Presentation on Development of Interface Specifications for Mobile Data Platforms on DOT Vehicles

In cooperation with & funded by:

CLEAR ROADS
research for winter highway maintenance

April 2010

Prepared by:

tec Thompson Engineering Company
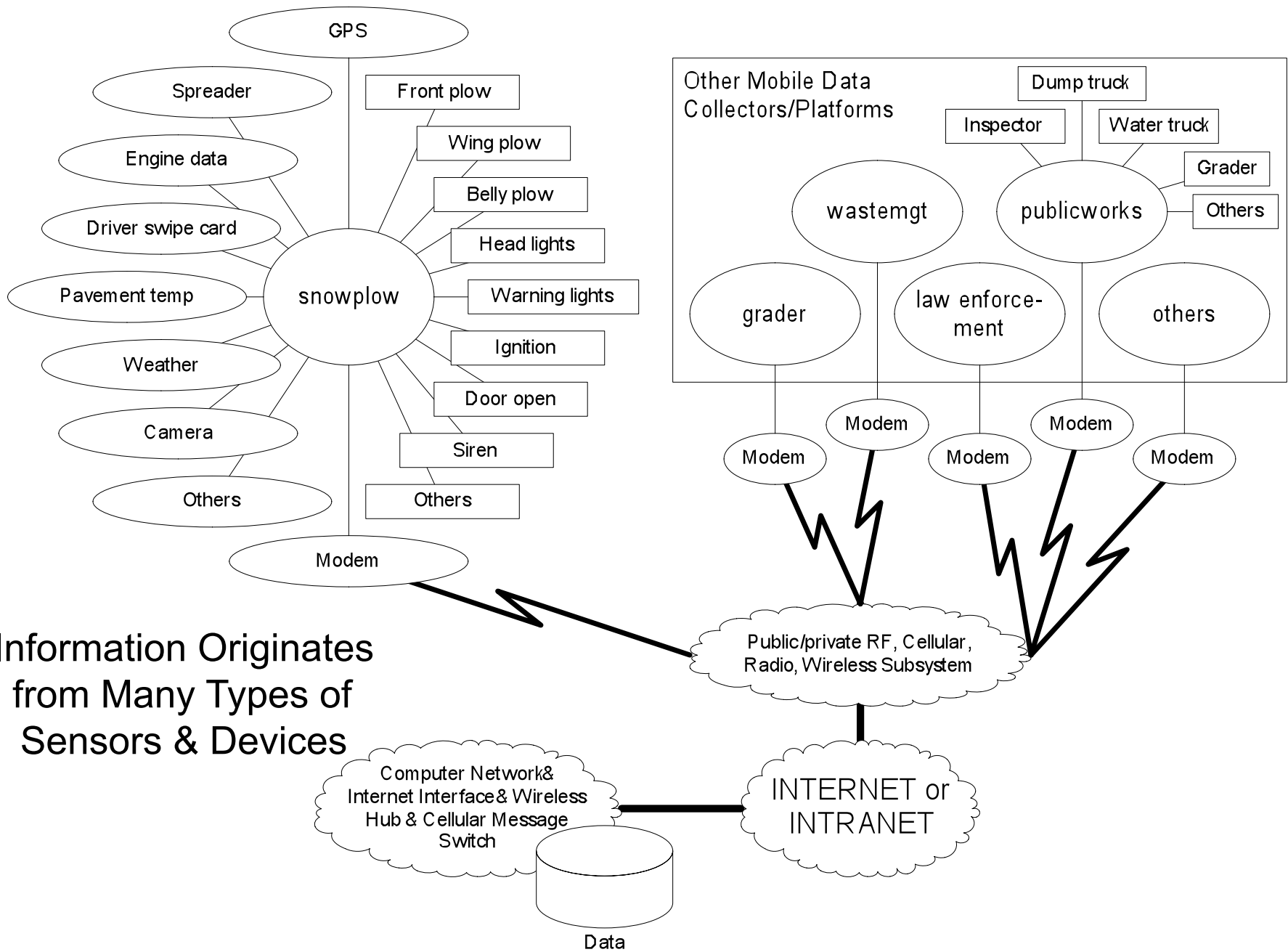
Attachment F to Final Report

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Project Purpose

- The Clear Roads pooled fund research program (www.clearroads.org), in coordination with the Wisconsin Department of Transportation, seeks to develop communication & data format specifications to support mobile data platforms used by State DOT's.

- The mobile data platforms could be equipment such as, snow plows, end-loaders, supervisor trucks, paint trucks, herbicide sprayers, trailers, oil distributors & other similar equipment used in roadway maintenance operations.

- Agencies that are considering adding GPS/AVL to support the mobile data platform need a set of specifications that will allow them to purchase a variety of different sensors that all use a common communication protocol & data format.
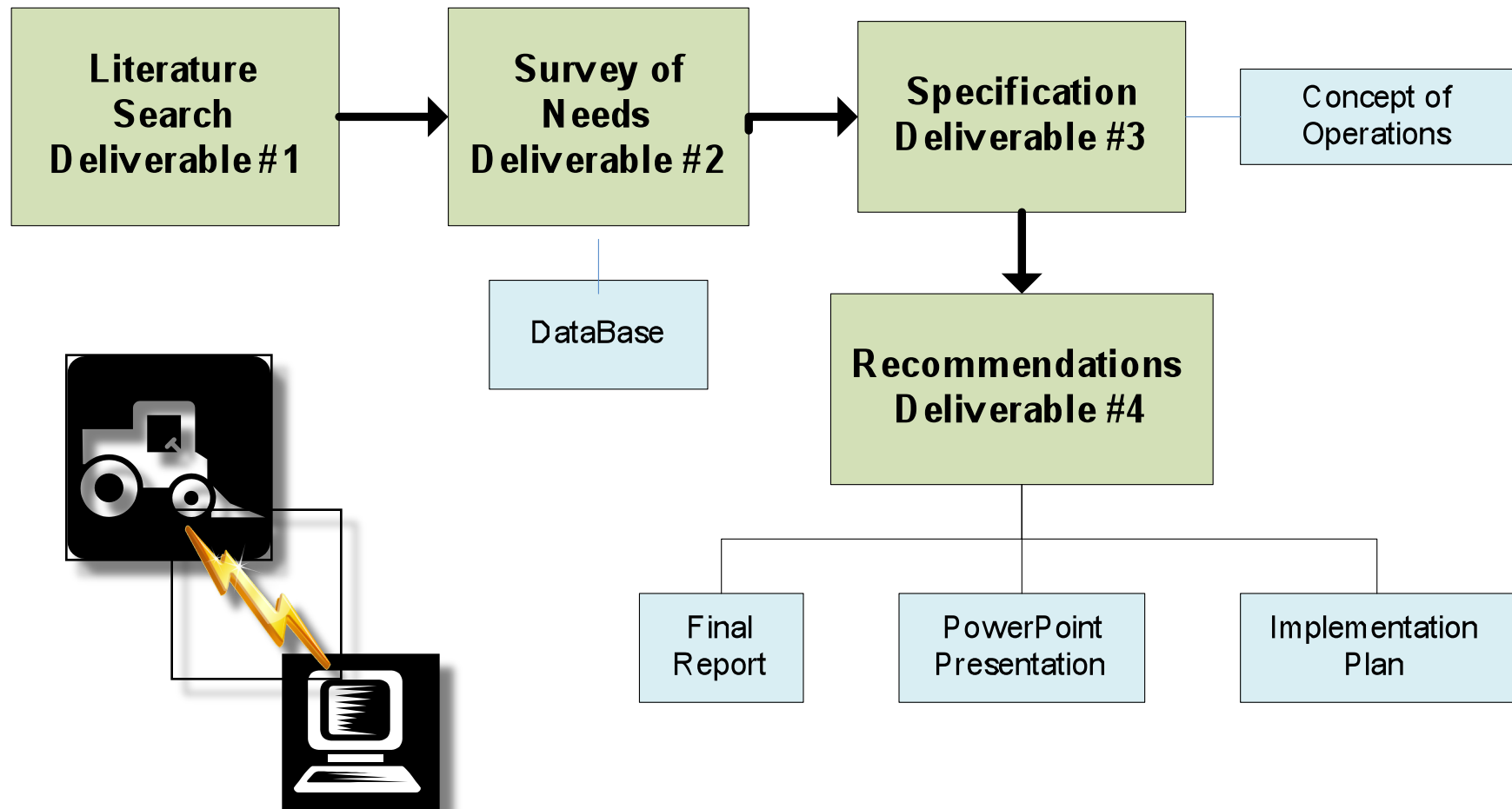
GPS

Spreader

Engine data

Driver swipe card

Pavement temp

Weather

Camera

Others

snowplow

Front plow

Wing plow

Belly plow

Head lights

Warning lights

Ignition

Door open

Siren

Others

Modem

Other Mobile Data Collectors/Platforms

Dump truck

Inspector

Water truck

Grader

Others

wastemgt

publicworks

grader

law enforce-ment

others

Modem

Modem

Modem

Modem

Modem

Information Originates from Many Types of Sensors & Devices

Public/private RF, Cellular, Radio, Wireless Subsystem

Computer Network& Internet Interface& Wireless Hub & Cellular Message Switch

INTERNET or INTRANET

Data

Project Tasks

- Literature Search
- Survey of Needs
  - Survey data & information
  - Survey results report
- Specification
  - Concept of operations
  - Detailed specifications
- Final Report
  - Recommendations
  - Presentation slides

Project Organization – Task Flow

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┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐      ┌─────────────────┐
│  Literature     │      │  Survey of      │      │  Specification  │      │  Concept of     │
│  Search         │ ───► │  Needs          │ ───► │  Deliverable #3 │ ───  │  Operations     │
│  Deliverable #1 │      │  Deliverable #2 │      │                 │      │                 │
└─────────────────┘      └─────────────────┘      └─────────────────┘      └─────────────────┘
                                  │                         │
                          ┌─────────────┐                   ▼
                          │  DataBase   │          ┌─────────────────┐
                          └─────────────┘          │ Recommendations │
                                                   │ Deliverable #4  │
                                                   └─────────────────┘
                                                           │
                                   ┌───────────────────────┼───────────────────────┐
                            ┌─────────────┐         ┌─────────────┐          ┌─────────────────┐
                            │   Final     │         │ PowerPoint  │          │ Implementation  │
                            │   Report    │         │Presentation │          │     Plan        │
                            └─────────────┘         └─────────────┘          └─────────────────┘
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Project Schedule (Dec 2008 – Mar 2010)

PROJECT SCHEDULE Tasks	Months 12/08 -2/09	3/09 4/09	5/09 6/09	7/09 8/09	9/09 10/09	11/09 -1/10	2/10 3/10
Literature Search	⟷						
Survey of Needs		⟷					
Specifications		⟷		⟷			
Recommendations						⟷	
Quarterly Progress Reports		▲	▲		▲		▲
Conference Calls		▲	▲		▲		▲
Final Report and Face-to Face Meeting or Webex			▲		▲		▲
PowerPoint Presentation and Summary of Results				⟷			▲
Implementation Plan							▲

Literature Search

- The focus of the review was directed towards foreign countries first, in particular, progressive snow fighting countries.

- Second, examine and identify the related literature in North America.

- Results – uncovered several interesting documents related to the project subjects.

- No one document or study addressed the topic directly or from the focused scope required to provide specifications.

Survey of Stakeholders

- Created three surveys
  - Government agencies
  - Vendors
  - Academic institutions
- Queried each group for ideas on specifications and standards for gathering information from mobile data platforms using on-board sensors.
- Survey was on-line for 7 weeks.
- Canvassed several organizations seeking responders; AASHTO, APWA, TRB, state DOTs

Survey Results – from Responders

- Interoperability & interchangeability are very important

- Focus on operational criteria not technology & design features

- Get as much "buy in" from players in the field as possible

- Keep implementation of the standards in mind from the beginning & throughout this process

- Challenge - all responders acknowledged that this would not be "easy" or anticipated that one solution would not fit all stakeholders.

Survey Results from Responders (Cont.)

- over 80% thought this project was a good idea
- There was a wide array of sensors in use or desired to be employed
- Most responders wanted to collect engine data
- One stakeholder says "Back this up with deployment & we have power." This emphasizes the issues surrounding approval & acceptance.
- Interface with existing standards (i.e. SAE, NTCIP, IEEE GPS, & wireless are important considerations

Specifications

- View each vehicle as a communications hub.

- Require all sensors connect to engine bus.

- Limit the standardized communications networks to cellular and Wi-Fi. Connect to engine bus.

- Introduce on-board intelligent agents to customize and tailor data collection requirement to each customer. Use J1939 data identifiers.

- Maintain vendors ability to remain competitive and be rewarded for performance
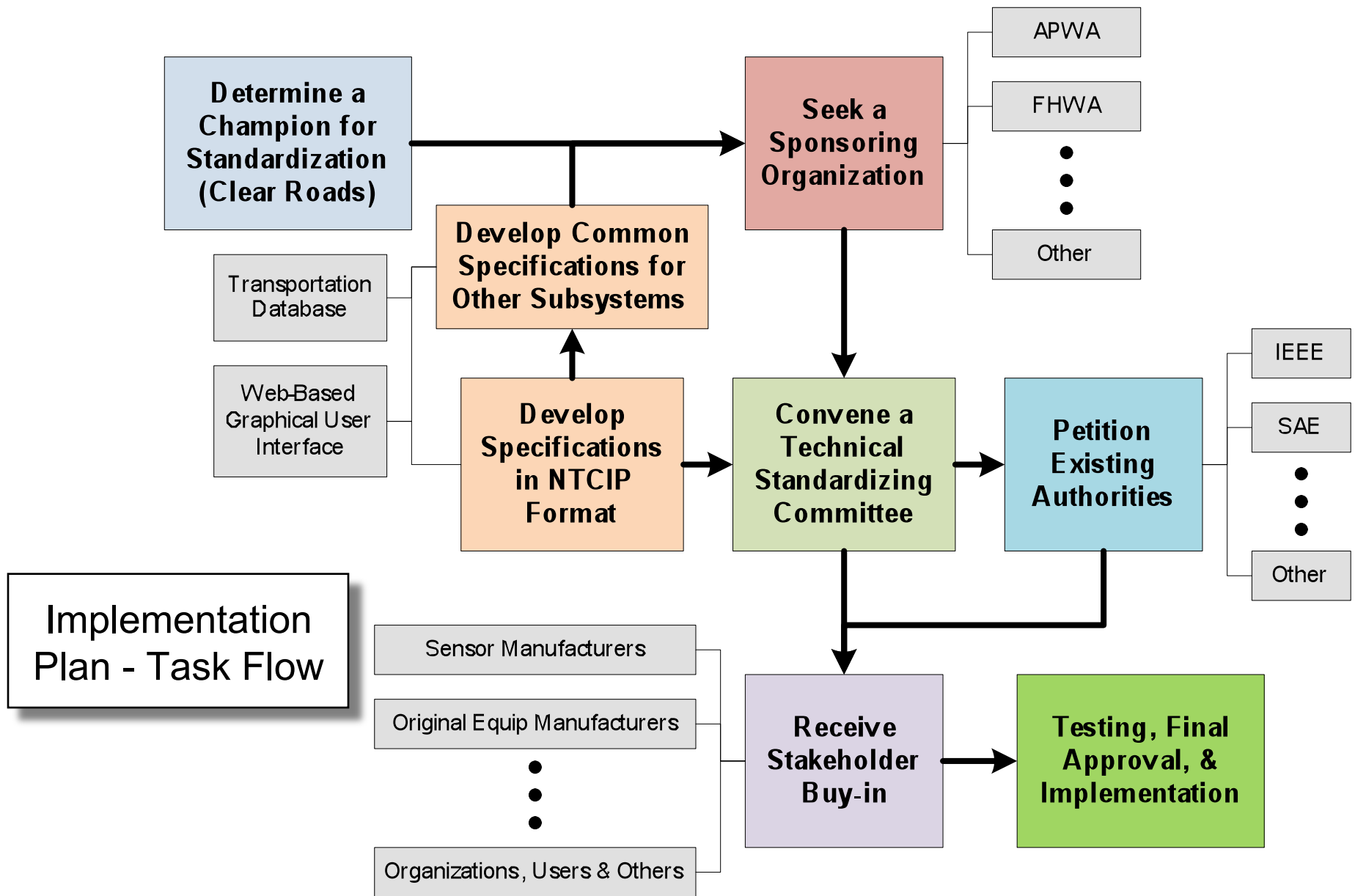
- Standardize database and web based GUI

Concept of Operations
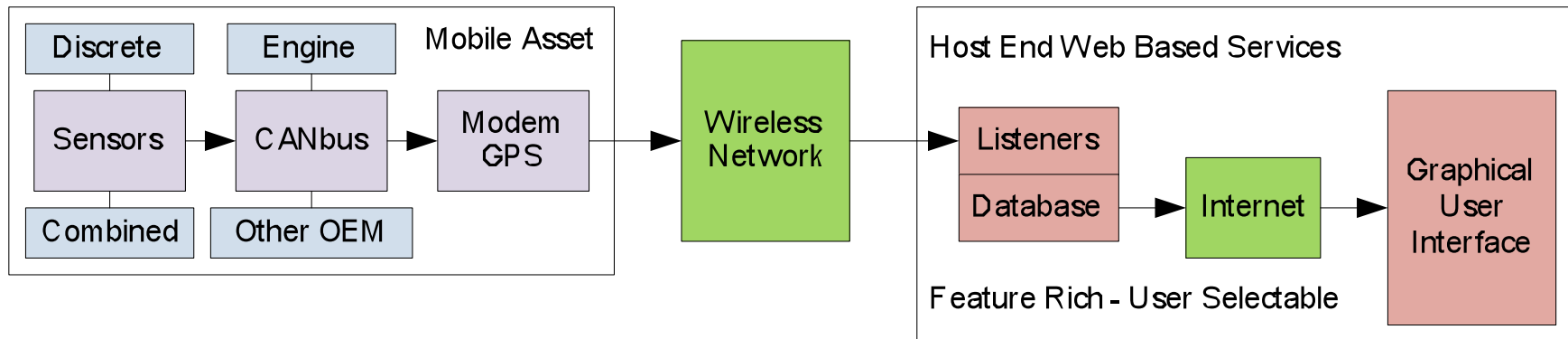
On-board Equipment & Host End Services

Implementation Plan

- Develop specifications for a transportation database and the web-based graphical user interface and database query methodology

- Seek a sponsoring organization at the national level to champion this effort

- Convene a technical committee of stakeholders to provide consensus on integration and interfaces

- Petition existing standardization agencies for inclusion, i.e. SAE & IEEE

- Prepare specifications in NTCIP format and receive stakeholder "buy-in"

- Conduct testing, gain final approval, and begin implementation

Implementation Plan - Task Flow

Flow diagram contents:

- Determine a Champion for Standardization (Clear Roads) → Seek a Sponsoring Organization
- Seek a Sponsoring Organization → APWA, FHWA, ⋮, Other
- Transportation Database, Web-Based Graphical User Interface → Develop Common Specifications for Other Subsystems
- Develop Specifications in NTCIP Format → Develop Common Specifications for Other Subsystems
- Develop Specifications in NTCIP Format → Convene a Technical Standardizing Committee
- Seek a Sponsoring Organization → Convene a Technical Standardizing Committee
- Convene a Technical Standardizing Committee → Petition Existing Authorities
- Petition Existing Authorities → IEEE, SAE, ⋮, Other
- Convene a Technical Standardizing Committee → Receive Stakeholder Buy-in
- Sensor Manufacturers, Original Equip Manufacturers, ⋮, Organizations, Users & Others → Receive Stakeholder Buy-in
- Receive Stakeholder Buy-in → Testing, Final Approval, & Implementation

Standardize Database & Web Based GUI

Transportation
Database

Web-Based
Graphical User
Interface

**Develop Common
Specifications for
Other Subsystems**

**Develop
Specifications
in NTCIP
Format**
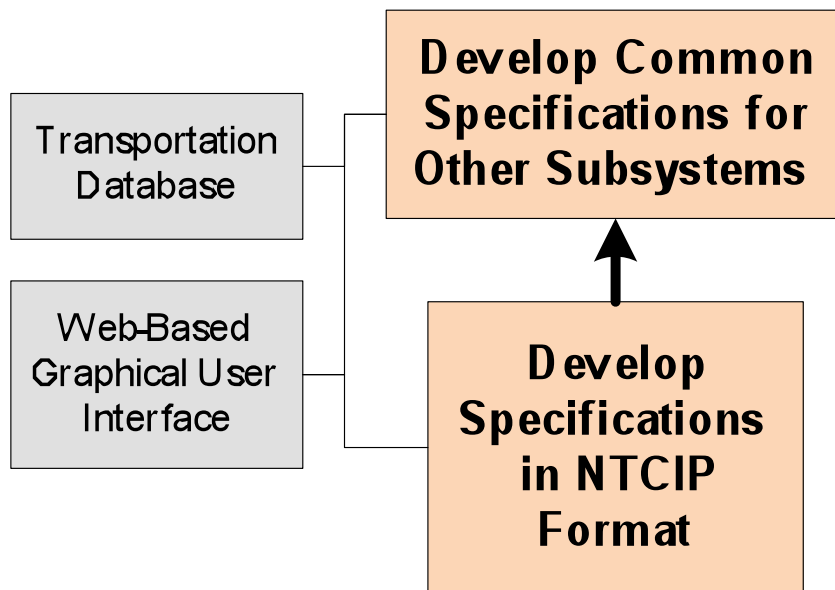
- Project Champion
- Common specs
  - Database
  - Web based GUI
- Develop using NTCIP formats for consistency
- Allows a plug and play style for host end.
- Maintain marketplace competition and performance rewards.

Seek Sponsor

Seek a Sponsoring Organization
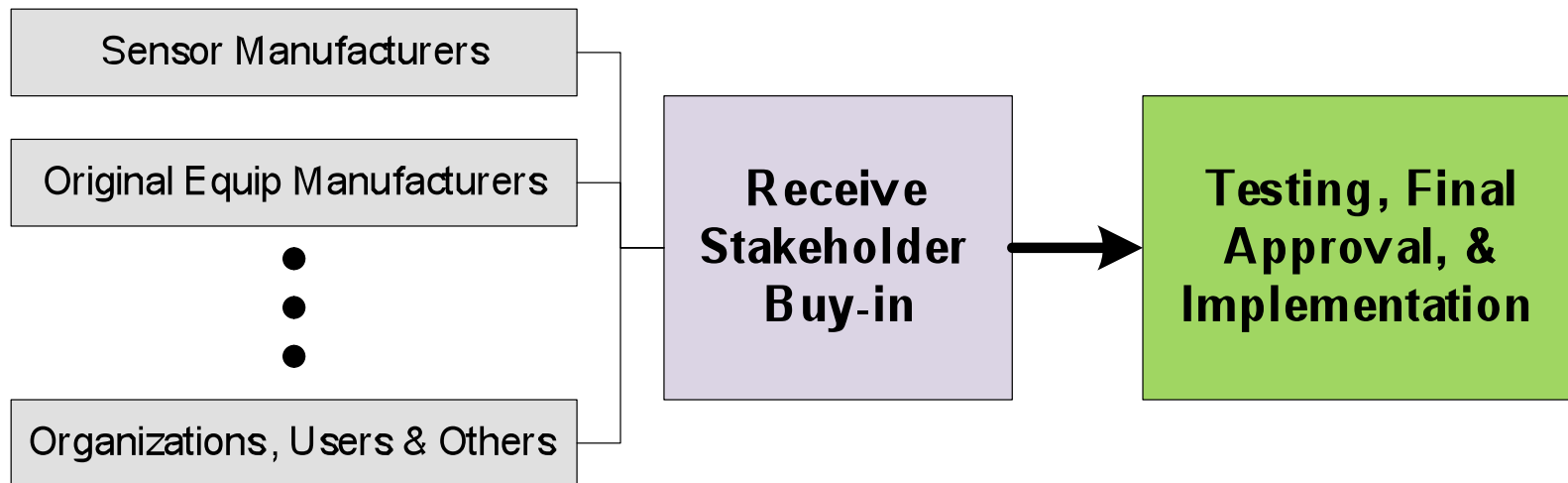
- APWA
- FHWA
- •
- •
- •
- Other
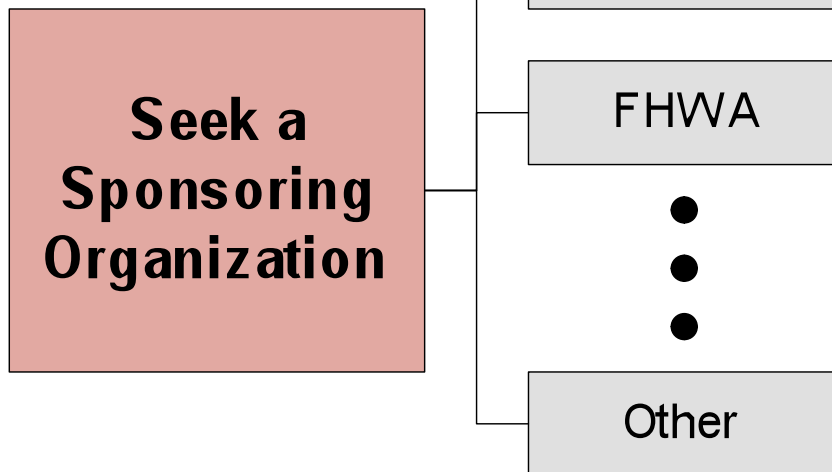
- National level
  - Stakeholder Coordination
  - International Cooperation
- Consolidate resources
- Funding
- Central clearinghouse for new ideas & emerging technology
- Sounding board & rallying point for negotiating hurdles during the process

Conforming to Existing Standards
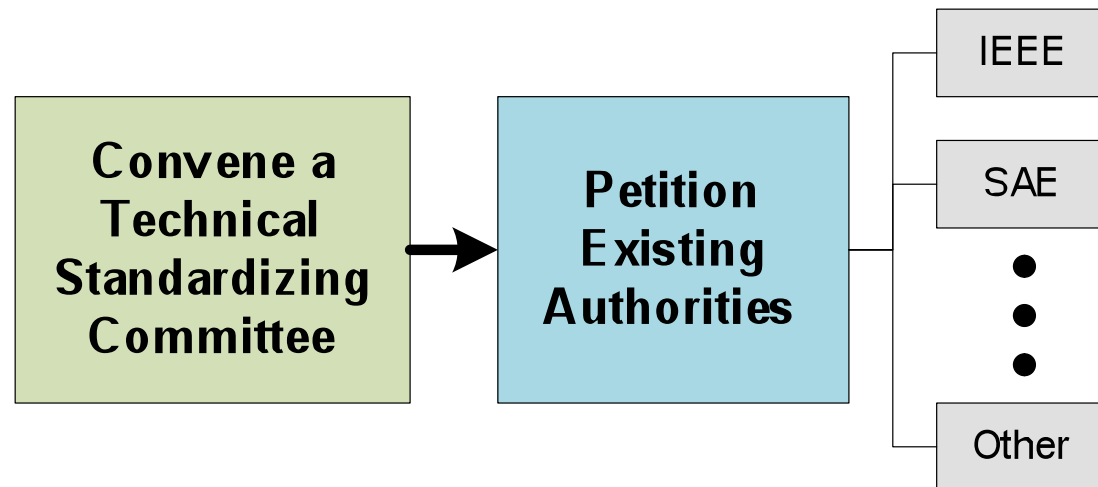
- Specifications must conform to related standards
- Capitalize on previous standards for similar information
- By coordinating with existing standards the approval process is less complicated
- Standards have placeholders for emerging requirements

Acceptance, Approval, & Implementation

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┌─────────────────────────────┐
│    Sensor Manufacturers     │──┐
└─────────────────────────────┘  │
┌─────────────────────────────┐  │   ┌──────────────┐      ┌──────────────┐
│ Original Equip Manufacturers │──┤   │   Receive    │      │ Testing, Final│
└─────────────────────────────┘  ├──▶│  Stakeholder │ ───▶ │   Approval, & │
            •                    │   │    Buy-in    │      │Implementation │
            •                    │   └──────────────┘      └──────────────┘
            •                    │
┌─────────────────────────────┐  │
│ Organizations, Users & Others│──┘
└─────────────────────────────┘
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- 100% consensus is difficult
- Maintain competitive marketplace for price & performance
- Build in flexibility, allow levels of sophistication
- Plan for a testing & tweaking period

Summary

- Literature search

- Stakeholder surveys

- Concept of operations

- Specifications

- Implementation plan & recommendations

- Key points

  – Vehicle as communications hub

  – Sensor data consolidated at engine bus

  – Programmable modem & GPS to customize data collection & transmission/storage

  – Standardize database & host end subsystems

Questions?

Questions?

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