All Public Roads (ARNOLD) Pooled Fund Study

Project Overview

- **Objectives:**
  To assist States in developing one of their significant capital assets – a statewide geospatial representation of their public road system. To build a nationwide ARNOLD this pooled fund study is open to a variety of approaches; however certain planning steps are required.

- **The Many Faces of ARNOLD**:



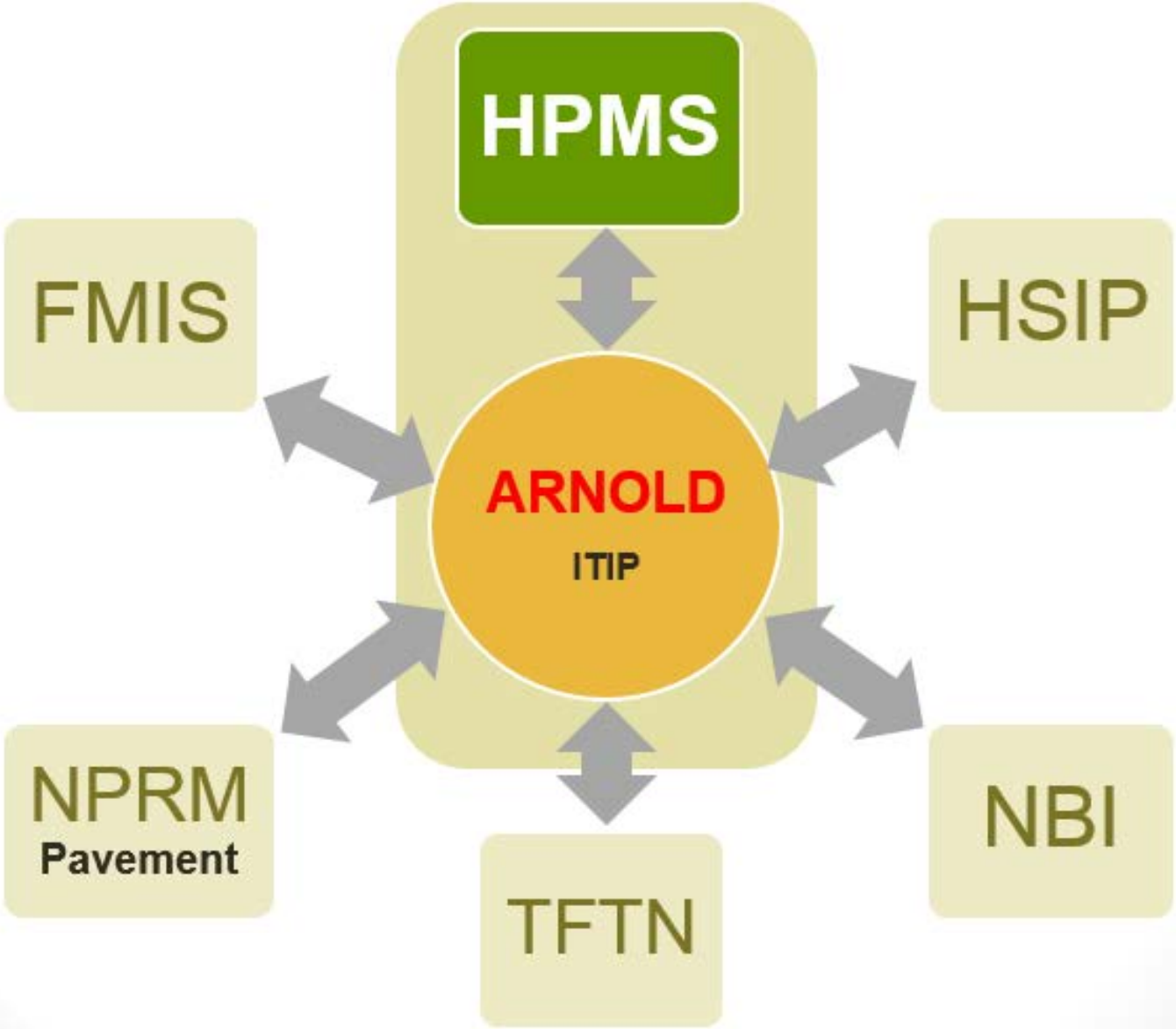

The PFS Team

U.S. Department of Transportation Federal Highway Administration	Joe Hausman – PFS Project Manager Tom Roff Justin Clarke Stuart Thompson Robert Pollack Mark Sarmiento
CDM Smith	John Wisdom - Deputy Project Manager Don Vary – Program Manager
dtsgis	Greg Yarbrough - Project Manager Allen Ibaugh

Key Points

- **This project is NOT just about HPMS**
- **PFS designed to accommodate individual State DOT needs**
  - **This Is NOT a traditional PFS (Not One Size Fits All)**
  - **States define and control their own project**
- **Prepares State DOTs to meet future requirements**
- **Helps a broad range of initiatives**

Support for Other Initiatives



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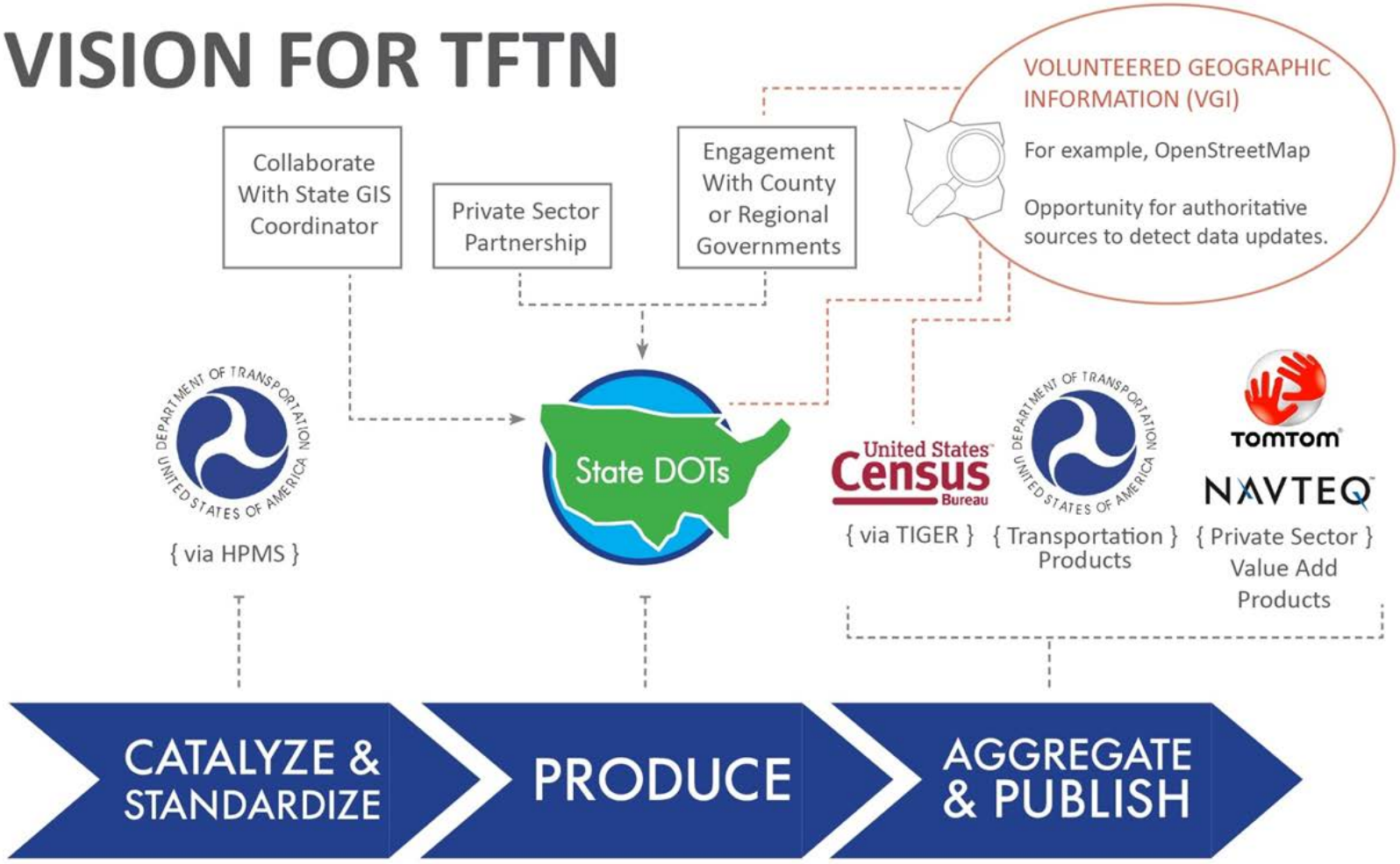


Federal Requirements

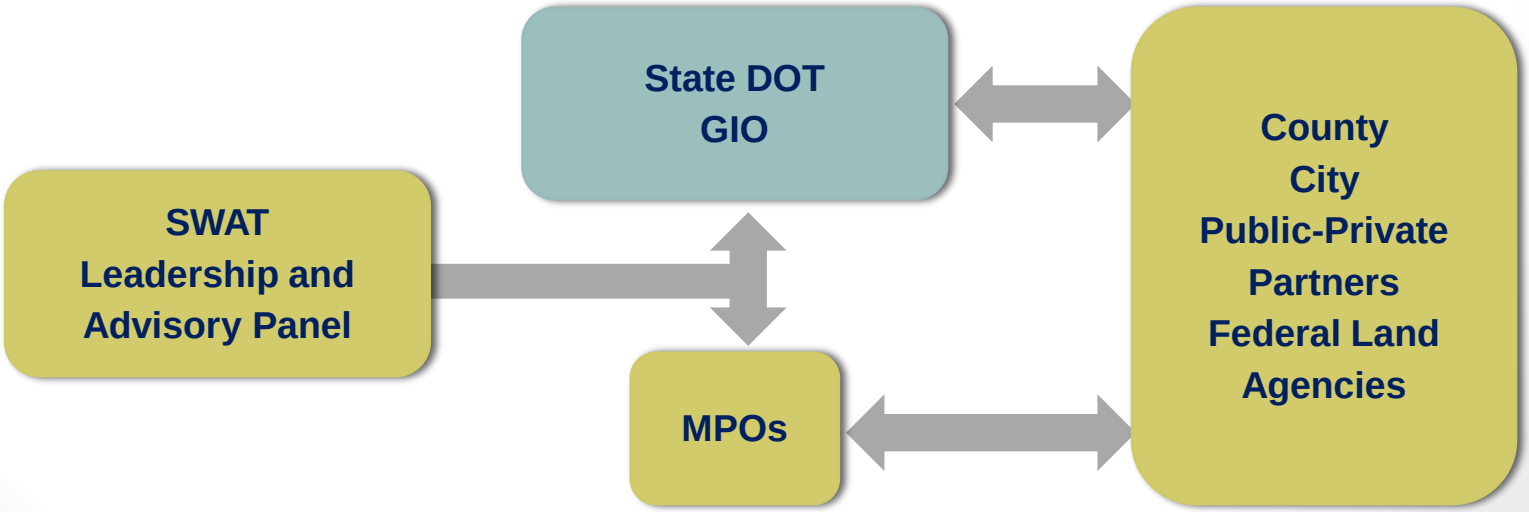
- Submission of an All Roads Network is a federal requirement
  - Must contain linear referencing information
- ARNOLD Strategic Plan Requirements
  - Plan should ensure long-term sustainability (communication, data integrity, maintenance)
  - Document data/communication pipelines.
- FMIS 5.0 – Project Mapping Requirements

Project Assistance Goals

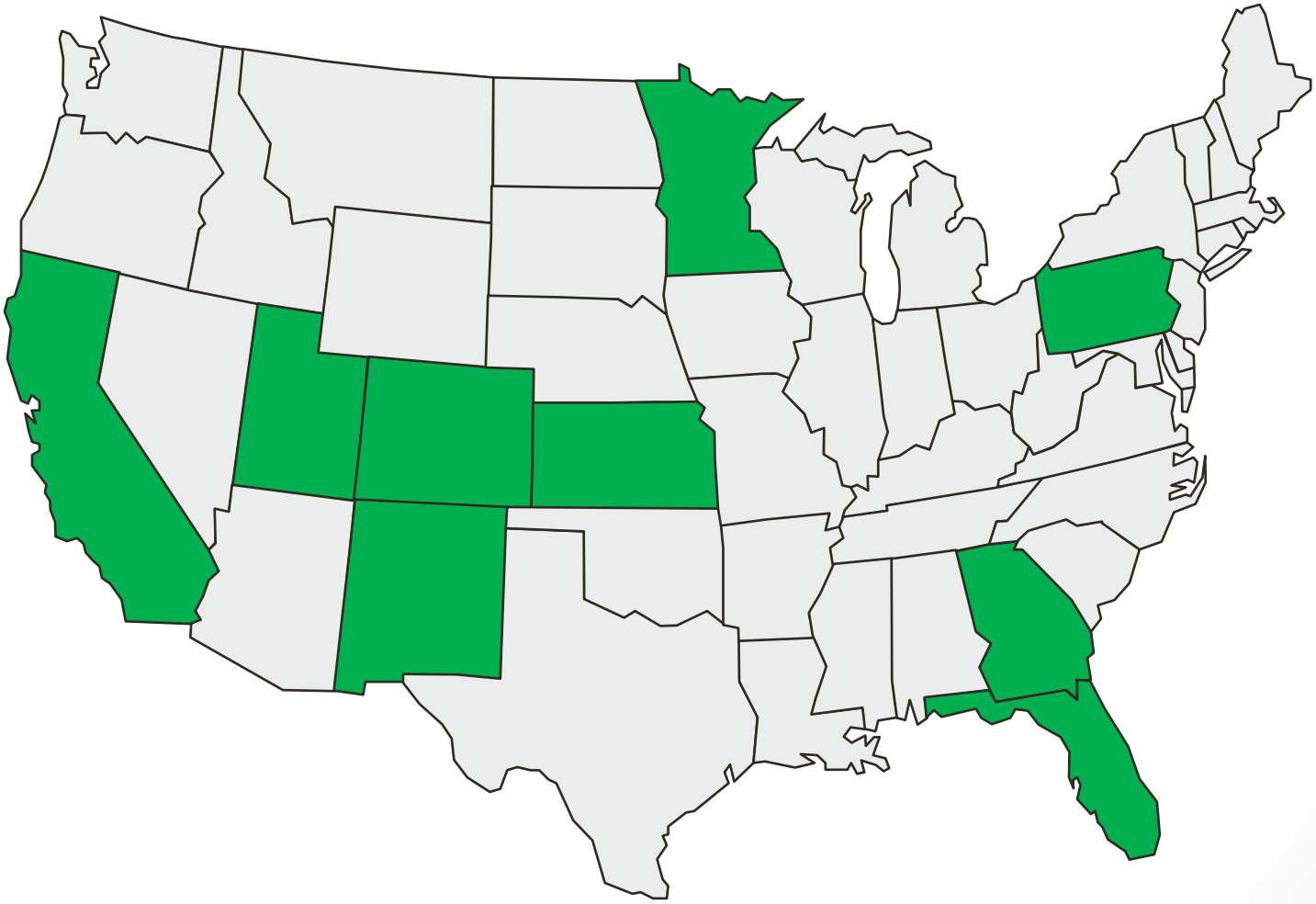
- **Provide Flexible Planning and Technical Assistance**
  - Strategic Plan Development
  - Data Gap Analysis
  - Data Collection/Assimilation
    - HPMS/ARNOLD/APR-LRS Geometry
    - MIRE (Safety – HSIP)
    - Pavement (NPRM)
  - LRS Development
  - Improve Certified Public Road Mileage

Project Assistance Goals

- **Provide Flexible Planning and Technical Assistance (continued)**
  - ARNOLD Guidance for Local Participants
  - Inter-Agency Coordination
  - MOU Development and Local/State Expert Panel Facilitation



Participating States

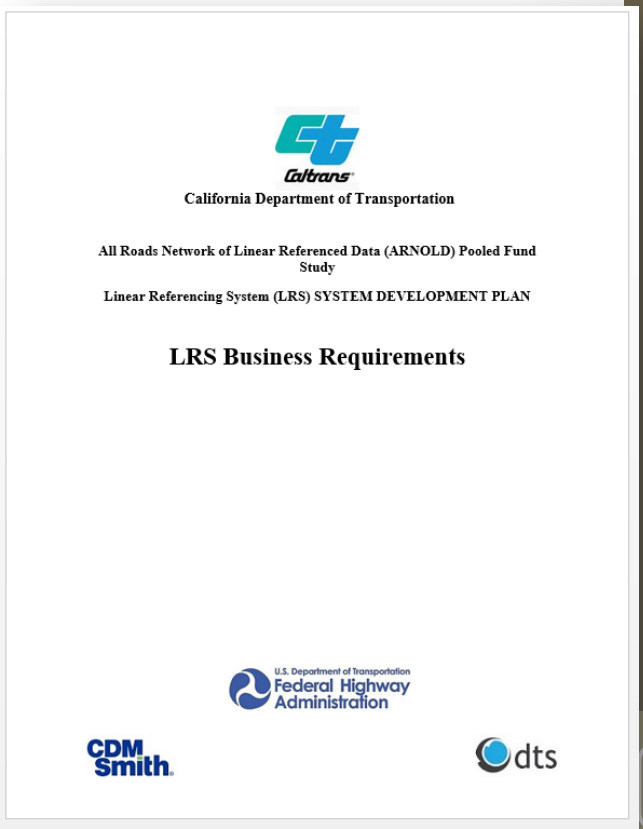


Project Starts

State	Solicitation Complete	Anticipated Project Start
1 – California	✓	February 2015
2 – Kansas	✓	March 2015
3 – Minnesota	✓	April 2015
4 – New Mexico	✓	May 2015
5 – Pennsylvania	✓	Fall 2015
6 – Florida	✓	Fall 2015
7 – Utah	✓	Fall 2015
8 – Georgia	✓	Fall 2015
9 – Colorado	✓	Fall 2015

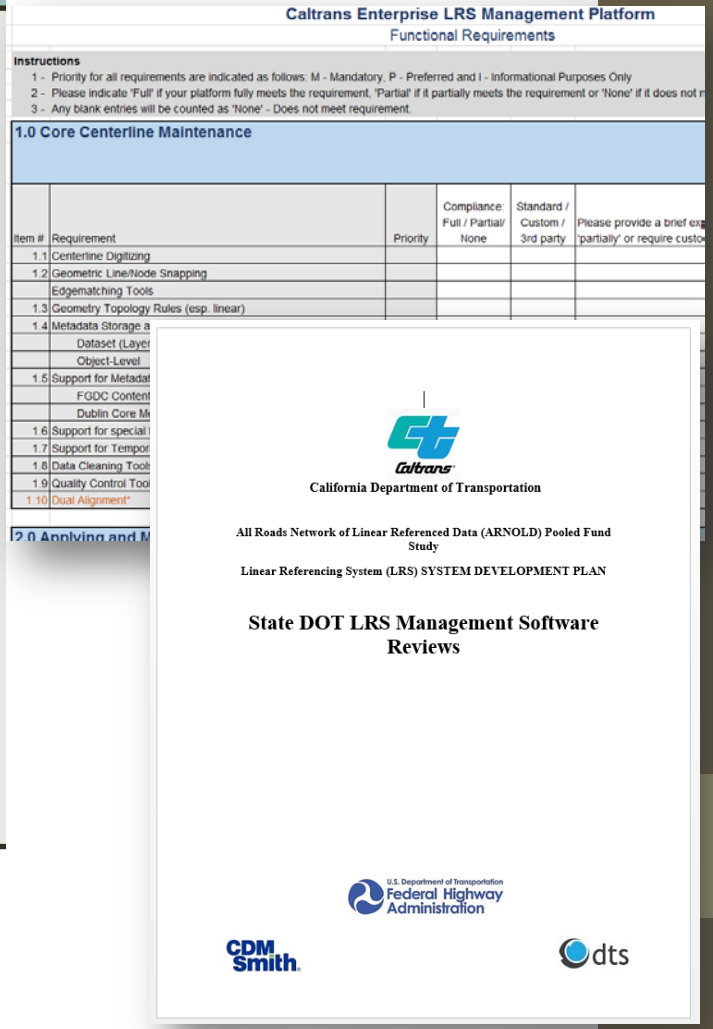
California
LRS System Development Plan

Task 1 - Assess Caltrans' LRS Business Needs and California's LRS Requirements Objectives	Status
▪ Interviews with Caltrans divisions, Caltrans district and local agency stakeholders	Complete
▪ Development of Caltrans Business Requirements Documentation (BRD)	Complete
▪ Assessment of Local Stakeholder interest in working with Caltrans to develop and maintain an all-roads network	Complete



California
LRS System Development Plan

Task 2 - Analysis of Alternatives for Caltrans' LRS Related Business Needs	Status
▪ Request for Information from LRS management software vendors	Complete
▪ Development of LRS Functional Requirements Matrix	Complete
▪ Conduct a State DOT Review with Vendor-Referenced States to Document Pros and Cons of each LRS Solution	Complete
▪ Comparative analysis of industry standard LRS Solutions. This will involve vendor responses to LRS Functional Matrix and Vendor Demonstrations	Complete
▪ Document summarizing results of LRS solution comparison.	Sep. 30th
▪ Caltrans to review all information and determine most suitable LRS Management Solution.	October

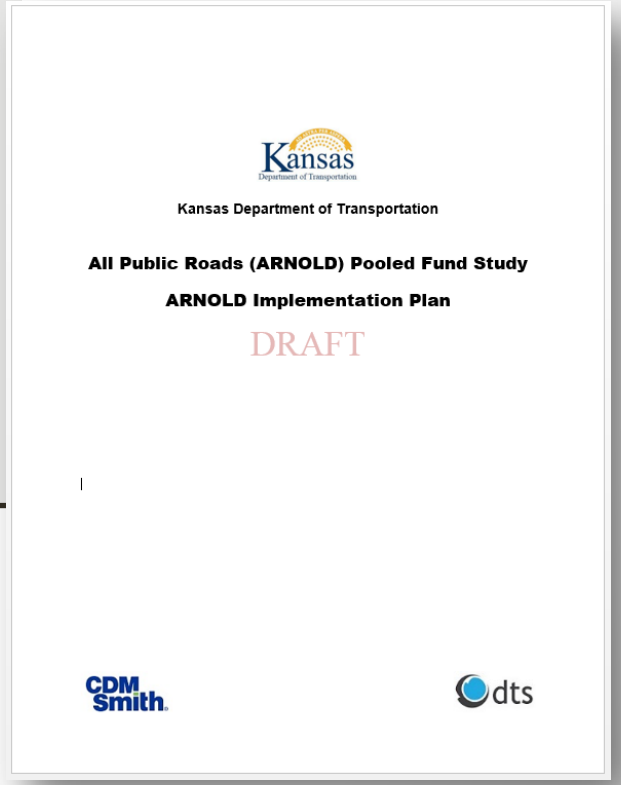


California
LRS System Development Plan

Task 3	Task Objectives	Status
System Development Plan for Caltrans	▪ Conduct On-Site meetings with Caltrans to develop the LRS Plan. ▪ Plan to provide Caltrans with topical guidance for implementing the chosen LRS Solution. Examples include: • System Design Guidelines • Programming Guidelines • Data Migration/Management Plan • Resource Requirements • Testing Plan • Training Plan	Late Oct. 2015 March 2016

Kansas
ARNOLD Implementation Plan

Task 1- Implementation Plan Technical Requirements	Status
▪ Define Business Data Requirements	Complete
▪ Develop ARNOLD Data Model Requirements	Complete
▪ Develop Linear Reference System Methods and Strategy	Complete
▪ Develop Implementation Plan	
▪ Deliver Geospatial Technical Requirements Documentation	Draft Complete
	On-Going



Kansas
ARNOLD Implementation Plan

Task 2 – Define Information Pipelines and Local Agency Coordination	Status
▪ Conduct State Best Practices Review	Fall 2015
▪ Identify Kansas Stakeholders	Complete
▪ Interview Local Agencies	Complete
▪ Conduct Local Stakeholder Gap Analysis	Draft Complete
▪ Conduct KDOT Gap Analysis	
▪ Develop Data Supply Chain Model	Complete
▪ Deliver Findings and Recommendations Report	Complete On-Going

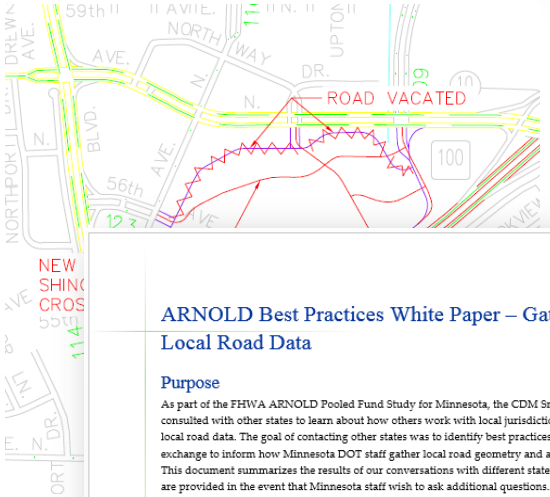
Kansas
ARNOLD Implementation Plan

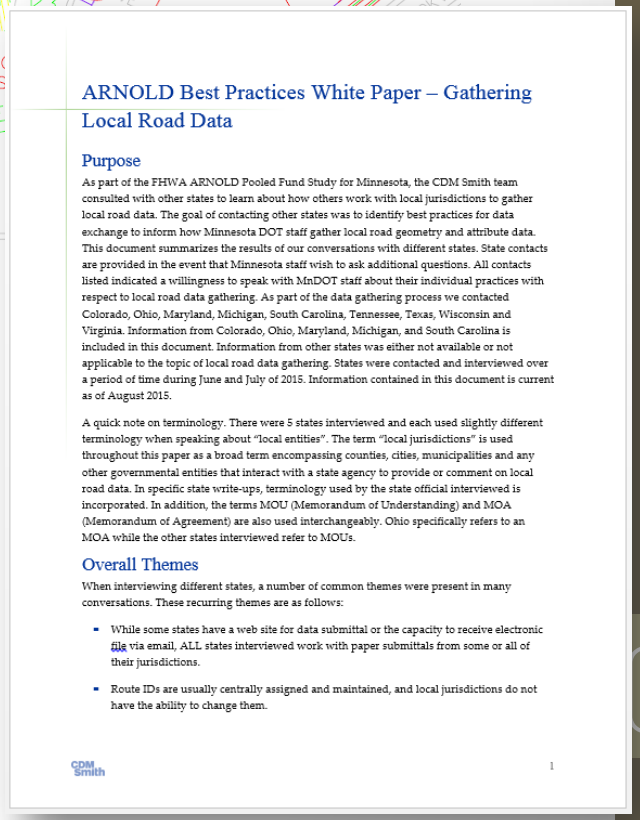
Task 3 & 4	Task Objectives
Project Pilot	▪ Define the Pilot Project ▪ Develop Pilot Project Plan ▪ Define Pilot Requirements and Measures ▪ Execute Pilot Project ▪ Develop Pilot Project Findings Report
Deliver Final Implementation Plan	▪ Develop draft Final Implementation Plan with Data Model Diagrams ▪ Develop and deliver Final Report with Executive Summary

Minnesota
ARNOLD Geospatial Portal Plan

Minnesota Geospatial Information Office
Minnesota Department of Transportation
MetroGIS

Task 1 – Shared Centerline Geospatial Portal Requirements	Status
• Define Portal Goals	Complete
• Develop System workflows (for Locals and MnDOT)	On-going
• Define Data Resources and Requirements	Complete
• Develop Portal Data Model	Complete
• Document Training Requirements	On-going
• Develop QA/QC protocols and acceptance criteria (for Locals and MnDOT)	On-going





ARNOLD Best Practices White Paper – Gathering Local Road Data

Purpose

As part of the FHWA ARNOLD Pooled Fund Study for Minnesota, the CDM Smith team consulted with other states to learn about how others work with local jurisdictions to gather local road data. The goal of contacting other states was to identify best practices for data exchange to inform how Minnesota DOT staff gather local road geometry and attribute data. This document summarizes the results of our conversations with different states. State contacts are provided in the event that Minnesota staff wish to ask additional questions. All contacts listed indicated a willingness to speak with MnDOT staff about their individual practices with respect to local road data gathering. As part of the data gathering process we contacted Colorado, Ohio, Maryland, Michigan, South Carolina, Tennessee, Texas, Wisconsin and Virginia. Information from Colorado, Ohio, Maryland, Michigan, and South Carolina is included in this document. Information from other states was either not available or not applicable to the topic of local road data gathering. States were contacted and interviewed over a period of time during June and July of 2015. Information contained in this document is current as of August 2015.

A quick note on terminology. There were 5 states interviewed and each used slightly different terminology when speaking about "local entities". The term "local jurisdictions" is used throughout this paper as a broad term encompassing counties, cities, municipalities and any other governmental entities that interact with a state agency to provide or comment on local road data. In specific state write-ups, terminology used by the state official interviewed is incorporated. In addition, the terms MOU (Memorandum of Understanding) and MOA (Memorandum of Agreement) are also used interchangeably. Ohio specifically refers to an MOA while the other states interviewed refer to MOUs.

Overall Themes

When interviewing different states, a number of common themes were present in many conversations. These recurring themes are as follows:

- While some states have a web site for data submittal or the capacity to receive electronic file via email, ALL states interviewed work with paper submittals from some or all of their jurisdictions.
- Route IDs are usually centrally assigned and maintained, and local jurisdictions do not have the ability to change them.

CDM Smith

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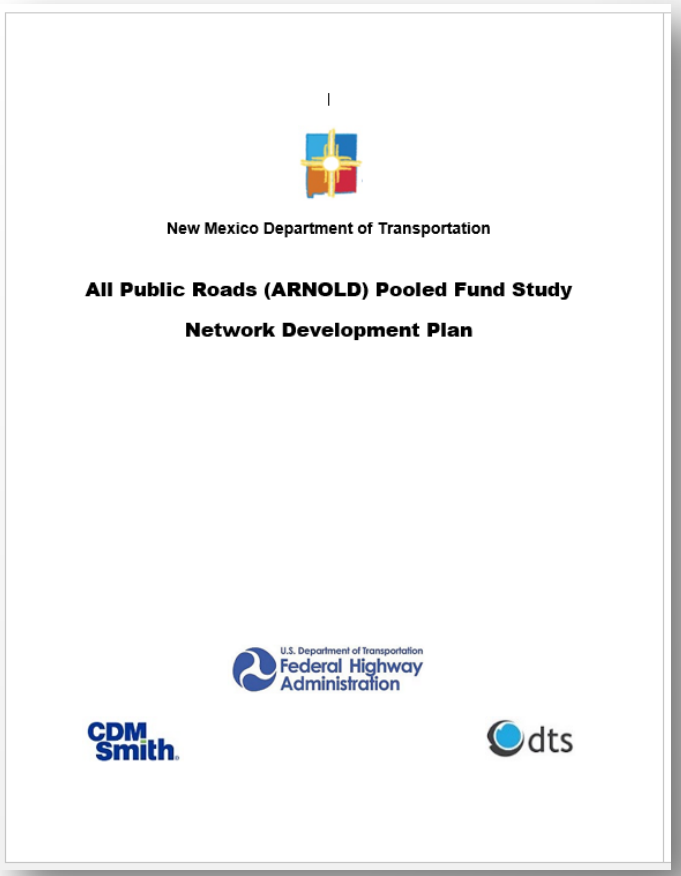
Minnesota
ARNOLD Geospatial Portal Plan

Task 2 & 3	Task Objectives
Shared Centerline Geospatial Portal System Architecture and Development Plan	▪ Develop System Architecture ▪ Develop Implementation Strategy ▪ Deliver Technical Requirements and Development Plan
Long Term Strategy for Improving the ARNOLD Network	▪ Assess Shared Centerline Pilot Data from local stakeholders. ▪ Develop whitepaper review of new and emerging data collection technologies and methodologies. ▪ Develop summary of recommendations

New Mexico
ARNOLD Development and Strategic Plan

Task 1 - All Roads Network Development Planning and Review	Status
▪ Conduct a review and gap analysis of NMDOT business data required to support HPMS and ARNOLD reporting requirements.	Complete
▪ Define ARNOLD Data Model and local road measure specifications.	Complete
▪ Develop LRS Route ID in conjunction with NMDOT Staff	
▪ Create a Development Plan which identifies appropriate spatial and attribute resources as well as procedures for creating the initial all roads network that will meet federal reporting requirements.	Complete Complete

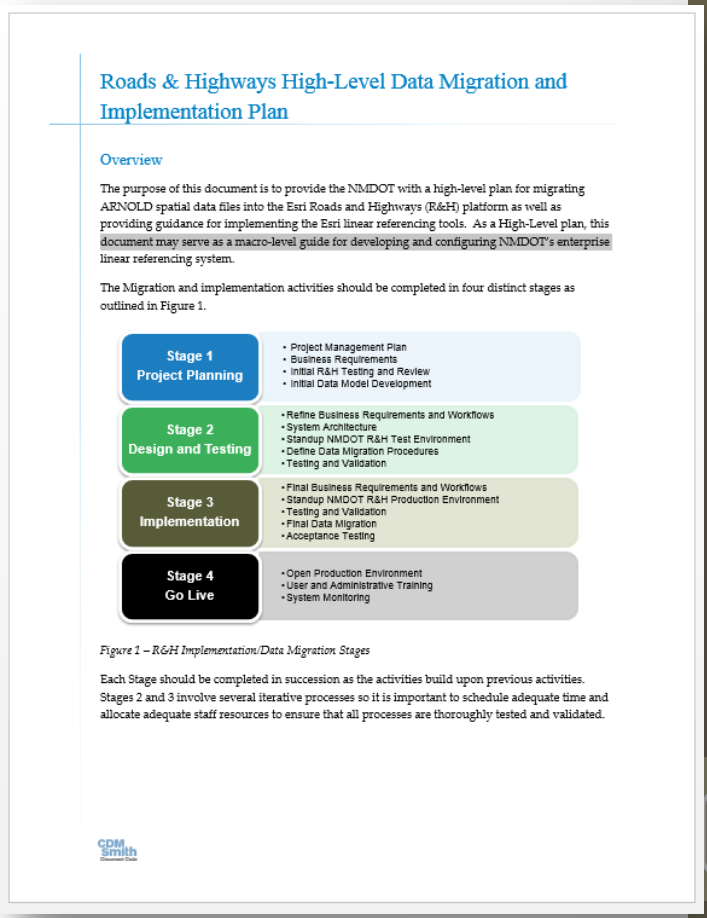


New Mexico
ARNOLD Development and Strategic Plan

Task 2 - All Roads Network Development	Status
▪ Assist in the development of the State system dual carriageways, ramps and LRS.	Complete
▪ Develop the all roads network centerline files and LRS.	On-Going
▪ Perform network system and data connectivity testing and validation.	On-Going
▪ Engage in Pilot submission to FHWA	December 2015

New Mexico
ARNOLD Development and Strategic Plan

Task 3 - Develop ARNOLD Maintenance Strategic Plan	Status
▪ Develop a high-level plan for migrating the all roads network to Esri Roads and Highways	Complete
▪ Deliver the NMDOT ARNOLD Strategic Maintenance Plan	March 2016



Roads & Highways High-Level Data Migration and Implementation Plan

Overview

The purpose of this document is to provide the NMDOT with a high-level plan for migrating ARNOLD spatial data files into the Esri Roads and Highways (R&H) platform as well as providing guidance for implementing the Esri linear referencing tools. As a High-Level plan, this document may serve as a macro-level guide for developing and configuring NMDOT's enterprise linear referencing system.

The Migration and implementation activities should be completed in four distinct stages as outlined in Figure 1.

Stage 1 Project Planning	• Project Management Plan • Business Requirements • Initial R&H Testing and Review • Initial Data Model Development
Stage 2 Design and Testing	• Refine Business Requirements and Workflows • System Architecture • Standup NMDOT R&H Test Environment • Define Data Migration Procedures • Testing and Validation
Stage 3 Implementation	• Final Business Requirements and Workflows • Standup NMDOT R&H Production Environment • Testing and Validation • Final Data Migration • Acceptance Testing
Stage 4 Go Live	• Open Production Environment • User and Administrative Training • System Monitoring

Figure 1 – R&H Implementation/Data Migration Stages

Each Stage should be completed in succession as the activities build upon previous activities. Stages 2 and 3 involve several iterative processes so it is important to schedule adequate time and allocate adequate staff resources to ensure that all processes are thoroughly tested and validated.

CDM Smith

Pennsylvania
Data Integration – ARNOLD Development

Task 1	Task Objectives
Develop Plan for building the ARNOLD Network	▪ Develop and document practices for developing Liquid Fuels and Non-Liquid Fuels networks o Sources of network data (geometry) o Sources of milepoint data o Procedures for building LRS/measures, route IDs o QA/QC procedures ▪ Develop procedures for integrating Liquid Fuels and Non-Liquid Fuels networks ▪ Develop methodology document for building the all-roads network

Pennsylvania
Data Integration – ARNOLD Development

Task 2	Task Objectives
Build/Develop the ARNOLD Network	▪ Perform QC on Liquid Fuels network LRS ▪ Develop LRS on Non-Liquid Fuels network ▪ Perform QC on Non-Liquid Fuels network geometry, LRS and attribute data o Identify remaining public roads not included in current network o Identify data sources for missing public roads ▪ Integrate Liquid Fuels and Non-Liquid Fuels networks to create ARNOLD network ▪ Perform QC on combined network (topology, LRS) ▪ Deliver first version of all-roads network

Pennsylvania
Data Integration – ARNOLD Development

Task 3	Task Objectives

Develop ARNOLD Maintenance Plan	▪ Identify network maintenance workflows
	  ▪ Network geometry
	  ▪ Network measures, IDs, other
	▪ Develop maintenance plan for maintaining ARNOLD network

Florida
ARNOLD Network Development Assistance

Task 1	Task Objectives
Develop Plan for Building ARNOLD	▪ Define existing business data requirements ▪ Define existing data resources ▪ Identify potential external, non-proprietary data sources for public roads ▪ Research and develop methodologies for building all-road network o Document existing FDOT LRS development practices o Sources of milepoint data o Workflows and Tools o QA/QC procedures ▪ Develop data requirements and methodology document

Florida
ARNOLD Network Development Assistance

Task 2	Task Objectives
Build/Develop the Network	▪ Build all-roads network (geometry, attributes, LRS) ▪ Develop tools (LRS, database, etc.) for building and maintaining network and associated data ▪ Conduct Quality Control testing on network o Support for FHWA requirements o Support of FDOT business requirements o Support of other requirements ▪ Deliver network development tools ▪ Deliver first version of all-roads network

Florida
ARNOLD Network Development Assistance

Tasks 3 & 4	Task Objectives
Develop ARNOLD Maintenance Plan	▪ Identify network maintenance workflows o Network geometry o Network measures o Network attribute data o Roadway IDs ▪ Develop ARNOLD maintenance plan
Update Network	▪ Test the Plan and update

Utah
ARNOLD and LRS Spatial Data Guidelines

Task 1	Task Objectives
UDOT Internal Stakeholders Needs Assessment	• On-site interviews with selected UDOT Divisions and Districts to identify LRS business needs • Conduct analysis of UDOT LRS requirements, data structures, maintenance, data sharing and federal requirements regarding geospatial data • Develop and deliver business case analysis documentation

Utah
ARNOLD and LRS Spatial Data Guidelines

Task 2	Task Objectives
UDOT Internal and Local Stakeholder Summary Assessment	• Local Stakeholder Study (by HDR) review. • Review current UDOT LRS Policy document. • Develop Executive Summary Findings Report using Task 2 Results and Local Stakeholder study findings. Report shall discuss UDOT's Geospatial data and its readiness to meet ARNOLD and Federal Safety Reporting Requirements. • Develop Geospatial Data Guidance Report for the developing and maintaining an all public roads centerline database that supports ARNOLD, NG 9-1-1, MIRE and HPMS.

Utah
ARNOLD and LRS Spatial Data Guidelines

Task 3	Task Objectives
Geospatial Architecture Data and Tools Assessment	• Based on Task 3 results, develop geospatial architecture goals and objectives • Define high level workflows to support data management and reporting activities by UDOT and Local Stakeholders • Create and deliver Geospatial Architecture recommendations document.

Georgia
ARNOLD Local Government Coordination and Portal Planning

Task 1	Task Objectives
Local Agency Coordination	• Identify Georgia Stakeholders • Interview Key Local Agencies (Workshop and Webinar TBD) • Conduct Local Stakeholder Data Gap Analysis • Conduct GDOT Data Gap Analysis • Develop Data Supply Chain Model(s) • Deliver Findings and Recommendations Report

Georgia

ARNOLD Local Government Coordination and Portal Planning

Task 2	Task Objectives

GDOT ARNOLD Portal Planning	• Define Portal Goals
	• Define Data Resources and Requirements
	• Develop Portal Data Model
	• Develop System workflows
	  o Front End Workflows (Locals)
	  o Backend Workflows (GDOT)
	  o Develop QA/QC protocols and acceptance criteria (for Locals and GDOT)
	• Document Training Requirements

Georgia
ARNOLD Local Government Coordination and Portal Planning

Task 3 & 4	Task Objectives
Design ARNOLD Portal Architecture	• Develop System Architecture • Develop Implementation Strategy • Deliver Technical Requirements and Development Plan
Final Report and Executive Summary	• Develop and deliver Final Technical Report via findings from Tasks 1-3. • Develop and deliver ARNOLD Portal PowerPoint presentation • Develop and deliver Executive Summary Findings Report

Questions / Open Discussion