

Data at the Edge: Providing Data Resources and Analytic Capabilities in Communication-Limited Environments

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Introduction

Data and information from remote sensing observations and in-situ sensing networks are a key part of research and operations in the polar regions. Scientists and equipment operators are reliant on data for their studies, to run models and simulations, for researchers' safety, and to plan daily operations. Current data delivery capabilities for operational information sharing cannot transmit some very large data resources that have potential value for science and decision-making. Here we present the Wildland Fire Data Logistics Network (WDLN), a prototype system developed to demonstrate technical ability to provide access to large geospatial data to wildfire operations personnel deployed in areas of limited or no communications infrastructure. WDLN is designed to make current systems stronger, more integrated, and with more resilient features than current digital networking systems allow. This prototype has three important attributes that directly support data access resilience, which will be described in this presentation. Data sharing limitations of current systems are not well articulated, because technologies to provide large data sets in a timely manner for efficient processing analysis are not commonly available. The product of the research presented provides a demonstrated capability to improve access to large data files in a seamless way for science and operations in locations where standard data infrastructure fails.

Polar Applications

The ability to deploy on-the-ground technology sensors in polar regions can be expensive or difficult

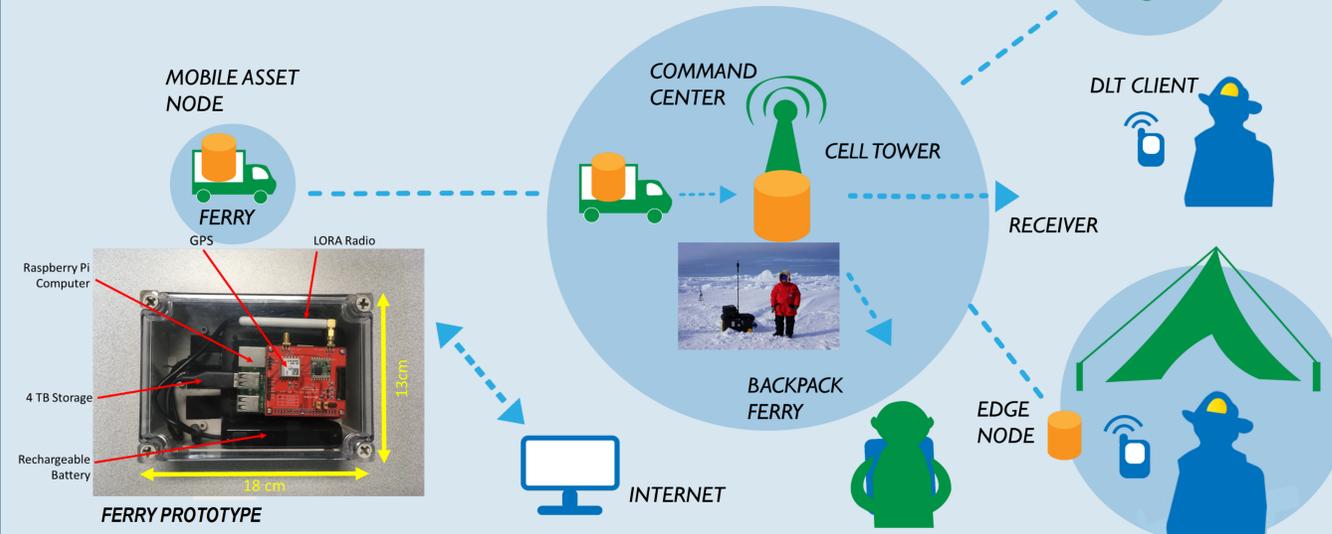
- Data ferries integrated with DLT software can be utilized as an ad-hoc communication infrastructure with integrated sensor networks
- Infrastructure that minimizes the number of on-ground sensors while providing enough data are desirable (location optimization)
- The addition of in-situ computational capabilities would minimize the bandwidth needed for data transfer
- Advanced computational paradigm designed for sparse, distributed data will help infer high-resolution (spatial & temporal) measurements



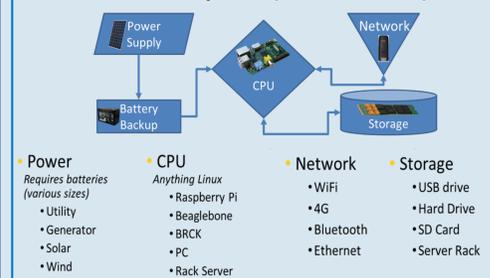
Polar research team

The Data Ferry Concept & Prototype

Data ferries are robust systems with three important attributes: local operation, intermittent connectivity, and heterogeneous connectivity. They can be used to deliver rich and informative data, support file transfer, and provide access in disconnected networks



Hardware Options (mix and match)



Future technologies and capabilities

- Design and develop an asynchronous and heterogeneous data system
- Integrate advanced in-situ computational capabilities within the network system for efficient data analytics

Objectives of the Wildland Fire Data Logistics Network

Wildland firefighting operations are regularly obstructed by construction and maintenance of ad hoc communication networks.



As a result, incident command decisions and wildfire containment is compromised.

- Deploy and test prototype hardware-software system with fire operations personnel that automates data ferrying and integrates it with existing capabilities and relevant data.
- Co-develop software systems for data logistics based on existing tools, including future proofing and generation of ideas to advance capabilities with further R&D.
- Work with the wildland fire management community to design and develop an asynchronous and heterogeneous data system.

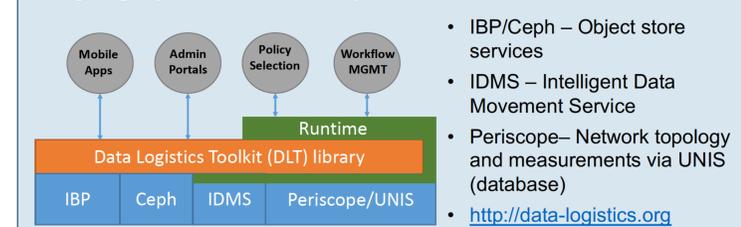


Fire Hotshot Crew

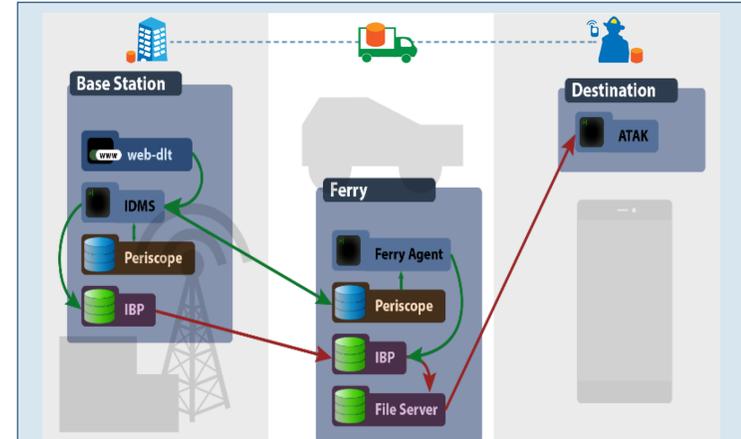
The Data Logistics Toolkit

The Data Logistics Toolkit consist of a set of tools to facilitate efficient and seamless data transfer in circumstances of poor or unstable connectivity.

- Local operation: Decentralized federation of available nodes and connected devices. Dynamic architecture that operates over intermittently connected and heterogeneous networks
- Logistical data distribution: Managed workflows for prioritizing and filtering data of importance over geographic and/or temporal criteria



Implementation of DLT



Base station	Ferry	Front-end system
<ul style="list-style-type: none"> Access to resources/data User-facing web site DLT software 	<ul style="list-style-type: none"> Ferry software resources Communications hardware 	<ul style="list-style-type: none"> Customized Android-based app (ATAK)

Data Ferry Prototype Testing



National Interagency
Fire Center

- Test access to geospatial data resources
- Improve current methods of moving data to on-site systems



COLORADO
Center of Excellence for Advanced
Technology Aerial Firefighting
Department of Public Safety

- Development of ATAK-based data access
- Improve current workflow for firefighters to access relevant geospatial data



NIST
National Institute of
Standards and Technology
PSCR U.S. Department of Commerce

- WDLN Prototype Sponsor
- Integrate data ferry functionality into First Responder technologies