management.
- Deleted Local Law Enforcement Agencies
- Deleted Maryland Arterial Management Agencies
- Maryland Public Safety Agencies – renamed to Maryland Public Safety and Emergency Management
- Deleted Maryland Toll Administration
- Added Maryland Transit Administration – based on COG's description
- Deleted MTAG
- Group name – Renamed from NOVA Public Safety Agencies to NOVA Public Safety and Emergency Management Agencies
- Deleted Parking Management Agencies (this pertains to non-VDOT parking management; it was decided that they were not needed in the architecture)
- Deleted Partners in Motion as the stakeholder does not exist anymore
- Renamed Rail Operators to Freight Rail Operators
- Deleted Regional Data Archive Organizations – this is under CAPCOM
- Added Regional Transit Electronic Clearinghouse
- Virginia Emergency Management – Renamed to Virginia Public Safety and Emergency Management
- Renamed Video Clearinghouse Agencies to Video Clearinghouses
- Added Federal Law Enforcement
- Added General Public
- Added CapCOM
- The current stakeholders have been deleted – their functions are under VDOT Central Office as the Stakeholder
    -Deleted VDOT Data Management Division

-VDOT Maintenance Division
-VDOT Traffic Engineering Division
-VDOT TEOC

3.2 Updates to System Inventory

- Added Emergency Telecommunications System as an entity under National Park Services
- Added Regional Transit Electronic Clearinghouse element under Regional Transit Electronic Clearinghouse stakeholder
- Changed the name of DDOT ITMS element to DCDOT ITMS/TOC
- Changed DC Emergency Preparedness Center element to DC Public Safety and Emergency Management Center. Also changed the description to remove FBI from this and added it under federal agencies.
- Changed element name from special event promoters to event promoters
- Changed entity name from Emergency Management to Other Emergency Management for Federal Installations
- Made Federal Law enforcement (under Federal agencies as stakeholder) into a new element.
- Added FEMA as a separate element (under federal agencies as stakeholder)
- Added University of Maryland to the description for Research and Data Collection Centers element.
- Changed element name from Media Outlets to Media. Also added ISP entity to this element.
- Added Emergency Management entity for MWAA center element.
- Changed the entity name from Archived Data User to Archived Data Management for NVTC center
- Added element NOVA Local Transit Vehicle under NOVA Local transit agencies.
- Added ISP entity for NOVA Local Transit Centers element
- Deleted Other Parking Management element
- Changed the name to Freight Rail Operators from Rail Operators
- Moved Laptop Computers element to VDOT NOVA District stakeholder from VDOT stakeholder.
- Moved Statewide 511 Virginia element to VDOT Central Office from VDOT
- Added new element VTIP under VDOT – with entities EM, ISP and TM
- Moved VDOT NOVA Parking Management to VDOT NOVA District from VDOT.
- Added Asset Management under VDOT Central Office with MCO as entity
- Removed MCO entity from VDOT TEOC.
- Changed IMMP element to Asset Management
- Split VDOT NOVA Maintenance and Construction to 2 separate elements – VDOT NOVA Maintenance and VDOT NOVA Construction.

- Added VDOT NOVA Maintenance Vehicle element to VDOT NOVA Maintenance
- Changed name of VDOT NOVA TCC to VDOT NOVA CSC – Removed other ISP entity.
- Moved RWIS element to VDOT Central Office
- Moved VDOT Mobility Store to VDOT Central office
- Added Rail Operations entity to VRE center element.
- Added a new Virginia Statewide Information Clearinghouse.
- Renamed Mobile Unified Command to Mobile Unified Command Center
- Added CAPCOM Center and RITIS as new elements under CAPCOM
- Added General Public element with Traveler and Driver as terminators.
- Added the following WMATA new elements:
    - WMATA Operations Center
    - WMATA Transit Vehicle
    - WMATA Emergency Management
    - WMATA Smart Trip Card
- Added VDOT NOVA ITS MCO – to represent ITS Maintenance activities which are expected to be delineated from the regular maintenance and construction operations.

3.3 Updates to Market Packages

New Market Packages

- Added Probe Surveillance (ATMS 02) as a new market package with the following elements
    - VDOT NOVA STC
    - VDOT NOVA STC Field Equipment
    - Greenway Center
    - Smart Tag Center (Need to determine if Dulles Toll Road element will be a better fit to obtain real-time toll reader data)

  The market package represents a desire of the NOVA STC to obtain travel time data from toll readers and toll administration agencies in the region.
- Added Multimodal Coordination (APTS 7) to address transit signal priority with the following elements
    - VDOT NOVA STSS
    - VDOT NOVA STSS Field Equipment
    - Local NOVA Transit Vehicles
    - WMATA Transit Vehicle-Bus

Updates to Existing Market Packages

- Added new element *CapCOM center* to Network Surveillance (ATMS 01) Market package.

- Added new element *CapCOM center* to Freeway Control (ATMS 04) Market package.
- Added new elements *CapCOM center* and *VDOT VOIS* to Traffic Information Dissemination (ATMS 06)
- Added new elements *CapCOM center, VDOT VOIS, RITIS, WMATA Operations Center, WMATA Emergency Management* to Traffic Incident Management (ATMS 07)
- Added new elements *WMATA Smart trip card* to Parking Facility Management (ATMS 16)
- Added *WMATA Operations Center* and *VRE Center* elements to Regional Parking Management (ATMS 17) to address parking management cooperation between VDOT owned parking facilities and others.
- Added new elements *CapCOM center, RITIS, VDOT NOVA GIS, VDOT NOVA CSC* and *VDOT VOIS* to Roadway Closure Management (ATMS 21)
- Added new element *VDOT Asset Management* to Maintenance and Construction Vehicle Maintenance (MC 02)
- Added elements *CapCOM center, VDOT NOVA STC, VDOT NOVA STSS, VDOT VOIS, Virginia Statewide Transportation Information Clearinghouse* to Weather Information Processing and Dissemination (MC 04)
- Added elements *CapCOM center, VDOT NOVA CSC, VDOT NOVA ITS MCO* to Roadway Maintenance and Construction (MC 07)
- Added *Asset Management, CapCOM center, RITIS, VDOT VOIS, VDOT NOVA ITS MCO* to Maintenance and Construction Activity Coordination (MC 10)
- Added *WMATA Operations Center* and *WMATA Transit Vehicle –Buses* to Transit Fixed Route Operations (APTS 02)
- Added *WMATA Operations Center* to Transit Demand Responsive Operations (APTS 03)
- Added *WMATA Operations Center, WMATA Smart trip card* and *WMATA Transit Vehicle –Buses* to Transit Passenger and Fare Management (APTS 04)
- Added *Local Transit Centers, Local Transit Vehicles, WMATA Operations Center, WMATA Emergency Management* and *WMATA Transit Vehicle –Buses* to Transit Security (APTS 05)
- Added *WMATA Operations Center, WMATA In-Station Displays_Kiosks* and *WMATA Transit Vehicle –Buses* to Transit Traveler Information (APTS 08)
- Added *VDOT VOIS* to Interactive Traveler Information (ATIS 02) to account for current use of the VOIS system to gather data for the 511 service
- Added *CapCOM center, Federal Law Enforcement, Maryland CHART, MWAA Center and VDOT Video Clearinghouse* to Transportation Infrastructure Protection (EM 05)
- Added *Adjacent STCs, CapCOM center* to Wide Area Alert (EM 06)
- Added *CapCOM center* to Early Warning System (EM 07)
- Added elements *CapCOM center, VDOT VOIS, WMATA Operations Center, WMATA Emergency Management* to Disaster Response and Recovery (EM 08)

- Added elements *CapCOM center, VRE Center, WMATA Operations Center, WMATA Emergency Management* to Evacuation and Re-entry Management (EM 08)
- Added elements *CapCOM center, WMATA Operations Center, WMATA In Station Displays_Kiosks, RITIS* to Disaster Traveler Information (EM 08)

3.4 Updates to Standards

Architecture standards have been identified in detail in Version 1.0 of the architecture. The website provides standards information for each architecture flow. Each element page has a link of all information flows associated with it; each of these information flows are linked to a page with standards information.

Some standards definitions were updated during this task:

- Removed NTCIP 2501 – Work has stopped on this standard
- Removed NTCIP 2502 – This standard may be replaced with another one. For now, it does not exist on the ITS standards web page.
- Changed document ID for ASTM E2259-xx to ASTM E2259-03 (2003)

3.5 Updates to Information Flows

With significant changes to the system inventory, entity mapping and market package associations, Turbo was used to build the information flows and the interfaces. Various new flows and interconnections were identified.

All the information flow diagrams were recreated and the operational concept for each of them revised and updated. These were summarized in a powerpoint presentation as well as on the website. Several new diagrams were also added to the website including information flow diagrams featuring interfaces from/to CapCOM, WMATA and VDOT VOIS (all new elements in the architecture)

It was pointed out that in the previous version of the architecture some flow diagrams did not have corresponding request/response flows i.e. a "request" type flow to an architecture element, e.g. "maint and constr resource request", implies that there at least should be a "response" type flow back from the element. This discrepancy was fixed in the current version of the NOVA Architecture.

Detailed information is provided for each flow in the architecture including the type of flow, description and the standards associated with it. These can be accessed through System Inventory page on the website (click on any element link and scroll down to the information flows section)

3.6 Operational Concept (Roles and Responsibilities)

VDOT has identified a separate task (Task D-3) for a NOVA-specific Concept of Operations (COO) Development. This task is part of the *VDOT NOVA District Program Plan Update*. The task will develop COOs organized by VDOT NOVA functional areas, identify dependencies and links between functional areas, and cross referenced by program elements. The COO will be developed in a dynamic format (within Turbo database) and a static document that describes the overall COO

However, to conform to the FHWA rule, at this stage of the project two approaches are used to define responsibility statements:

1. MWCOG's operational concept document and the matrix table[1]. This was the primary source for regional and non-VDOT NOVA stakeholder information.
2. NOVA Architecture Functional Analysis Matrix developed as part of the initial architecture (Version 1.0 final report -Appendix A, table A-1) – This was the basis for roles and responsibility statements for NOVA centric elements. Some of the statements were expanded to fit into the Turbo approach

It is expected that the roles and responsibility statements will change as Task D.3 gets underway and these will be updated during Task C.2 (Architecture Maintenance beyond Rule Conformity).

In addition to roles and responsibility statements, VDOT NOVA architecture also defined operational concepts by information flow diagrams. Each information flow diagram has a concept of operations associated with it on the website. Another source for concept of operations is the customized market package descriptions on the website.

3.7 Functional Requirements

Functional requirements are high-level descriptions of what each part of the regional ITS system must do. They are normally expressed as "**shall statements**". Whereas the roles and responsibilities presented in Section 3.6 (as part of the concept of operations) focus on *agencies'* functions within the ITS system, functional requirements identify what various *technology systems* must do. In addition to providing further elaboration of how the regional ITS system will operate, the ITS functional requirements will provide useful information for a more detailed, project-specific requirements developed during project design.

As is expected of an architecture this size, the number of elements and their many functionalities result in a rather voluminous list of shall statements. Table 3-1 is a sample of the "shall" statements for a single element – VDOT NOVA STC.

[1] (http://www.mwcog.org/transportation/committee/committee/documents.asp?COMMITTEE_ID=178).

To ensure readability, the "shall" statements are not provided on the website. They are available in the Turbo database where these statements can be viewed by element. The website only lists the functional area and the functional area description for each element.

Table 3-1 Sample Functional Requirements

Element Name	Functional Area	Functional Area Description	Requirement	Status
VDOT NOVA STC	Collect Traffic Surveillance	Management of traffic sensors and surveillance (CCTV) equipment, and distribution of the collected information to other centers and operators.	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center.	Existing
			The center shall monitor, analyze, and distribute traffic images from CCTV systems under remote control of the center.	Existing
			The center shall maintain a database of surveillance and sensors and the freeways, surface street and rural roadways, e.g. where they are located, to which part(s) of the network their data applies, the type of data, and the ownership of each link (that is, the agency or entity responsible for collecting and storing surveillance of the link) in the network.	Existing
			The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic data.	Existing
			The center shall distribute road network conditions data (raw or processed) based on collected and analyzed traffic sensor and surveillance data to other centers.	Existing
			The center shall respond to control data from center personnel regarding sensor and surveillance data collection, analysis, storage, and distribution.	Existing
	ITS Data Repository	Collect and maintain data and data catalogs from one or more data sources. May include quality checks, error notification, and archive coordination.	The center shall collect data to be archived from one or more data sources.	Existing
	Service Patrol Management	Dispatch and communication with roadway service patrol vehicles that monitor roads to aid motorists, offering rapid response to minor incidents.	The center shall store the current status of all service patrol vehicles available for dispatch and those that have been dispatched.	Existing
			The center shall share incident information collected by the service patrol with traffic, maintenance and construction, and traveler information centers for incident management, incident notification to travelers, and incident cleanup.	Existing
			The center shall track the location and status of service patrol vehicles.	Existing
	TMC Environmental Monitoring	Management of environmental sensors and assimilation of collected data with other current and forecast road conditions and surface weather information from weather service providers and roadway maintenance operations.	The center shall assimilate current and forecast road conditions and surface weather information using a combination of weather service provider information (such as the National Weather Service and value-added sector specific meteorological services), data from roadway maintenance operations, and environmental data collected from sensors deployed on and about the roadway.	Existing
	TMC Evacuation Support	Development, coordination, and execution of special traffic management strategies during evacuation and subsequent reentry of a population in the vicinity of a disaster or major emergency. Interfaces with emergency management and other traffic management centers.	The center shall coordinate planning for evacuation with emergency management centers - including pre-planning activities such as establishing routes, areas to be evacuated, timing, etc.	Existing
			The center shall support requests from emergency management centers to preempt the current traffic control strategy, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems to support evacuation traffic control plans.	Existing
			The center shall coordinate information and controls with other traffic management centers.	Existing

Element Name	Functional Area	Functional Area Description	Requirement	Status
			The center shall coordinate execution of evacuation strategies with emergency management centers - including activities such as setting closures and detours, establishing routes, updating areas to be evacuated, timing the process, etc.	Existing
	TMC Freeway Management	Remotely controls ramp meters, mainline metering, and lane controls on freeways based on upstream and downstream traffic flow and ramp queue length algorithms.	The center shall remotely control systems to manage use of the freeways, including ramp meters, mainline metering, and lane controls.	Existing
			The center shall collect operational status from ramp meters, mainline metering, and lane controls and compare against the control information sent by the center.	Existing
			The center shall collect fault data from ramp meters, mainline metering, and lane controls.	Existing
			The center shall implement control strategies, under control of center personnel, on some or all of the freeway network devices (e.g. ramp meters, mainline metering, and lane controls), based on data from sensors monitoring traffic conditions upstream, downstream, and queue data on the ramps themselves.	Existing
	TMC HOV Lane Management	Remotely controls high-occupancy vehicle (HOV) lane sensors, driver information systems, and ramp meters to manage use of HOV or High Occupancy Toll (HOT) lanes; also detects HOV violators and notifies enforcement agencies.	The center shall remotely control sensors to detect high-occupancy vehicle (HOV) lane usage.	Existing
			The center shall remotely control driver information systems to notify users of lane status for lanes that become HOV or High Occupancy Toll (HOT) lanes during certain times of the day on freeways.	Planned
			The center shall remotely control freeway control devices, such as ramp signals and mainline metering and other systems associated with freeway operations that control use of HOV lanes.	Existing
			The center shall collect traffic flow measures and information regarding vehicle occupancy (i.e., lane usage) in HOV lanes.	Existing
			The center shall collect operational status for the freeway control devices associated with HOV lane control.	Existing
			The center shall collect fault data for the freeway control devices associated with HOV lane control for repair.	Existing
	TMC Incident Detection	Remotely controls traffic and video sensors to support incident detection and verification; exchange information with other agencies including emergency management, maintenance and construction, alerting and advisory systems, event promoters, intermodal freight depots, and traveler information systems.	The center shall receive inputs from the Alerting and Advisory System concerning the possibility or occurrence of severe weather, terrorist activity, or other major emergency, including information provided by the Emergency Alert System.	Existing
			The center shall collect and store traffic flow and image data from the field equipment to detect and verify incidents.	Existing
			The center shall receive inputs concerning upcoming events that would affect the traffic network from event promoters, traveler information service providers, and intermodal freight depots.	Existing
			The center shall exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Existing
			The center shall support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field.	Existing
			The center shall provide road network conditions and traffic images to emergency management centers to support the detection, verification, and classification of incidents.	Existing
			The center shall provide video and traffic sensor control commands to the field equipment to detect and verify incidents.	Existing

Element Name	Functional Area	Functional Area Description	Requirement	Status
	TMC Incident Dispatch Coordination/Communication	Center-based capability to formulate an incident response that takes into account the incident potential, incident impacts, and/or resources required for incident management including proposing and facilitating the dispatch of emergency response and service vehicles as well as coordinating response with all appropriate cooperating agencies.	The center shall exchange alert information and status with emergency management centers. The information includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public. The information may include the alert originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert. This may also identify specific information that should not be released to the public.	Existing
			The center shall coordinate planning for incidents with emergency management centers - including pre-planning activities for disaster response, evacuation, and recovery operations.	Existing
			The center shall support requests from emergency management centers to remotely control sensor and surveillance equipment located in the field, provide special routing for emergency vehicles, and to provide responding emergency vehicles with signal preemption.	Existing
			The center shall exchange incident and threat information with emergency management centers as well as maintenance and construction centers; including notification of existence of incident and expected severity, location, time and nature of incident.	Existing
			The center shall respond to requests from emergency management to provide traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. This may also involve coordination with maintenance centers.	Existing
			The center shall receive inputs concerning upcoming events that would affect the traffic network from event promoters, traveler information service providers, media, and rail operations centers.	Existing
			The center shall provide road network conditions and traffic images to emergency management centers, maintenance and construction centers, and traveler information service providers.	Existing
			The center shall exchange road network status assessment information with emergency management and maintenance centers including an assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Existing
			The center shall coordinate information and controls with other traffic management centers.	Existing
			The center shall receive inputs from emergency management and transit management centers to develop an overall status of the transportation system including emergency transit schedules in effect and current status and condition of the transportation infrastructure.	Existing
			The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for traffic incident management.	Existing
	TMC Probe Information Collection	Collects, assimilates, and disseminates vehicle probe data collected from roadside beacons and centers controlling transit vehicles, emergency vehicles, toll collection points, and route-guided vehicles.	The center shall collect traffic data from toll administrative centers containing journey times between toll collection points for those vehicles equipped for electronic toll collection; the data may be aggregated and processed at the sending center.	Planned
	TMC Reversible Lane	Remotely controls traffic sensors, surveillance, and automated reversible	The center shall remotely control devices to detect traffic in reversible lanes, including wrong-way vehicles.	Existing

Element Name	Functional Area	Functional Area Description	Requirement	Status
	Management	lane equipment and lane control signals to control traffic in reversible lanes.	The center shall monitor the use of reversible lanes and detect wrong-way vehicles in reversible lanes using sensor and surveillance information, and the current lane control status (which direction the lane is currently operating). This may include identification of wrong-way violators.	Existing
			The center shall remotely control automated reversible lane equipment and driver information systems (such as lane control signals) that control traffic in reversible lanes on surface streets.	Existing
			The center shall remotely control automated reversible lane equipment and driver information systems (such as lane control signals) that control traffic in reversible lanes on freeways.	Existing
			The center shall collect operational status for the reversible lane field equipment.	Existing
			The center shall collect fault data for the reversible lane field equipment and send to the maintenance center for repair.	Existing
			The center shall provide the capability for center personnel to control access and management of reversible lane facilities, including the direction of traffic flow changes during the day, especially between the peak hours and dedication of more lanes to the congestion direction during special events.	Existing
	TMC Traffic Information Dissemination	Controls dissemination of traffic-related data to other centers, the media, and travelers via the driver information systems (DMS, HAR) that it operates.	The center shall remotely control dynamic messages signs for dissemination of traffic and other information to drivers.	Existing
			The center shall remotely control driver information systems that communicate directly from a center to the vehicle radio (such as Highway Advisory Radios) for dissemination of traffic and other information to drivers.	Existing
			The center shall collect operational status for the driver information systems equipment (DMS, HAR, etc.).	Existing
			The center shall collect fault data for the driver information systems equipment (DMS, HAR, etc.) for repair.	Existing
			The center shall retrieve locally stored traffic information, including current and forecasted traffic information, road and weather conditions, traffic incident information, information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements), etc.	Existing
			The center shall distribute traffic data to maintenance and construction centers, transit centers, emergency management centers, and traveler information providers.	Existing
			The center shall distribute traffic data to the media upon request; the capability to provide the information in both data stream and graphical display shall be supported.	Existing
			The center shall provide the capability for center personnel to control the nature of the data that is available to non-traffic operations centers and the media.	Existing
	TMC Traffic Network Performance Evaluation	Systems to predict travel demand patterns to support traffic flow optimization, demand management, and incident management. Collects data from surveillance equipment as well as input from other management centers including emissions, event promoters, and other TMCs.	The center shall monitor, analyze, and store traffic sensor data (speed, volume, occupancy) collected from field elements under remote control of the center to support overall network performance evaluations.	Existing
			The center shall collect wide-area pollution data from emissions management centers to support overall network performance evaluations.	Existing
			The center shall collect and store plans from event promoters for major future events possibly impacting traffic to support overall network performance evaluations.	Existing
			The center shall exchange information with transit management centers including details current transit routes, the level of service on each route, and the progress of individual vehicles along their routes for use in forecasting demand and estimating current transportation network performance.	Existing

Element Name	Functional Area	Functional Area Description	Requirement	Status
			The center shall exchange traffic information with other traffic management centers, including incidents, congestion data, traffic data, signal timing plans, and real-time signal control information to support overall network performance evaluations.	Existing
			The center shall support an interface with a map update provider, or other appropriate data sources, through which updates of digitized map data can be obtained and used as a background for network performance evaluations.	Existing
	TMC Work Zone Traffic Management	Coordination with maintenance systems using work zone images and traveler information systems (such as DMS), and distribution of work plans so that work zones are established that have minimum traffic impact.	The center shall remotely control driver information systems (such as dynamic messages signs, highway advisory radios) to advise drivers of activity around a work zone.	Existing
			The center shall receive proposed maintenance and construction work plans, analyze the activity as a possible incident, and provide work plan feedback to the sending center.	Existing
	Traffic and Roadside Data Archival	Collects and archives traffic and environmental information directly from the roadside for use in off-line planning, research, and analysis.	The center shall collect traffic sensor information from roadside devices.	Existing
	Traffic Data Collection	Collection and storage of traffic management data. For use by operations personnel or data archives in the region.	The center shall collect traffic management data such as operational data, event logs, etc.	Existing
			The center shall be able to produce sample products of the data available.	Existing

4.0 Regional ITS Architecture Assessment – FHWA Rule Conformity

This section documents how the current NOVA ITS Architecture addresses the FHWA Rule and FTA Policy on ITS Architecture and Standards Conformity. Prior to developing the NOVA ITS Architecture, there was no specific guideline for demonstrating conformity. Conformity guidelines are now available and it is VDOT's intent to review NOVA ITS Architecture's conformity level and identify areas that need to be improved.

The table below is a checklist that represents desired elements of a regional ITS architecture, and includes the requirements of the FHWA Rule and FTA Policy on ITS Architecture and Standards Conformity. The checklist is a tool FHWA is using for assessing the completeness and identifying improvements to regional ITS architectures. The questions are listed by main topic area with an area for a reviewer to make an assessment. The "Comments" column allows a reviewer to document any suggestions, notes, strengths, or shortcomings. This table displays what components of the rule have been addressed by the NOVA ITS Architecture.

Table 4-1: NOVA Conformity Table

Criteria/Question	Yes/No/ Partly	Comments
1. Architecture Scope and Region Description		
a. Is the region defined geographically? Have boundaries been established such as counties, municipal boundaries, metropolitan areas, statewide, etc.?	**Yes**	A map was provided that displayed the counties that were included in the NOVA ITS Architecture in the scope section. Boundaries are also described in the introduction.
b. Has a timeframe for the architecture been defined? (For example, 5 or 10 years into the future, or the TIP/STIP planning period)?	**Yes**	No specific timeframe indicated. 10 years was selected as how far out the architecture should include planned/future elements and project ideas.
c. Has the scope of the regional architecture been defined (i.e. the range of services, institutions, or jurisdictions)? Does the scope seem appropriate given the circumstances?	**Yes**	The scope is defined in the version 1.0 executive summary and Architecture report. The scope is the VDOT-NOVA Centric. NOVA region (geographically) includes Fairfax County, Prince William County, Loudoun County and cities and towns within those Counties. The architecture scope being VDOT-NOVA Centric and consistent with the Metropolitan Washington regional ITS

Criteria/Question	Yes/No/ Partly	Comments
		architecture for the overlapping area is adequate and appropriate.
2. Stakeholder Identification		
a. Are the stakeholders identified in sufficient detail to understand who the players are and for what they are responsible? Are they identified by name, responsibility, jurisdiction, and/or typical roles and activities?	**Yes**	These are identified in the Turbo Database and on the web site.
b. Is the range of stakeholders commensurate with the defined scope of the regional architecture?	**Yes**	
c. Does the range represent a broad cross-section of all transportation related organizations in the region?	**Yes**	
d. Is there sufficient information to assess the degree of involvement of each critical stakeholder in the architecture development process?	**Yes**	
3. System Inventory		
a. Has a system inventory been defined?	**Yes**	These are identified in the Turbo Database and the web site.
b. Does it include a list of applicable regional systems along with descriptions of each system and their functionality?	**Yes**	
c. Have National ITS Architecture subsystems and terminators been correctly linked to regional systems?	**Yes**	
d. Are user-defined entities described in sufficient detail to understand their function?	**N/A**	User defined entities were not used in the NOVA ITS Architecture.
4. Needs and Services		
a. Are needs and services defined and described?	**Yes**	Services are described through market packages identified for the NOVA ITS Architecture. A needs section is not provided in the document or website. These were identified during the initial stakeholder meetings. In addition, the largest portion of the VDOT NOVA Centric ITS Architecture is the NOVA STC system and VDOT is developing administrative and technical needs for the STC system which will be completed by June 2005.
b. Are the needs and services adequately represented in the regional architecture?	**Yes**	Services are adequately represented in the NOVA ITS Architecture. Once the STC system needs are finalized, they will be incorporated to the NOVA ITS Architecture.

Criteria/Question	Yes/No/ Partly	Comments
5. Operational Concept		
a. Has an architecture operational concept been described in sufficient detail for the existing systems to understand the roles and responsibilities (technical, financial, human resource, mutual relationship and functional areas) of the primary stakeholders and the systems they operate in the region?	**Yes**	Concept descriptions are provided for each flow diagram in the NOVA ITS Architecture. Also tailored market package descriptions are used to describe operational concepts at the services level. Roles and Responsibilities are also identified in Turbo for NOVA specific stakeholder agencies/groups.
b. Has an architecture operational concept been described in sufficient detail for the future systems?	**Yes**	Scenario based operational concepts are included on the website. In addition, VDOT is going to develop a NOVA District wide Concept of Operations which will provide further detail
6. Functional Requirements		
a. Have high-level functional requirements been identified for each regionally significant system that is included in the architecture? ("Regionally significant systems" are defined as those with interfaces that cross agency boundaries.)	**Yes**	Functional areas and shall statements are identified for regionally significant systems.
b. Are the requirements categorized by stakeholders?	**No**	Functional requirements are defines by elements which are associated by stakeholders in the inventory.
c. Are the requirements unambiguously stated in terms of shall statements?	**Yes**	These are identified in the Turbo Database.
d. Is the architecture output presented in a way that is understandable to a variety of audiences, including the public and decision-makers?	**Yes**	The website contains the high-level functional areas for each element. Detailed shall statements can be obtained from the Turbo database.
7. Interfaces/ Information Flows		
a. Are interconnections defined to indicate what subsystems are connected together? Has this been illustrated by diagrams or tables?	**Yes**	These are reflected through diagrams and tables of the Turbo Database.
b. Have information flow diagrams or tables been developed to illustrate the information flows that are exchanged between subsystems?	**Yes**	These are reflected through diagrams and tables of the Turbo Database.
c. Is enough supporting information provided to understand the information exchanged?	**Yes**	These are reflected through diagrams and tables of the Turbo Database.
d. Does the architecture include appropriate linkages to overlapping or adjacent region architectures?	**Yes**	Linkages to the Washington Area Regional and Maryland regional architectures.

Criteria/Question	Yes/No/ Partly	Comments
e. Is the connection status (existing or planned) identified for each link?	**Yes**	These are reflected through diagrams and tables of the Turbo Database.
f. Are there any important integration opportunities that may have been overlooked?	**No**	Integration opportunities have been explored by conducting nine outreach workshops with stakeholders.
8. Project Sequencing		
a. Has a plan been established by which projects would be defined and sequenced over time?	**Yes**	An updated planning process memorandum which discusses project sequencing was developed with FHWA requirements in mind (Appendix B). A separate ITS strategic plan report will be developed under Task D.
b. Has an initial sequencing of currently defined projects been established?	**Yes**	
c. Does the sequencing adequately address the interdependencies among projects?	**Yes**	
d. Have opportunities to coordinate implementation schedules with other transportation improvements been investigated?	**Yes**	
9. Agreements		
a. Has a list of the agreements needed between key stakeholders in order to implement the projects that will come out of the regional ITS architecture been defined?	**Yes**	See Appendix A. These agreements were also included in Turbo.
b. Can existing agreements be used?	**Yes**	
10. Standards Identification		
a. Are ITS standards described that are applicable to the development of projects coming out of the regional ITS architecture?	**Yes**	The NOVA ITS Architecture includes a discussion of ITS standards in the final report based on what was derived from Turbo and the center to center level.
b. Are these standards associated with specific information flows or interconnects?	**Yes**	The NOVA ITS Architecture displays associated standards on a center to center level.
c. Are there any important standards that may have been overlooked?	**No**	All ITS standards have been identified in the Turbo Database.
11. Using the Regional ITS Architecture		
a. Is there a description for incorporating and using the regional ITS architecture in the region's planning process?	**Yes**	This is reflected in the final report and website.
b. Will a regional stakeholder organization or committee monitor and manage the planning process and the architecture use? Are all important responsibilities addressed?	**Yes**	ITS PPA Group is responsible for maintaining the architecture
c. Is there a description for using the regional ITS architecture in support of project implementation?	**Yes**	Project Development Process Memo (Appendix C) provides detailed explanation of how to use the architecture for projects based on the systems engineering process.
12. Maintenance Plan		
a. Is there a documented plan for maintaining the architecture? (If not, are there informal	**Yes**	

Criteria/Question	Yes/No/ Partly	Comments
agreements for how the regional architecture will be maintained?)		
b. Have the various reasons for updating the architecture been addressed (project updates, new requirements or initiatives, etc.)?	**Yes**	Planning Process Memo - Diagrams address stages of project implementation which require architecture changes (Appendix B). Maintenance plan also addresses changes arising due to updates to MWCOG or Maryland architectures (Appendix C).
c. Is there a plan for communicating changes in the architecture to stakeholders?	**Yes**	Final report states that the ITSPPA manager will communicate changes to project managers.
d. Have the responsibilities of the various stakeholders or groups been well defined?	**Yes**	These are identified in the Turbo Database.

5.0 Ongoing and Future Activities affecting Regional ITS Architecture

5.1 Task C.2 Architecture Maintenance beyond Rule Conformity

This task will update the NOVA ITS Architecture to incorporate activities conducted under Subtask Areas A (Operational Platform/Architecture) and B (Strategic Assessments). Task C.2 will also support Task A and Task B technical teams to ensure their documentation and designs are consistent with the NOVA ITS Architecture. This task will ensure that all initiatives documented in version 1.2 and the new initiatives started after May 2004 is included in the NOVA ITS Architecture (version 2.0). The Task is scheduled to begin in May 2005.

The task will also involve five (5) one-day workshops in the Northern Virginia Region to present the Strawman Architecture to the key stakeholders and MWCOG. Based on the comments received from the stakeholders, a list of changes will be compiled. The final deliverable for this task will be a Strawman NOVA ITS architecture version 3.0.

5.2 Task C.3 Architecture Training

This subtask shall update training course materials developed in FY 04 to reflect modifications to Architecture definitions as well as incorporate the newest Turbo Architecture Version. Training will consist of a one-day training course on the NOVA ITS Architecture to be held in Northern Virginia.

5.3 Task D.3 Concept of Operations (Part of Task D Program Plan Update)

The purpose of this task is to develop a NOVA-Centric regional Concept of Operations (COO) that is organized by VDOT NOVA functional areas, identifies dependencies or links between functional areas, cross-referenced with the program elements, and is documented in the Turbo Database. The Concept of Operations will be in two formats, a dynamic format within the bounds of the Turbo database and a static document that describes the overall COO. The task will involve coordination with MWCOG on CapCOM and RITIS COOs.

Appendices

APPENDIX A – LIST OF AGREEMENTS

Table A-1 – List of Agreements for NOVA ITS Architecture

Agreement Number	Title	Agreement Type	Agreement Description	Stakeholders Involved	Agreement Status Name
Incident Management					
Incident-01	Quick Clearance Laws	Master Agreements	Law discussing the quick clearance policies for VSP, DOT staff especially SSP and local law enforcement providing them with the right to remove vehicles from the roadway	Virginia State Police, VDOT NOVA District, NOVA Public Safety and Emergency Management Centers	Planned
Incident-02	VSP CAD Integration MoU	Memorandum of Understanding (MoU)	Agreement between Virginia State Police and VDOT NOVA STC for CAD integration for incident notification.	Virginia State Police, VDOT	Existing
Local Traffic Management					
Local-01	Arlington CCTV Agreement	Intergovernmental Agreement	The County of Arlington and the Commonwealth of Virginia, Department of Transportation will prosecute a project for the installation of Traffic Control Closed Circuit Television and DSL Communication Network at three intersections in Arlington County, UPC 58602, Project Number TMCO-000-10	VDOT NOVA District, County of Arlington	Existing
Local-02	Leesburg ATMS Agreement	Intergovernmental Agreement	Advanced Traffic Signal Management System	Town of Leesburg and VDOT NOVA District	Existing
Local-03	Arlington County Signal Preemption/Priority on Columbia Pike	Intergovernmental Agreement	Consulting Services for Signal Preemption/Priority Project on Columbia Pike	VDOT NOVA District, County of Arlington	Existing
Local-04	City of Fairfax DMS Implementation	Intergovernmental Agreement	DMS implementation in the City of Fairfax (2004)	City of Fairfax, VDOT NOVA District	Existing
Local-05	Fairfax CCTV Agreement	Intergovernmental Agreement	City of Fairfax and the Commonwealth of Virginia, Department of Transportation will prosecute a project for the installation of Video Monitoring Cameras at major intersections in City of Fairfax	City of Fairfax, VDOT NOVA District	Existing

Table A-1 – List of Agreements for NOVA ITS Architecture

Agreement Number	Title	Agreement Type	Agreement Description	Stakeholders Involved	Agreement Status Name
Local-06	Alexandria King Street Improvement Project Agreement	Intergovernmental Agreement	Agreement for King Street Improvement project between City of Alexandria and VDOT	City of Alexandria, VDOT NOVA District	Existing
Local-07	Arlington and VDOT Signal Maintenance Agreement	Intergovernmental Agreement	Agreement between Arlington County and VDOT for maintenance of VDOT signals by Arlington County. VDOT owns 120 of 243 signals in Arlington County and is billed by Arlington county including maintenance and repair of loop detectors and other vehicle detection equipment	VDOT NOVA District, County of Arlington	Existing
VDOT NOVA STC/STSS Operations					
Op-01	Use of Live Video Images of Traffic Conditions	Interagency Agreements	VDOT agrees to supply to Channels 4, 5, 7, 8 and 9 , without charge, the video images generated by its closed-circuit television cameras used for monitoring traffic conditions within the area encompassed by the STC, during the normal operating hours of the control center (5:00 a.m. - 12:30 a.m., Monday - Friday; and 5:30 a.m. - 12:30 a.m., Saturday, Sunday and holidays). The camera view supplied by VDOT shall be solely at the discretion of the TMS control center personnel. Agreement in Place since 1992.	VDOT NOVA District and Media (Channels 4,5,7,8,9)	Existing
Op-02a	TrafficCast and VDOT NOVA STC	Operational Agreement	This License Agreement (Agreement) is entered into by and between TrafficCast (TC) and Virginia Department of Transportation (Licensee") as of the Effective Date: March 2003. 1) Licensed Products/Services. The following products and services as delivered to VDOT by TC -- TC Travel-Time/Speed Database and TC Travel Time/Speed Channel for the geographic areas served by the Northern Virginia Smart Traffic Center only (based on historical Weather construction incident and speed where available) which provide the following traffic data: - Estimated/predicted travel times on all links which VDOT can disseminate on its VMS - Geo-coded construction data on all links - Geo-coded incident data on all links. The VDOT shall be authorized to use the licensed products to conduct traffic management and operations (Licensed Services) for geographic areas served by the Northern Virginia Smart Traffic Center only."	TrafficCast, Inc. and VDOT	Existing

Table A-1 – List of Agreements for NOVA ITS Architecture

Agreement Number	Title	Agreement Type	Agreement Description	Stakeholders Involved	Agreement Status Name
Op-02b	TeleAtlas and VDOT NOVA STC Sensor Sharing	Interagency Agreements	Agreement between TeleAtlas and VDOT NOVA District for Traffic Volume/Speed Data Sharing from VDOT Sensors	TeleAtlas and VDOT	Planned
Op-02c	Tricord Inc and VDOT Data Sharing Agreement	Interagency Agreements	Agreement (May 2002) by and between the Commonwealth of Virginia. Department of Transportation: and Trichord, Inc. VDOT agrees to allow access to the public right-of-way by TRICHORD for the placement, installation, maintenance, repair, and upgrade of the non-intrusive detection devices. TRICHORD agrees to provide VDOT a limited license to use TRICHORD information for internal traffic management purposes only. This shall include at a minimum, a web-accessible system map, and access to archived data.	TriCHORD Inc and VDOT	Existing
Op-02d	Mobility Technologies and VDOT Data Sharing Project	Operational Agreement	Agreement (May 2002) by and between the Commonwealth of Virginia. Department of Transportation: and Mobility Technologies. VDOT agrees to allow access to the public right-of-way by Mobility Technologies for the placement, installation, maintenance, repair and upgrade of the non-intrusive detection devices. Mobility Technologies agrees to provide VDOT a limited license to use TRICHORD information for internal traffic management purposes only. This shall include at a minimum, a web-accessible system map, and access to archived data.	Mobility Technologies and VDOT	Existing
Op-04	Incident Management Team Agreement	Interagency Agreements	Incident Management Agreement between NOVA Local Public Safety & Emergency Centers, and VDOT NOVA District	VDOT NOVA District, NOVA Public Safety and Emergency Management Centers, VSP	Planned
Op-05	TrafficLand and VDOT Statewide Video Clearinghouse	Interagency Agreements	Agreement between VDOT Central Office and TrafficLand for Statewide Video Distribution System. Contract allows up to three private vendors for this project	VDOT Central Office and Traffic Land and other Video Clearinghouse agencies	Existing
Op-06	Probe Data Collection from Dulles Toll Road	Intergovernmental Agreement	Agreement for Planned Toll Tag Data Collection on Dulles Toll Road between Smart Tag Center (owned by VDOT), and VDOT NOVA District. May include Greenway Center also	VDOT NOVA District, VDOT (Smart Tag Center) and Greenway Center	Planned
Op-07	Communications Agreement for	Interagency Agreement	Agreement between Verizon and VDOT NOVA STSS for communication service between STSS traffic signals and two signal	Verizon and VDOT NOVA District	Existing

Table A-1 – List of Agreements for NOVA ITS Architecture

Agreement Number	Title	Agreement Type	Agreement Description	Stakeholders Involved	Agreement Status Name
	VDOT NOVA STSS Signal System		operating centers (SOCs) located at VDOT NOVA STC in Arlington and VDOT NOVA Camp 30 in Fairfax		
Regional Cooperation and Integration Agreements					
Regional-01	CapWIN End-User Agreement	Interagency Agreements	Agreement between the University of Maryland, Center for Advanced Transportation Technology (CATT) on behalf and for the benefit of the Capital Wireless Integrated Network (CapWIN) and VDOT for the purpose of establishing the terms and conditions for participation in and use of the CapWIN System.	UMD (on behalf of CAPWIN) and users of CAPWIN	Planned
Regional-02	GMU- CAPCOM Agreement	Interagency Agreements	Washington Regional Transportation Communications and Coordination Program Agreement pertaining to CapCOM	George Mason University and VDOT	Existing (Unsigned)
Regional-03	UMD and VDOT RITIS Agreement	Interagency Agreements	Agreement for work pertaining to developing the project Regional Integrated Transportation Information System Prototype for the DC-VA-MD Region.	UMD and VDOT NOVA District	Existing (Unsigned)
Regional-04	PSTOC Joint Operations Agreements	Master Agreement	Agreements for agencies within PSTOC including City of Fairfax, VDOT NOVA STC and VSP	City of Fairfax, VSP and VDOT NOVA District	Planned

APPENDIX B – PLANNING PROCESS MEMORANDUM

Using the Architecture

Introduction

The work done to develop the NOVA ITS Architecture is valuable only if it contributes to improving the integration of transportation systems in Northern Virginia, particularly VDOT systems. VDOT transportation planning is a process that involves project definition, review, prioritization, approval, funding allocation, and incorporation into the transportation plan. The path a project follows in the planning process is dependent on the funding source being sought for the project. There are several basic funding sources that the planning process supports: ITS Earmark funds, Federal, State, Congestion Mitigation and Air Quality (CMAQ), Surface Transportation Program (STP) funds, and Special Grant funds. The planning process was examined in light of these various funding sources to determine how the NOVA ITS Architecture, and other pertinent documents like the strategic plan and the concept of operations could be used as a reference in the pursuit of integration opportunities.
The general process required to define a project in VDOT's NOVA District is discussed below. The points where the NOVA ITS Architecture, ITS Strategic Plan, Concept of Operations, and the Regional ITS Architecture will be beneficial are highlighted.
The goal of this effort is not to impose more work upon the NOVA Staff managing the ITS project development, but to ensure that the projects are defined with integration in mind. Each project should consider all potential integration possibilities. FHWA policy requires the definition of ITS projects that are consistent with a regional plan or architecture to better support integration. The architecture, strategic plan and the concept of operations provide a guide to integration opportunities among VDOT systems and between VDOT and regional stakeholders. Projects defined without considering integration opportunities will be found to be more costly in the long run due to the cost of redesign in the future. These tools will allow VDOT to better financially plan ITS investments and assist VDOT managers in understanding the priorities of ITS deployment in the NOVA District.

Process for Defining, Planning and Implementing Projects

Ideally, the NOVA ITS Architecture should be used at the very beginning of this process when projects are first being defined. This may be an evolutionary step to be taken in the future as the use of the architecture in the process becomes more mature.

A benefit of using the NOVA ITS Architecture in this process will be more comprehensively defined projects with attention being paid to integration opportunities. By referencing a larger plan for ITS in the NOVA District, projects may be able to take advantage of other information that exists or will be made available in the future. In addition, a more focused plan will be made available across the District and those VDOT organizations from outside of NOVA that are involved in the project planning process will be able to make more informed decisions based on the information available in the architecture.

The general process for defining, planning, and implementing projects involves several VDOT and non-VDOT organizations. In short, a project is defined at a high level and a cost estimate is associated with it. The various funding sources for different projects present variations on the general project initiation process. The rest of the document details the general process with relation to three main funding sources: Six Year Improvement Program (SYIP), ITS Earmark Funds, and Special Grant Funds. The processes and the illustrations for these funding sources highlight the areas where the NOVA ITS Architecture should be used and relates this process to the project development documentation. There are three stages in all the processes that the NOVA ITS Architecture should be used:

- Stage 1 – Before Funding is identified
- Stage 2 – When Funding is Available
- Stage 3 – After a Project has been completed

These three stages and "how and what" needs to be done from using the NOVA ITS Architecture is "briefly" described in each of the funding processes below. Additional detail on the specific architecture requirements for the three stages in provided in the "Project Development" documentation.

SYIP Process

Stage 1 - Before Funding is identified

The first variation is the SYIP process as illustrated in Figure 1. The proposed projects for the NOVA District are initially prioritized by the NOVA ITS PPA team and approved by the NOVA Operations and Administration team. As projects are initially defined, the project initiators and the NOVA ITS Planning, Programming, and Administration (ITS PPA), who is responsible for the NOVA ITS Architecture, can use the architecture (website) to define a project architecture to better illustrate the project definition. The ITS PPA collects projects throughout the year from the NOVA operational functional area managers and maintains a project pool. This project library is used by the ITS PPA to prioritize and generate a list of projects along with sequencing of when these projects will be funded and implemented. This project pool is a "living document" and will be updated as and when new projects are provided to the ITS PPA. The project library is also prioritized using the program plan as a guide to strategize and phase the project deployment using the deployment plan of the ITS strategic plan.

The NOVA Operational and Functional areas can use the architecture website to examine subsystems/stakeholders and their interfaces to define the project scope. This information is sent to the NOVA ITS PPA team before the projects are sent to the VDOT Central Office (and Transportation Board) for assessment. When CMAQ and RSTIP funds are used, the projects are sent to the Northern Virginia Transportation Authority (NVTA) for approval and then forwarded to the VDOT Central Office.

The VDOT Central Office sends the projects to the Smart Travel Oversight Board for approval, and then defines the projects for programming, scheduling and allocation of funds. The projects

are then sent to the Commonwealth Transportation Board for another approval before entering the approved projects into the 6 year plan.

Stage 2 – When Funding is available

The approved projects that make up the SYIP are sent back to the District offices. Each project manager who is responsible for a project in the 6-year plan develops a project scope and implements the project. The project managers will develop "project architectures" that provide greater detail on the specific components of the architecture. They would download the NOVA Turbo database from the web site and access the database and application software to develop project architectures based on the NOVA ITS Architecture. These project architectures along with information regarding their projects' relationship to NOVA ITS Strategic Plan and Concept of Operations are sent to the NOVA ITS PPA for review and approval. For local government projects receiving funding for ITS projects that will have interface or integration with VDOT, the local government project manager will use the NOVA ITS Architecture Turbo Database. When other agencies are involved with the local government projects, the local governments are encouraged to use the Regional ITS Architecture Turbo Database to define their project interfaces. The Project Manager will then implement the project using the ITS Architecture and the systems engineering process as defined in the "project development" document.

Stage 3 – After a project has been implemented

Following project implementation, the final project architecture reflecting the actual state of the project implementation is provided to the NOVA ITS PPA for incorporation into the NOVA ITS Architecture. The project manager will use the NOVA Architecture website to send the project architecture information for inclusion into the into the NOVA ITS Architecture definition to reflect its implementation and make sure its other projects are aware of the interfaces and information that is available from the implemented system. There is also a concurrent process to incorporate the project into the Metropolitan Washington Regional ITS architecture to ensure consistency. In the future, when a Virginia Statewide Architecture is developed, the project architectures will be incorporated into that database to ensure consistency.

The completion of this cycle makes the most accurate architecture data available to the NOVA District, reflecting what exists and what is planned for future project definition and planning.

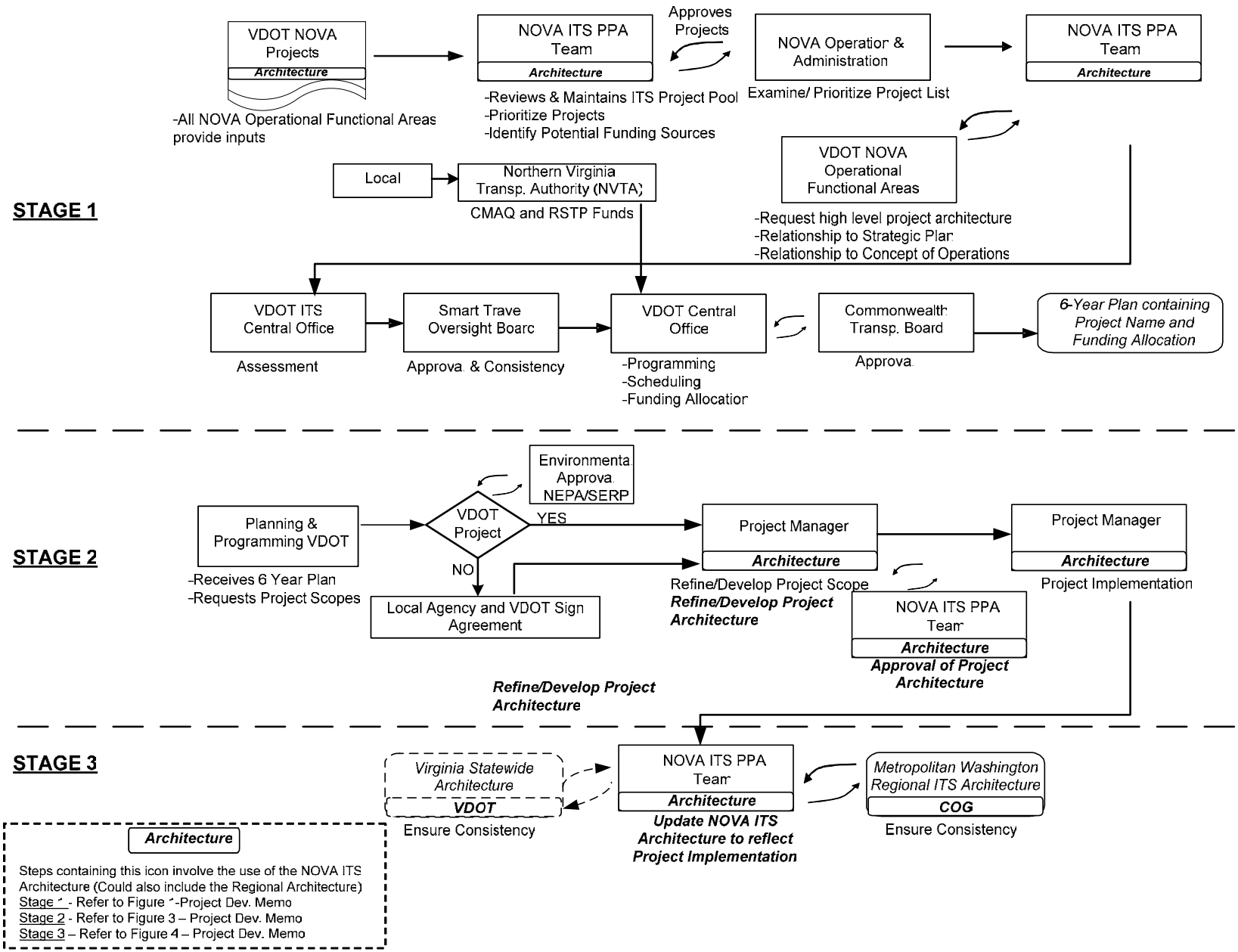

Figure 1: VDOT NOVA District ITS Project Initiation Process through the Six Year Improvement Plan

ITS Earmark
Stage 1 – Before Funding is Obtained

Figure 2 illustrates the Project Initiation Process for ITS Earmark Funds. In this process, once the Congress approves earmark funds, FHWA notifies VDOT Central Office. VDOT then requests the fund-receiving agency to provide high level scope, a financial plan and a draft schedule. The fund receiving agency can use the NOVA Architecture website to define this high level architecture. The central office then adds the earmark funds into the VDOT system and assigns it a project number and sends it to the VDOT Planning and Programming for TIP and STIP requirements.

Stage 2 – When Funding is Obtained

Once the TIP and STIP are amended the projects are then evaluated by the FHWA and VDOT ITS PPA team. These projects are further reviewed and follow one of two paths. If the ITS project is being implemented by a VDOT agency, then FHWA and VDOT sign a partnership agreement pending FHWA final approval. If the ITS project is being implemented by a local non-VDOT agency, but being administered by VDOT, the local agency signs an agreement with VDOT for implementing the project. Similar to the SYIP process, the project managers use the NOVA ITS Architecture to scope and define their projects. They have access to the Turbo Architecture database and application software to develop project architectures based on the NOVA ITS Architecture. They provide their project architectures to the NOVA ITS PPA Manager for review and approval for consistency with the NOVA ITS Architecture. For the VDOT projects, project managers are also expected to provide information of their projects in relationship to the NOVA ITS Strategic Plan and the Concept of Operations as they would with the SYIP process.

Stage 3 – After project is implemented

Following implementation, the final project architecture reflecting the actual state of the project implementation will be provided to the NOVA ITS PPA for incorporation into the NOVA ITS Architecture. There is also a concurrent process to incorporate the project into the Metropolitan Washington regional ITS architecture to ensure consistency. In the future, when a Virginia Statewide Architecture is developed, the project architectures will be incorporated into that database to ensure consistency.

The use of the NOVA ITS Architecture in the development of an earmark project should highlight the integration opportunities and make them evident to the US DOT that the earmark funds are being targeted to a worthwhile project.

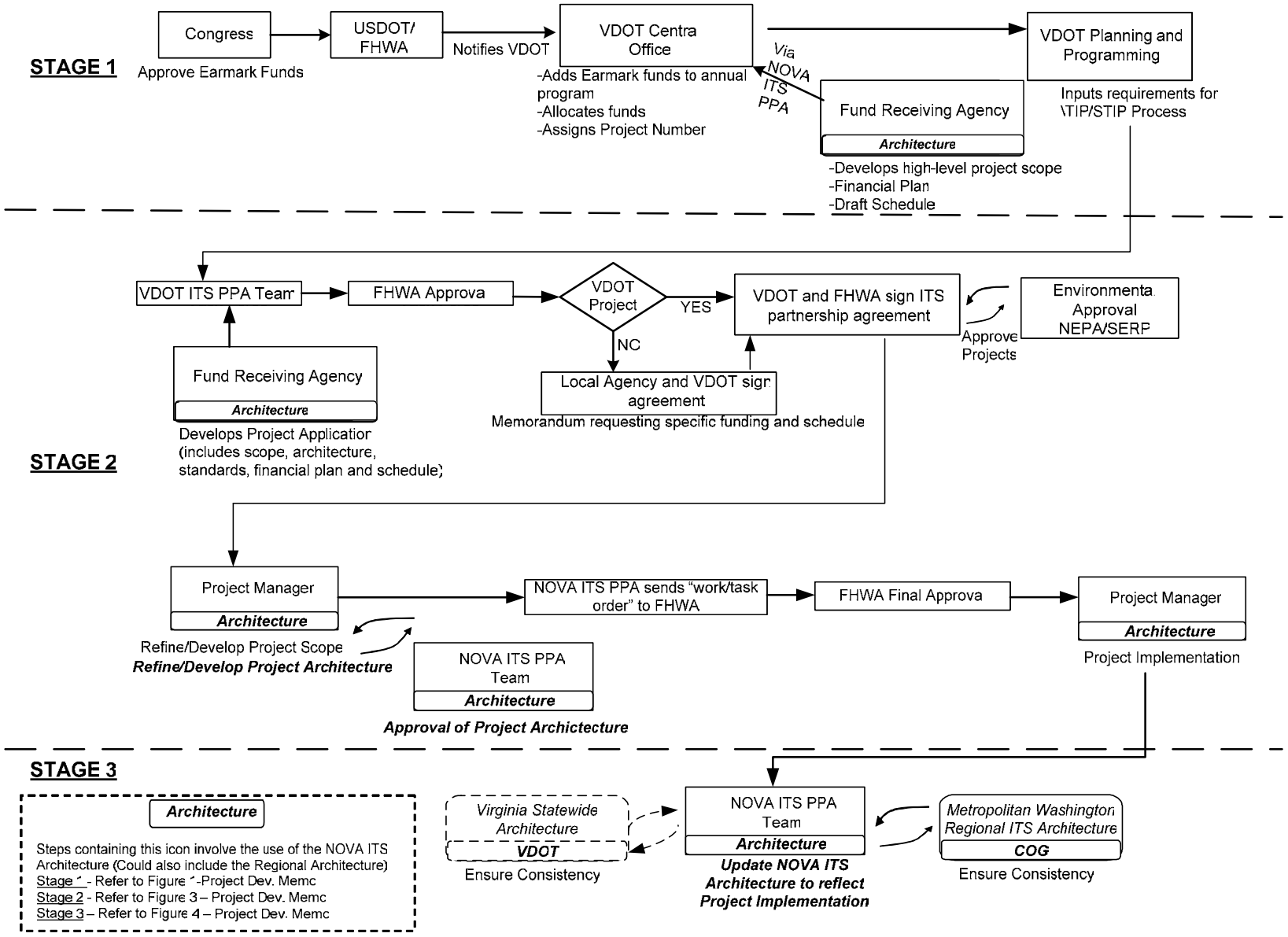

Figure 2: VDOT NOVA District ITS Project Initiation Process for ITS Earmark Fund

Special Grants

Stage 1 – Before Funding is obtained

Figure 3 illustrates the Project Initiation Process for Special Grant Funds. This process is not as involved as the previously discussed processes. Projects are proposed to the NOVA ITS PPA team from all the NOVA operational functional areas. The ITS PPA team endorses NOVA priority, and the NOVA Grant Development team gets the projects approved by the VDOT Central Office, Regional Stakeholders, and the NOVA Operations and Administration team. This team reviews and approves the projects that receive the grant funding. Every grant may have special requirements and involve more stakeholders in the grant development, this process should be used as a guide only and incorporate each grant's requirements.

Stage 2 – After Funding is obtained
The rest of the process is similar to the first two processes.

Stage 3 – After Project is implemented
The rest of the process is similar to the first two processes.

As can be seen in each of these process variations, the NOVA ITS Architecture is consistently applied at key steps of the project definition and implementation.

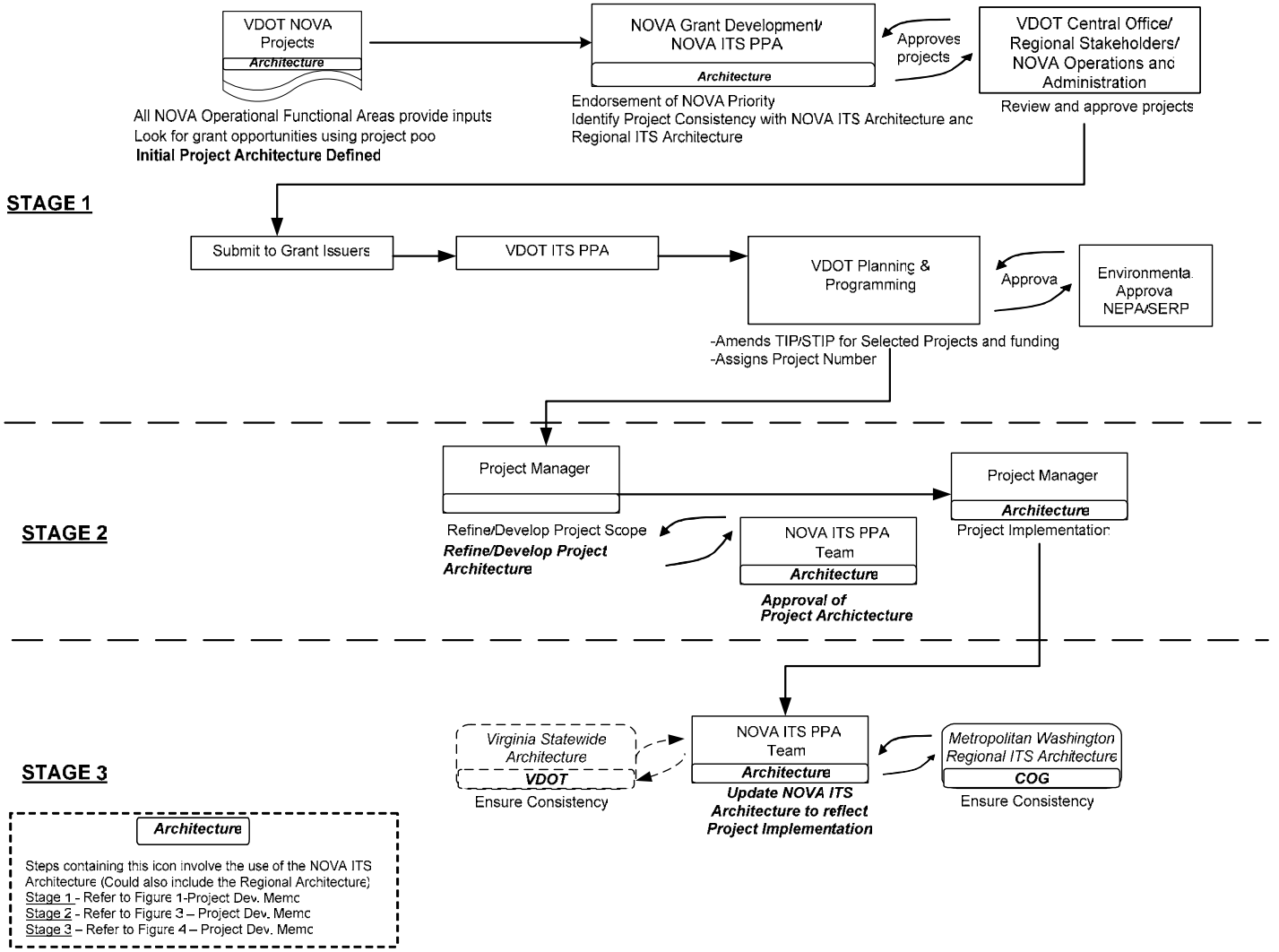

Figure 3: VDOT NOVA District ITS Project Initiation Process for Special Grant Fund

APPENDIX C: PROJECT DEVELOPMENT MEMORANDUM

PROJECT DEVELOPMENT

INTRODUCTION

The NOVA ITS Architecture Version 2.0 describes subsystems, interconnects, and information flows necessary to deploy an integrated transportation system in NOVA. The architecture is used by VDOT project managers to define ITS projects that implement portions of the architecture in a phased manner. Based on priorities established by VDOT concerning the immediate goals for ITS in the NOVA District, projects are defined that incrementally deploy the required elements over time. Prior to using the architecture, it is recommended that the project manager reviews the planning process memorandum[2] which describes in detail the necessary steps for project definition, review, prioritization, approval, funding allocation, and incorporation of VDOT projects into the transportation plan. The planning process documentation describes several paths a project follows dependent on the funding source being sought for the project. The planning process document also highlights where the NOVA ITS Architecture, ITS Strategic Plan, Concept of Operations, and the Regional ITS Architecture will be beneficial during the planning process based on three stages of a life cycle of a project. This document follows the same three stages and elaborates the specific components of the architecture process that comprise of a project architecture to comply with the Federal Rule on ITS Architecture and Standards.

The NOVA ITS Architecture can be used for many purposes from gathering information about a particular subsystem to planning and generating requirements for a project. The NOVA ITS architecture is available through the web page (www.vdot-itsarch.com) and also through the Turbo Database. In the overall life cycle of a project, the NOVA project manager can benefit from using the NOVA Architecture during three phases as follows:

Stage 1 – Before Funding

The architecture is useful when a project's scope has not been defined and funding has not been estimated. To define the scope, the lead agency that would like to implement the project can use the VDOT NOVA web site to identify a high-level project architecture that will include subsystems or stakeholders that best match their organization. Figure 1 illustrates the process in using the website to generate a high-level project architecture. Using the subsystems or the system inventory, the project manager can select the appropriate subsystems and view their relationship or interfaces to other subsystems. This will provide a better understanding of the proposed project's scope and interface requirements. This will also allow the project manager to develop a high-level concept of the overall system that can be used initially to gain consensus from stakeholders on the project scope, interfaces, and integration opportunities prior to implementation.

[2] Task C.1.2.2 Report- Planning Process Memorandum

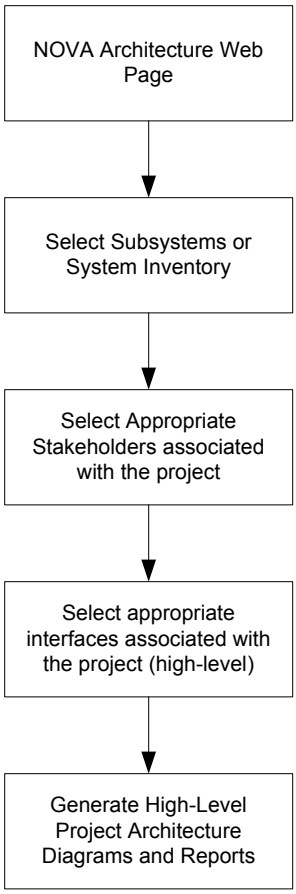

Figure 1: Process to develop High-level Project Architecture (Before Funding)

Stage 2 - Development of a Detailed Project Architecture - Project Implementation with Secured Funds

The ideal use of the NOVA ITS Architecture is to define Project Architectures when funding for a project has been identified. Based on the stakeholders that are involved in the project, the project manager can use the NOVA Architecture and/or the Metropolitan Washington Regional ITS Architecture as a starting point. For developing the detailed project architecture, it is recommended that the project managers use the NOVA Architecture Turbo Database and follow a systems engineering process as required by FHWA Rule 940.

The systems engineering (SE) process is an inter-disciplinary approach to procurement and implementation of a successful project. The process enables the implementer to identify and document all of the project requirements, to effectively manage the results of steps during implementation of the project and to verify that the requirements are thoroughly and correctly implemented. The use of this process assures that all phases of a system's lifecycle are addressed, from conception through design, installation and testing, and operations and maintenance. Figure 2, more commonly termed as the "V" diagram illustrates the various steps of a generic systems engineering process. This process is well-established and will allow NOVA project implementers a consistent approach to facilitate integration and ensure that they adhere to the

federal rule and requirements on ITS architecture. Defining a project using the SE process and the NOVA ITS Architecture maximizes the integration opportunities available by examining the interfaces that the project should accommodate.

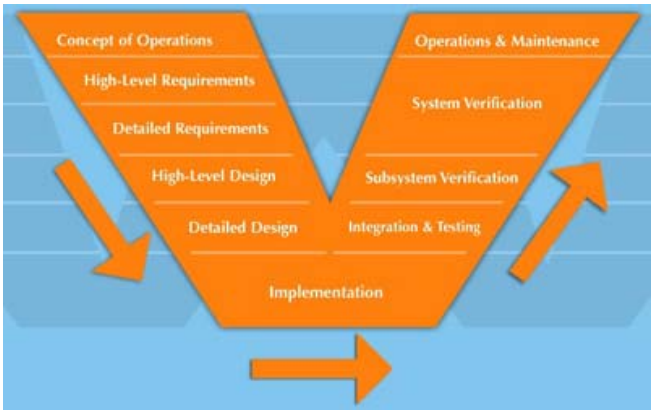

Figure 2: Typical Systems Engineering Process "V" Diagram

Figure 3 illustrates the process to develop the detailed project architecture using the NOVA Turbo Database and the systems engineering process. To start the process, the project manager should download the NOVA Turbo Architecture database from the website. This database allows the project manager to enter details of the project architecture. Using the project scope (previously defined in a high-level project architecture prior to funding), the project manager can initiate the project architecture by entering appropriate information into the Turbo database. Each of the Turbo Architecture steps illustrated in the figure can be entered directly into the database to generate a project architecture. The steps illustrated in the process combine the Turbo Architecture products and the seven steps of the systems engineering process to implement a project. The steps that requires the use of both the architecture and the systems engineering process is highlighted in the figure. This combined process allows the project manager to efficiently track and use a systematic approach to fulfill the Rule requirements and implement a successful project.

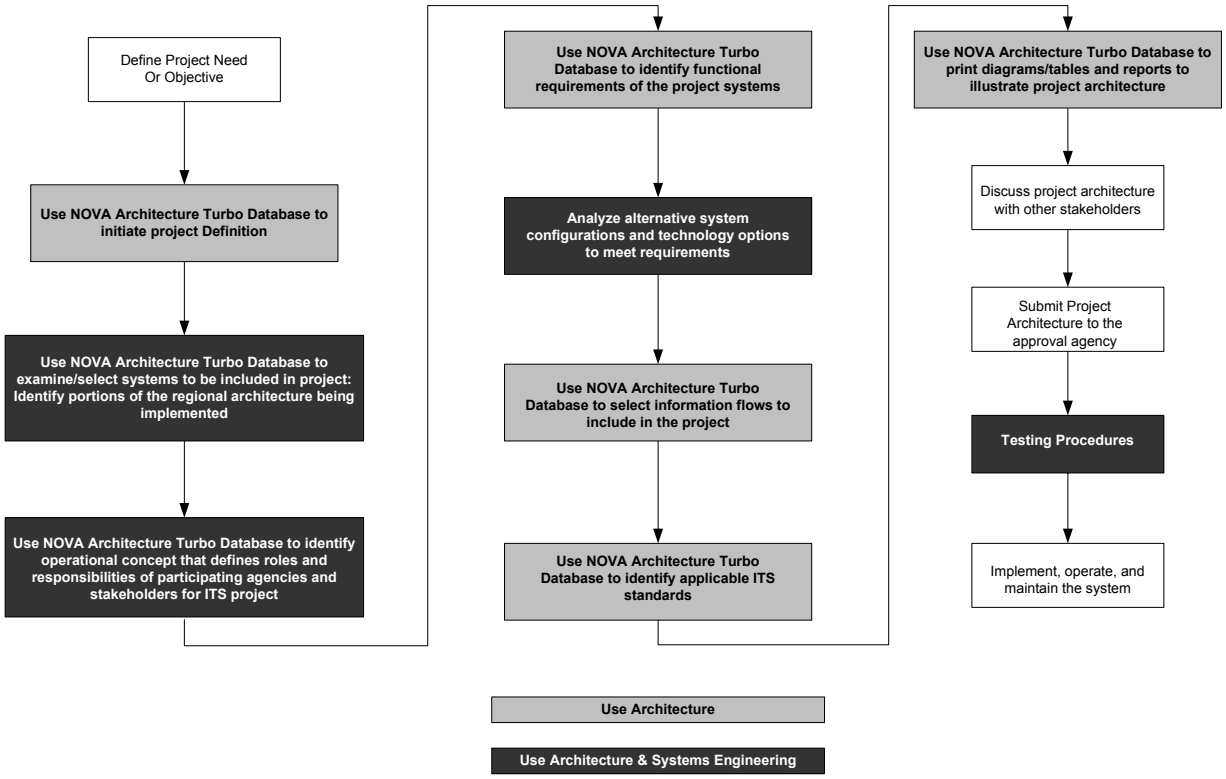

Figure 3: Process to develop Detailed Project Architecture (After Funding Approval)

Once the project definition has been initiated in the Turbo Database, the project manager must select the appropriate systems and subsystems that need to be included in the project. It is also at this stage that the project manager will identify the portions of the regional architecture that is being implemented. After selecting appropriate systems and subsystems, the project manager needs to identify an operational concept that would define the roles and responsibilities of the stakeholders included in the project. It is recommended that the project manager also review the NOVA Concept of Operations document for additional reference. The next step in the process is the identification of functional requirements for selected project elements from the system inventory. Following this step, an analysis of alternative system configurations and technology options should be considered for identified requirements.

Following the requirements phase, detailed information flows and interfaces with other subsystems for inclusion in the project to maximize system integration within the region need to be developed. The project manager needs to also review the list of current ITS standards that are applicable for the systems being deployed and consider any that can be used for project implementation. After completing all the entries and selecting the appropriate systems, the Turbo Architecture database provides the project manager with the capability to generate several reports, produce diagrams and tables to convey the architecture to others for review and approval. The detailed project architecture is then discussed with participating stakeholders and submitted to the approval agency.

Following the approval, the project manager develops testing procedures and other design requirements to implement, operate and maintain the project.

By creating a project Architecture in this manner, the Project Manager is using the NOVA ITS Architecture and the systems engineering process to make informed decisions about the integration boundaries of the project in the initial implementation and what will need to be supported in the future.

Stage 3 -Submit Project Architecture after Project Implementation

It is important that the NOVA ITS Architecture definition remain accurate. As each project is implemented or deployed, the "as deployed" project architecture should be submitted to the NOVA ITS PPA. The NOVA ITS PPA team is responsible for the update and maintenance of this architecture along with ensuring that there is consistency between the NOVA architecture and the Metropolitan Washington Regional ITS Architecture. To assist the NOVA ITS PPA team and to ensure that the architecture reflects the updated and current NOVA projects, the project manager can send architecture details by selecting the Submit Project Architecture in the NOVA architecture website. Figure 4 illustrates the process to enable project managers to send their architectures. This process requires that the project manager fill in specific information on the project including scope, stakeholders, inventory systems, standards, and other federal requirements that are necessary while implementing ITS projects. The submitted project architecture will be incorporated into the NOVA ITS Architecture periodically during the maintenance phase. This process allows for the evolution of the NOVA architecture and maintains its usefulness to other stakeholders.

Once the project architecture has been submitted, the NOVA ITS PPA will share this information with the Council of Governments (COG) staff for inclusion of the project in the Metropolitan Washington Regional ITS Architecture and also the future Statewide Architecture (planned). This will ensure consistency with the NOVA and the regional architectures.

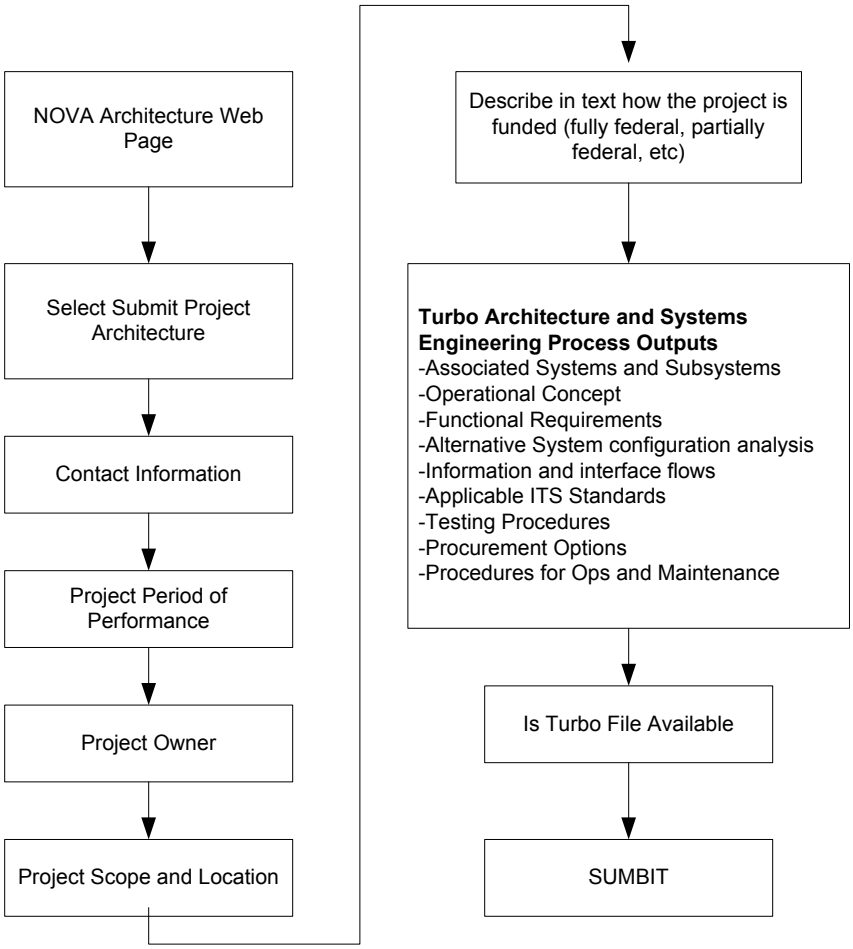

Figure 3: Process for Submission of Project Architecture

Maintaining the NOVA ITS Architecture

As mentioned in the previous section, it is very important that the NOVA ITS Architecture be kept as up-to-date so that the project managers using the architecture to define projects in the NOVA District have the most accurate information available. To maintain the accuracy of the NOVA ITS Architecture definition, each project manager must provide the NOVA ITS PPA with project architectures that reflect the projects implemented state when the project is completed. These project architectures should be defined using Turbo Architecture and the resulting database will be imported into the master NOVA ITS Architecture that is under the control of the NOVA ITS PPA. The NOVA ITS PPA is responsible for making the NOVA ITS Architecture database available to all Project Managers and sending out notification about any updates.

The NOVA ITS Architecture website at www.vdot-itsarch.com will also be updated with the latest NOVA ITS Architecture definition, Strategic Plan, Concept of Operations and other relevant documents as well as alternative methods for quickly examining the Architecture database information. This site is interactive and allows the user to examine architecture subsystems, information flows, and related elements.

The NOVA architecture will also be maintained and updated as and when additional NOVA Go-Forward strategic assessment tasks are performed to ensure that the results of the activities are accurately reflected and are consistent with the ITS Architecture.