Comparative Analysis of Intelligent Systems in the Transportation and Energy Sectors

Victor Wanningen (victor.wanningen@gatech.edu)

Background

National Broadband Plan
• Chapter 12 “Energy and the Environment” mentions transportation and energy sectors as strategic areas for broadband development, implementation, and innovation in information and communication technologies.

Transportation sector: Intelligent transportation systems (ITS)
• Definition: “A broad area of advanced communications technologies that, when integrated into transportation infrastructures and vehicles, relieves congestion, improves safety, and mitigates environmental impact” (Federal Communications Commission, 2010, p. 352).
• Thus: network infrastructure of highways, surface roads, vehicles, and traffic management, enriched with a digital two-way communication network infrastructure.

Energy sector: Smart grid systems (SGS)
• Definition: “The electric delivery network, from electrical generation to end-use customer, integrated with sensors, software, and two-way communications technologies to improve grid reliability, security, and efficiency” (Federal Communications Commission, 2010, p. 357).
• Thus: network infrastructure and with each other (V2X) to improve safety, reliability, efficiency, carbon footprint etc.

Transportation Sector – Intelligent Transportation Systems (ITS)

Conceptual Framework

Hybrid framework for analyzing networked transitions
1. Governance framework:
   • Operational domain (systems or sectors):
   • High-level functions:
   • Policy challenge:
   • Institutions (rule-making procedures):
   • Prescriptions (rules):
   • Standard-setting organizations:
   • Stakeholder groups:
   • High-level system functions:

2. Layered model of Internet connectivity:
   • Content layer:
   • Application layer:
   • Network layer:
   • Link layer:

Network Topology

Energy Sector – Smart Grid Systems (SGS)

Preliminary Conclusions

ITS & SGS are in networked transition:
1) Supplier-side infrastructure (back-office):
   • US DOT
   • NIST
   • US DOE
   • FCC, NTIA
   • Other regulatory/administrative orgs:
2) User-side infrastructure (front-office):
   • Smart grid information systems and apps
   • Energy Security
   • Efficiency Grid
   • Interoperability standards
   • Pilot Projects:

Locl & Intensity of (user-side) innovations:
1) ITS sector:
   • IT regulation: Network infrastructure
   • IT utility companies
   • IT consumer applications
2) SGS sector:
   • IT regulation: Smart grid infrastructure
   • IT utility companies
   • IT consumer applications

Application and Service Areas

Current State Intelligent Transportation Systems (ITS)

1) Supplier-side infrastructure (back-office):
   • Road DOS/ITS management of ITS infrastructure (e.g., the Federal Highway Administration (FHWA), the National Highway Traffic Administration (NHTSA), etc.)
   • ITS regulatory/administrative organizations:
   • IT initiatives:
   • Pilot Projects:

Current State Smart Grid Systems (SGS)

1) Supplier-side infrastructure (back-office):
   • Grid infrastructure management by generation, transmission, and distribution companies (e.g., Georgia Power, etc.)
   • IT regulatory/administrative organizations:
   • IT initiatives:
   • Pilot Projects:

Vision future state ITS:
• Fully connected & networked vehicles with the ITS infrastructure and with each other (V2X) to improve safety, efficiency, environmental impact etc.

Vision future state SGS:
• Fully connected & networked grid systems with the SGS information systems and apps, extending beyond (e.g., decentralized renewable energy, and extending into the home to improve grid reliability and efficiency, and efficient operation, etc.)