

Title:

Transportation Infrastructure Connectivity within Smart Communities & Corridors

Submitted by:

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Scope:

The Internet of Things (IoT) provides a general framework for understanding connectivity between infrastructure and management systems using devices, wired and wireless networks, and advanced analytics and fog computing. IoT (which may include Infrastructure-to-infrastructure (I2I) connectivity) will be essential to the integration of transportation systems into broader smart community capabilities such as Smart Cities and Smart Connected Corridors. Transportation system infrastructure connectivity is currently focused on vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and other vehicle-to-external (V2X) technology development. Transportation system infrastructure connectivity also entails connectivity within multimodal transportation systems infrastructure (highway, rail, intermodal facilities), and between transportation systems infrastructure and other civil infrastructure systems. These other systems include those associated with

- telecommunications,
- community lighting & public safety surveillance,
- building information modeling (BIM),
- electrical energy distribution (grid),
- fuel distribution (pipeline),
- agriculture & food distribution, and
- water management and distribution systems
...and others.

There is limited structured knowledge or initiative within the national transportation community to frame dialogue and national development of broader infrastructure connectivity strategies, technologies, and institutional models.

This proposed synthesis will scan and summarize current documented concepts, implementation proposals, experiments, and pilot deployments in the United States that illustrate or demonstrate transportation infrastructure systems connectivity with other types of civic infrastructure. The proposed synthesis will also identify global initiatives or models for discussing, researching, planning, or developing transportation systems infrastructure connectivity within these broader connected community and corridor environments.

The **key objectives** of the proposed synthesis project are the following:

1. Identify primary **national and global sources** of infrastructure connectivity concepts and technologies related to transportation systems, including both public and private sector enterprises.
2. Recognize primary organizations and **entities that are exploring or creating methods** for infrastructure connectivity systems architecture, standards development, and technology implementation planning.
3. Capture and summarize infrastructure connectivity **concepts proposed in the USDOT Smart Cities Challenge**.
4. Identify and summarize infrastructure connectivity **terms and taxonomies** that do address or could address the incorporation of transportation infrastructure into foundations for Smart Cities and Connected Corridors.
5. Enable a **Framework for National Dialogue** on Transportation-Based Infrastructure Connectivity.

The **target audiences** for the proposed synthesis project are the following:

- Transportation agency **executives**, who need to understand and influence how broader infrastructure connectivity relates to transportation policy, economic development, and quality of life.
- Transportation agency **managers & administrators**, who will lead organizational and workforce development and adaptation to transportation system management within a connected infrastructure context.
- Transportation agency **chief information officers** and information technology teams, who will evolve corporate data management capabilities, analytical tools, and decision support systems for interface with a wider array of community infrastructure based data and information. They will also ensure cybersecurity and cyber-physical resilience of corporate and transportation infrastructure systems within Smart Cities and Connected Corridors.

- Transportation **planners & financial programmers**, who will integrate implications of Smart Cities and Connected Corridors into state and regional planning and financial programming for connected transportation infrastructure and associated transportation management systems.
- Transportation project development & delivery (**design & construction**) **engineers**; who will anticipate and incorporate sensing and communication technologies and standards for infrastructure connectivity into the design and implementation of transportation facility improvements at segment, corridor, and network levels.
- Transportation **operations engineers, public safety & emergency response professionals**, and others; who will actively manage traffic flow, traveler warning & information services, and logistics management services across a transportation network integrated with broader community and economic infrastructure systems.

Proposed tasks to be completed by this synthesis project include the following:

1. **Conduct a desk scan** of available web-based documents and other digitally accessible resources on civic and community infrastructure connectivity and IoT that encompass, address, or are readily extensible to transportation systems infrastructure. The desk scan will efficiently consider both U.S. and global examples of infrastructure connectivity concepts and initiatives, and include current as well as research projects proposed or underway as well as research problem statements. The scan will include documentation of lessons learned from the USDOT Smart Cities Challenge, project proposals for the Advanced Transportation & Congestion Management Technology Deployment (ATCMTD) Program, and others.
2. **Draft an annotated outline** summarizing the desk scan and tentatively defining a framework for national dialogue on transportation systems infrastructure connectivity, to include items below among others.
 - Lexicons of terminology & taxonomy of technologies (sensing, communication, data processing, etc.)
 - Institutional & business models including public-private partnerships around device deployment and data collection as well as governance and enterprise architecture practices to align development with business goals
 - Frameworks and organizational models for contracting, planning, deployment, and operational management
 - Data management and decision support systems to analyze data in motion for real-time decision making at the place of action according to policy (may include “edge and fog” applications)
 - Integrated systems planning techniques and approaches, and systems engineering processes
 - Relevant technical standards and standards development organizations
 - Experimental, prototype, and other deployments proposed or considered
 - Security of devices and connectivity
3. **Finalize the annotated outline** through a virtual panel meeting to be organized and hosted by the collaborative sponsors of this synthesis proposal
4. **Complete a synthesis report** that incorporates the desk scan annotated outline, and provides a foundation for subsequent research roadmap on transportation systems infrastructure connectivity. The synthesis report will also -
 - a. Define and describe existing or evolving models for evaluating, planning, and implementing transportation systems infrastructure within smart city, connected community, and connected corridor schemes.
 - b. Recognize and summarize primary national and global organizations and institutions that are the most strategically significant for U.S. transportation community engagement and partnership.
 - c. Concisely highlight primary research gaps and needs apparent from the scan and initial reaction to scan materials and summaries by sponsoring committees and other national transportation research groups.

The expected **outcome from the project** includes the followings.

- A **Framework for National Dialogue on Transportation-Based Infrastructure Connectivity** will be drafted by the collaborative sponsors of this synthesis proposal for review and deliberation by TRB and AASHTO.
- Results of the synthesis and a preliminary draft of the Framework will be presented and further developed through facilitative leadership of TRB Committee ABJ50 of committee meetings and special sessions at the **2018 TRB Annual Meeting**.

Information Sources:

- TRB Partners in Research Symposium: Transformational Technologies in Transportation Proceedings, November, 2016, <http://onlinepubs.trb.org/onlinepubs/conferences/2016/TT/Presentations.pdf>

- “Civil Integrated Management for Departments of Transportation, Volume 1: Guidebook” NCHRP, 2016
- “The Road Ahead: Intelligent & Transformative Transportation – A Public Policy Roadmap” ITS America, 2017
- “Catalyst for Growth: America’s Hybrid Infrastructure Leveraging Technology and Information” Business Roundtable, 2013, http://businessroundtable.org/sites/default/files/BRT_Catalyst_for_Growth_FINAL.pdf
- “Six Maps that Show the Anatomy of America’s Vast Infrastructure” The Washington Post, December, 2016 <https://www.washingtonpost.com/graphics/national/maps-of-american-infrastructure/>
- “Cisco Connected Rail” Cisco Systems, September, 2016 http://www.cisco.com/c/dam/en_us/solutions/industries/docs/trans/rail-solution-overview.pdf
- “ASCE Grand Challenge”, 2017, <https://ascegrandchallenge.com/>
- “These Smart Cities are Building Infrastructures for the 23rd Century” Digital Trends, January, 2017 <http://www.digitaltrends.com/home/smartest-cities-in-the-world/>
- “Chicago Becomes First City to Launch Array of Things” UChicagoNews, August, 2016 <https://news.uchicago.edu/article/2016/08/29/chicago-becomes-first-city-launch-array-things>

Notes:

Statement submitted on behalf of TRB ABJ50 Standing Committee on Information Systems & Technology
In partnership with

- TRB Special Task Force on Data for Decisions and Performance Measures- agreed to co-sponsor
- TRB AHB10 Committee on Regional Transportation Systems Management and Operations,
- TRB ABJ70 Committee on Artificial Intelligence and Advanced Computing Applications
- AASHTO Subcommittee on Transportation Systems Management & Operations