

SCC: Integrating heterogeneous wireless networks and advanced data science to bridge the digital divide in rural emergency preparedness and response

NSF Award #1831547

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IRG FY2018**

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Community Partners

- *Town of Thurman, NY*
- *Thurman Fire Company*
- *Warren county Emergency Service Department, NY*



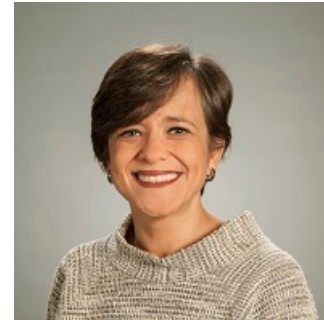
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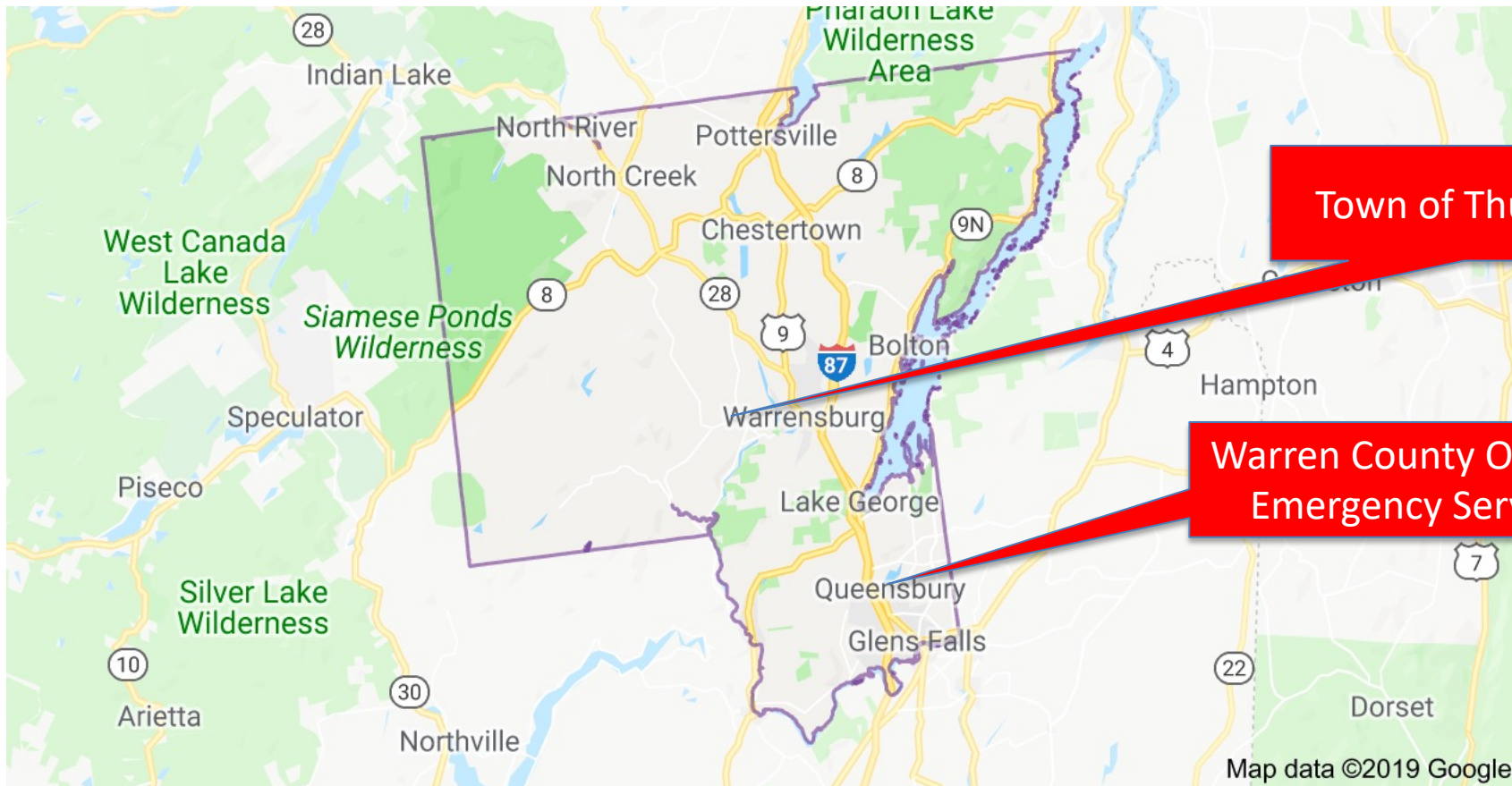
Project website:

<http://www.cs.albany.edu/sccepr/>

Project Overview

Use-Inspired Research

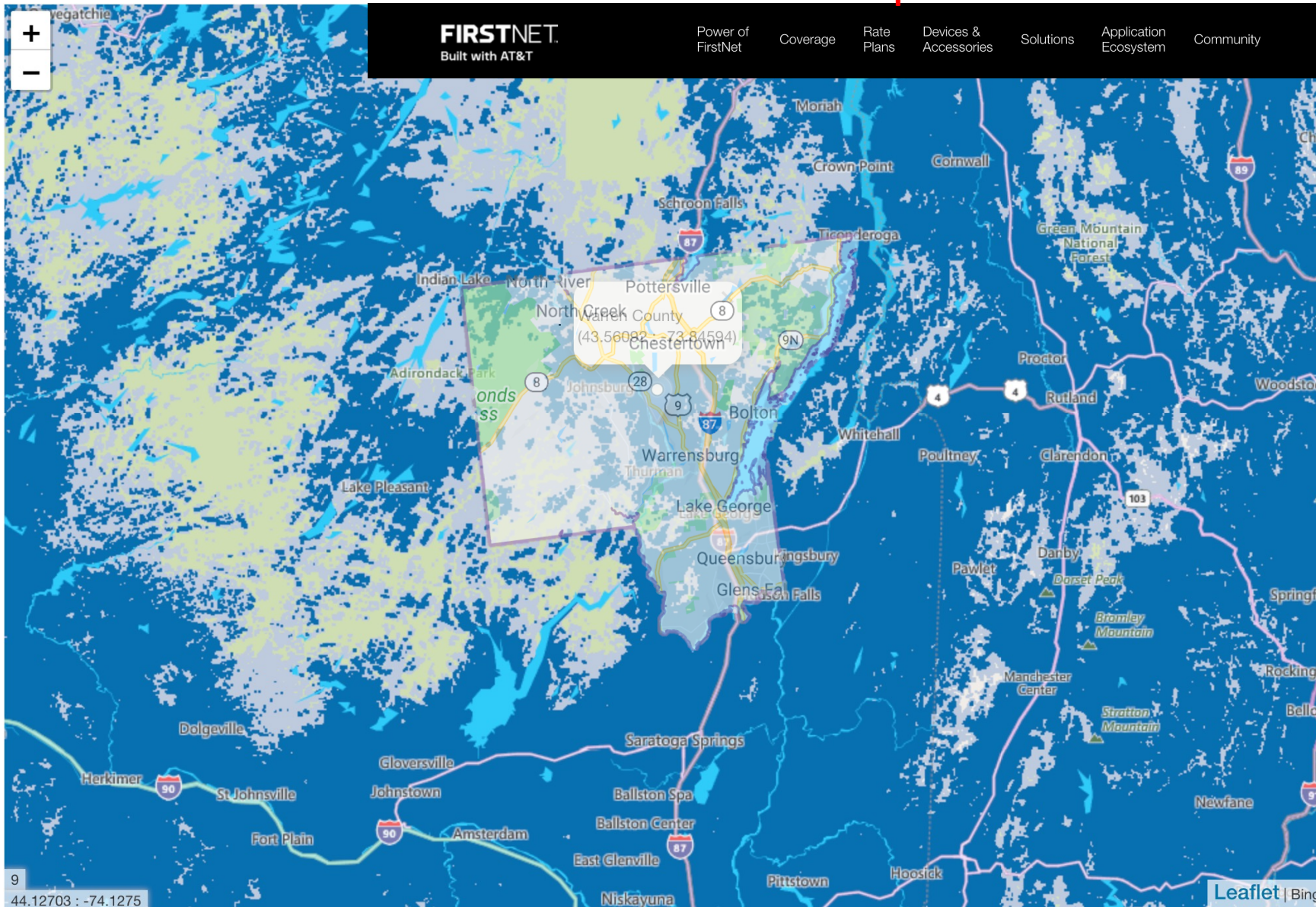
How to improve emergency preparedness and response in rural areas with limited mobile broadband connectivity?



Warren County, NY Population: 65,000
Area: 932mi² Tourist economy: 12M visitors per year

Project Overview

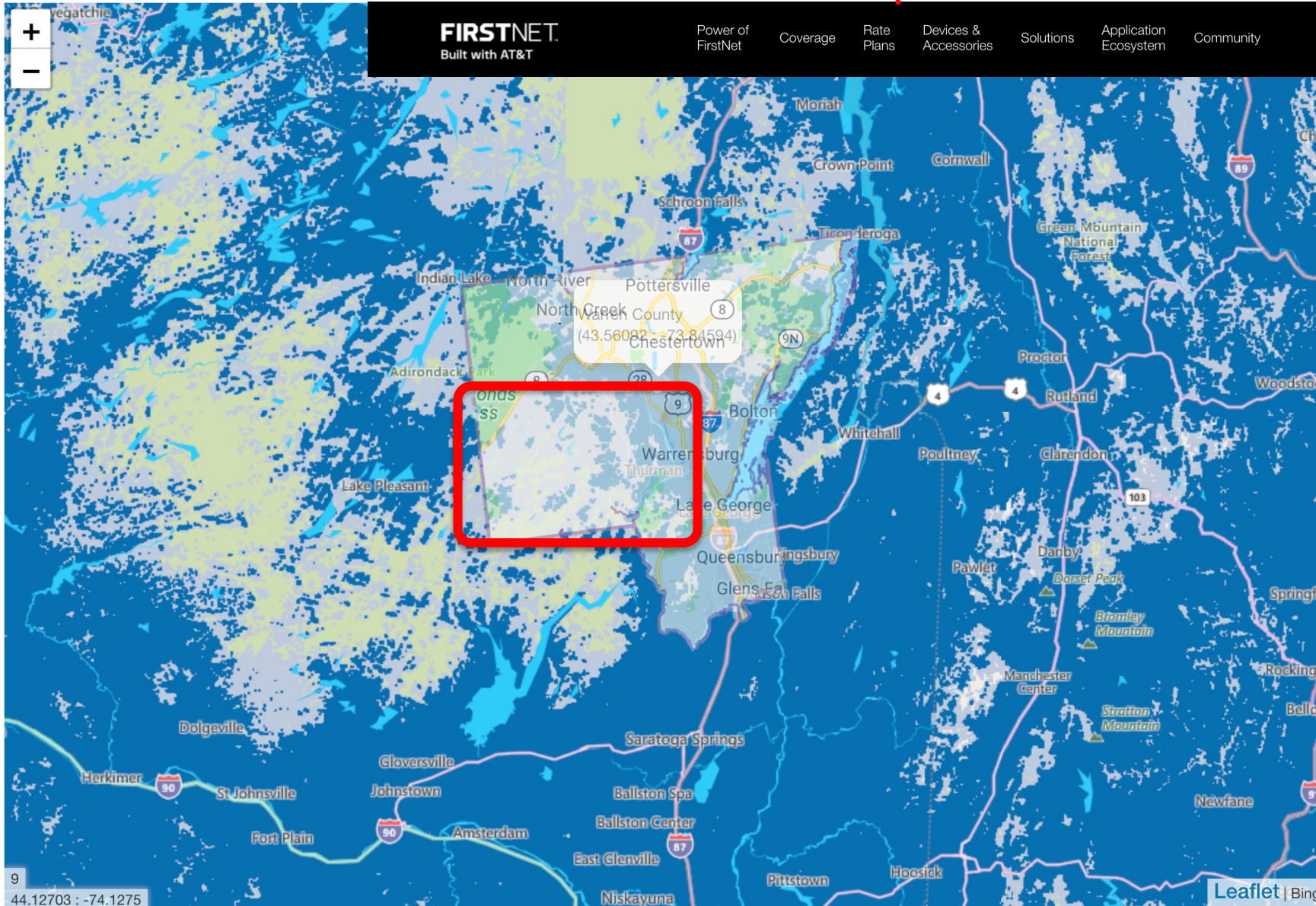
Use-Inspired Research



FirstNet Coverage Map for Warren County, NY [https://www.firstnet.com/coverage.html]

Project Overview

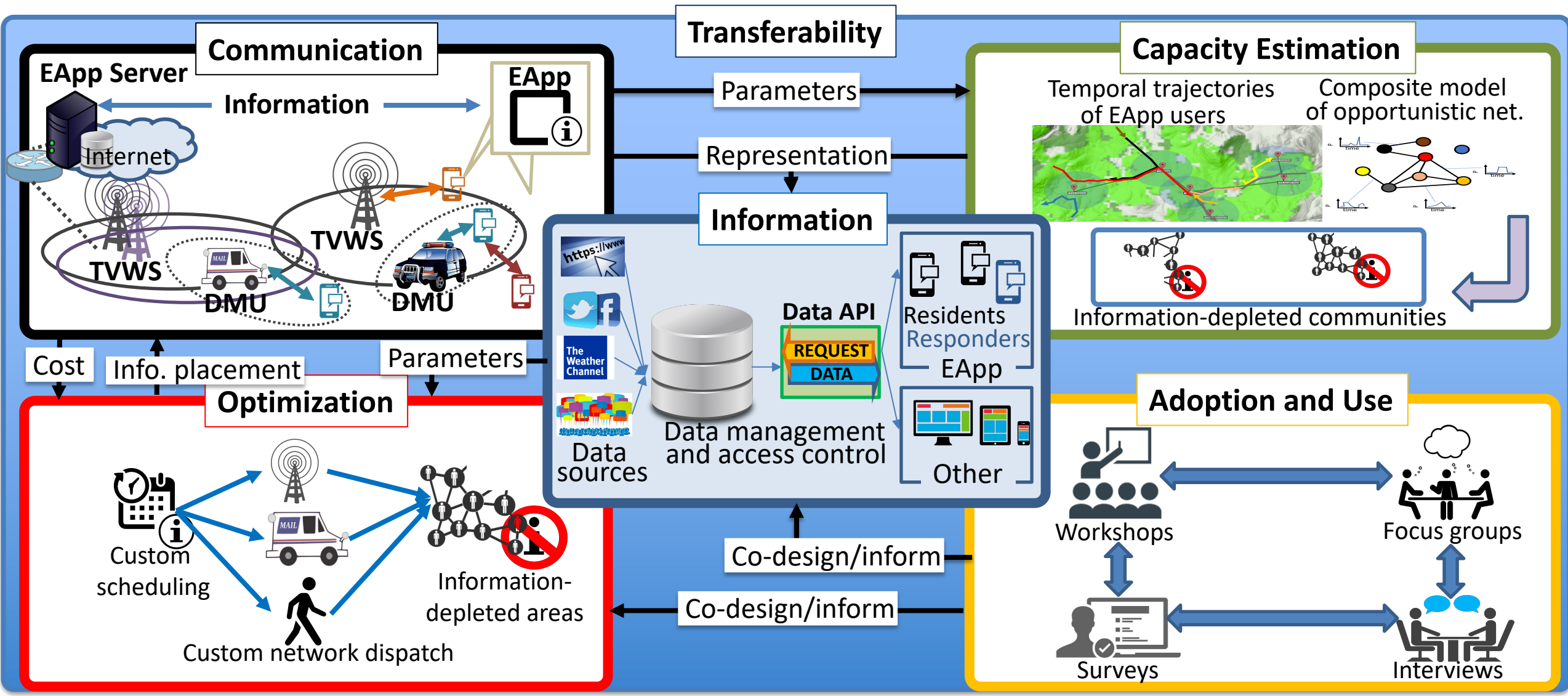
Use-Inspired Research



[Full article: *Can you hear us now?*, NYS Association of Towns' Magazine, Vol.33 No.1 January/February 2019]

Project Overview

Project Vision: Analyze the feasibility of Emergency Preparedness and Response (EPR) information dissemination in rural areas via heterogeneous wireless networks and data science.



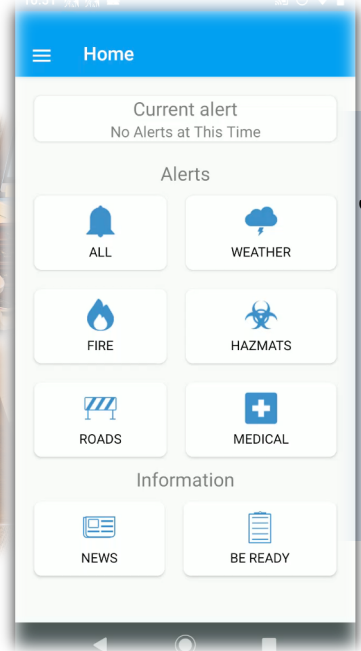
Project Overview

Fundamental Research Contributions

- Systems and protocols for heterogeneous wide-area networks with infrastructure mobility.
- Framework for emergency information integration, presentation and exchange.
- Algorithms for improved information exchange in rural socio-physical networks.
- Investigating co-design, adoption and use of information technologies for rural emergency preparedness and response.

Project Update

- **Alpha version of E!App** developed and deployed in Thurman
 - Adoption and use of ICT in emergency management in rural areas [HICSS'21, ICEGOV'20, GetMobile'20]
 - Emergency information sharing among citizens and public organizations in rural areas [DG.O'20]
 - Energy-efficient P2P communications through reinforcement learning
- **TVWS Data Mule Unit** built; field-testing is ongoing
- **Fundamental data science for mobility and information dissemination**
 - Periodic communities [ICDM'19a]
 - Network information propagation [ICDM'19b]
 - Periodic timeseries with missing values [DSAA'20, ICDM'20]
 - Classification of network snapshots [SDM'19]
- **Fundamental methodologies for characterization and resource allocation in dynamic spectrum access networks with mobility**
 - Transmitter fingerprinting with imperfect traces [INFOCOM'20, VTC'20]
 - Privacy-preserving networks with user mobility [WiSec'20]
- **Understanding the dynamics and challenges of multi-actor collaborations in the co-creation of public value** [RESER'21].



EApp User Interface

DMU field testing

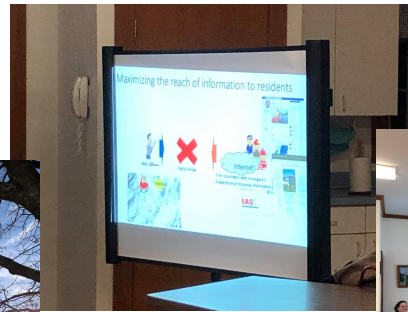


Project Evolution

- Perceived utility of resident crowd-sourced information by residents and first responders.
 - Limit to verified sources of EPR information to ensure trustworthiness and safety.
- Community changes: town leadership, priorities, fiber Internet access.
 - Residents and first responders still engaged in co-creation, adoption and use research.
 - Community TVWS network decommissioned as of Feb. 2021.
 - Plans to demonstrate DMU to first responders at UAlbany instead of Thurman.
- Community engagement slowed down by the COVID-19 pandemic.
 - Traditional in-person community meetings replaced by socially-distant outdoors meetings in small groups.
 - Focus groups replaced by 1:1 Zoom interviews.

Evaluating Project Impact on Communities

- Anticipated long-term impacts stem from improved information access for residents and first responders.
 - Increased use of the E!App.
 - A demonstration of TVWS utility for first responder access.
- Immediate impacts stem from empowering the community in developing technology that truly meets their needs.



Anticipated outcomes & success measures for next year

- **Evaluate the impact of improved information distribution through the E!App on rural emergency preparedness and response.**
 - Success measures:
 - App usage consistency and usefulness (interviews).
 - Impact of information access on residents' quality of life (interviews).
 - Efficiency, battery use, exchange success rate, information “freshness” (quantitative).
- **Larger beta deployment of the E!App (40 users).**
- **Joint DMU testing with first responders.**
- **Distributing outcomes through high-impact publications.**
 - E!App design, evaluation, adoption and use. Lessons learned for the impact of improved information access on rural EPR.
 - DMU design and solutions for rate adaptation in mobile TVWS backhaul.
 - Energy-efficient P2P communications informed by machine learning.
 - Improved human mobility and temporal contact network modeling.