

Advancing Applications from the Edge In with Named Data Networking

Lixia Zhang

July, 2017

ice-ar.named-data.net

NDN-Enabled Secure Edge Networking with Augmented Reality

- ◇ Integration of heterogeneous low-level wireless tech. with domain-specific acceleration as a service.
- ◇ robust and resilient networking that comprehensively uses infrastructure resources, also withstand infrastructure failures
- ◇ transitioning content delivery from monolithic, context-independent streams to highly granular and context-dependent.
- ◇ management of identities and trust relations in dense deployments in large campus networks of the future where content can be generated by all edge devices.

Edge-in Approach

- Target greenfield applications where IP is challenged
- Pursue decentralized computing and communication models:
 - Built on NDN's "fundamentally new abstraction for general purpose networking"
 - Remove cloud dependency for content, processing, rendezvous and trust management

Looking at AR in a different light

“It is widely accepted that creative design is not a matter of first fixing the problem and then searching for a satisfactory solution concept;

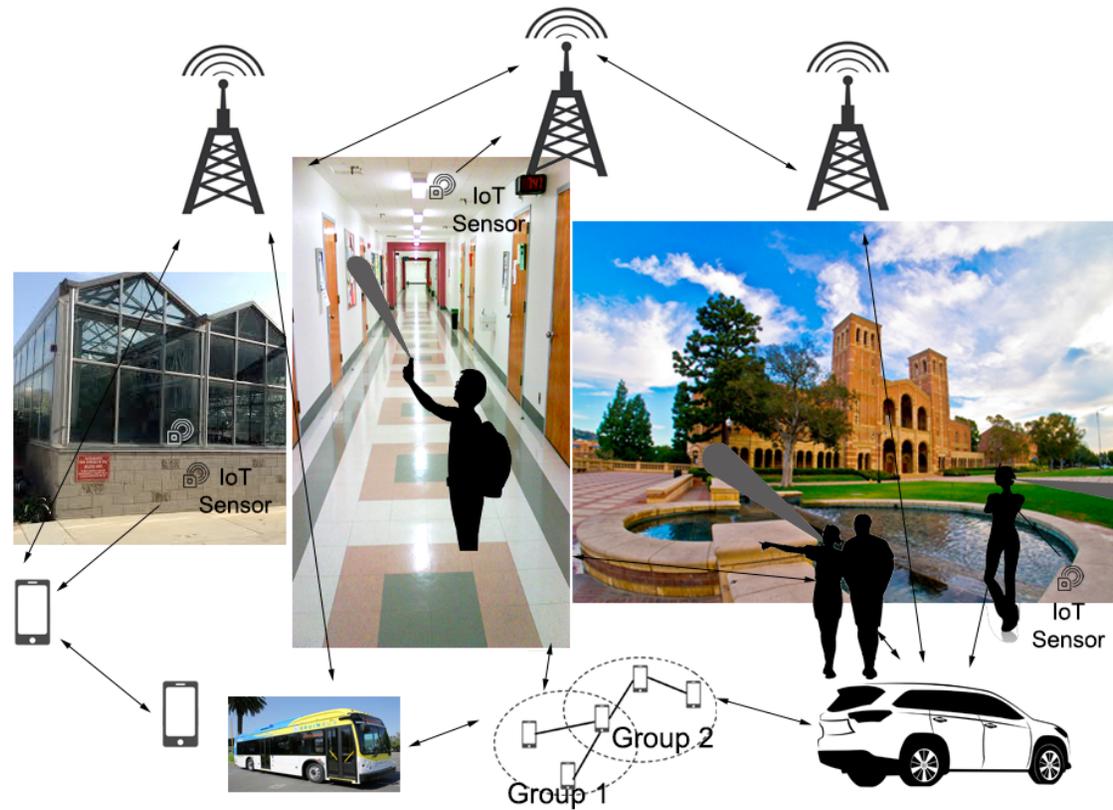
instead it seems more to be a matter **of developing and refining together both the formulation of the problem and ideas for its solution.**”

- ◇ Cross & Dorst (1999), quoted by Brooks (2010).

AR as “multiparty context-content exchange”

- ◇ with a mix of local / global sources, non-binary trust, context-dependent privacy.
- ◇ Decentralized ecosystem of data and services, seen via various views and filters
- ◇ Cloud-assisted but not cloud-reliant. The same design works in disrupted infrastructure scenarios (e.g., emergencies).
- ◇ Names to standardize exchange of data:
 - media; metadata / media descriptions;
 - sensor readings;
 - code; function or service pointers
 - Keys, trust policies
- ◇ Relationship between names for trust management & rendezvous

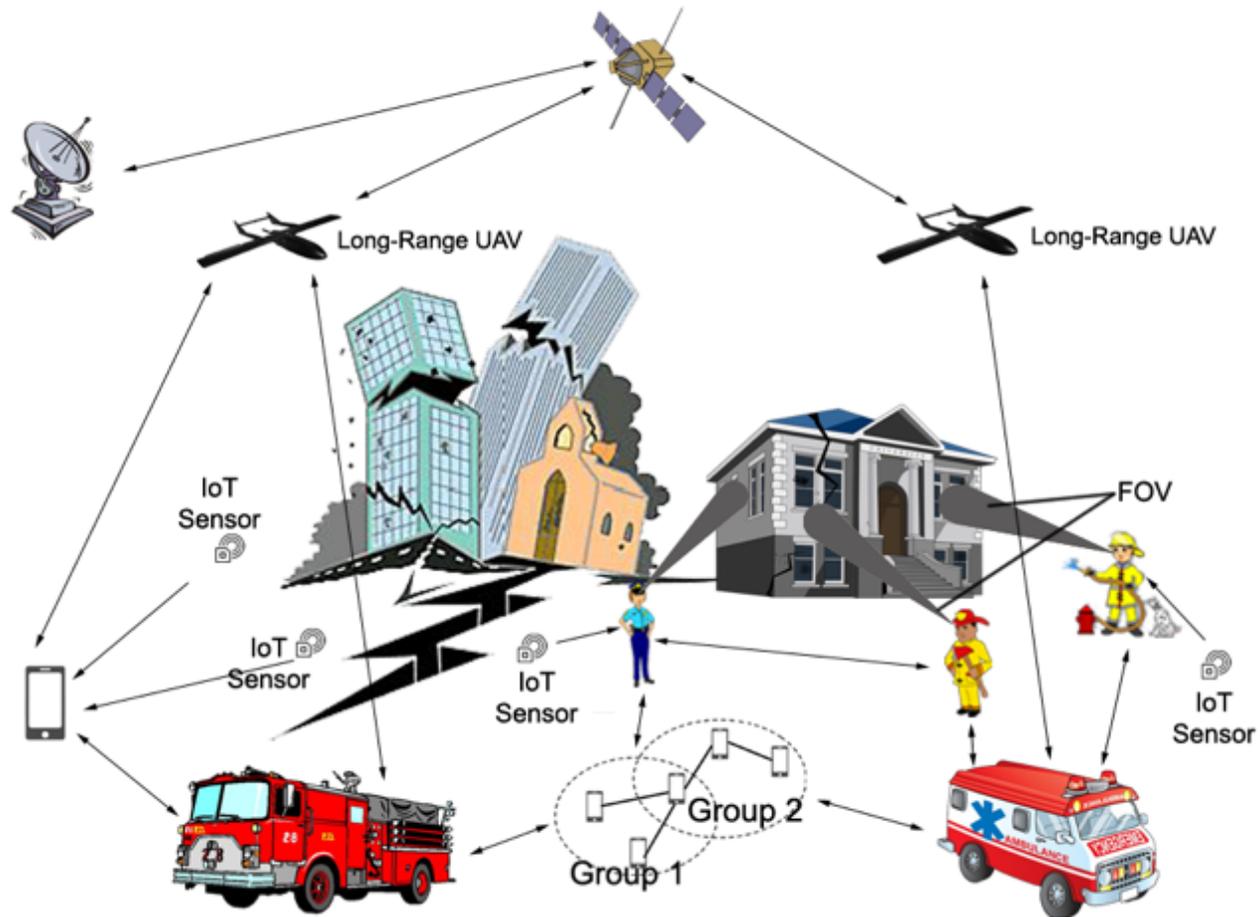
Daily Network Usage: campus browser



AR as a Browser: Context \Leftrightarrow Content Exchange



The same network remains functional when under stress



Research Challenges

- ◇ Naming
- ◇ Performance
- ◇ Security / Privacy

Naming

Designing the namespace(s):

- ◇ Context (and Meta-Context)
- ◇ Content (and Meta-Content)
- ◇ Keys (Certs)

Considerations

- ◇ Supporting discovery of desired data
- ◇ Seamlessly embedding edge acceleration
- ◇ Leverage benefits of B5G wireless

Performance

Idea

- ◇ 1) Run NDN directly over wireless
- ◇ 2) Name-based architecture for enabling edge acceleration of:
 - **Context creation / processing** (e.g., location services, SLAM, viewing path, collaborative viewing)
 - **Content generation / processing** (e.g., transcoding, chunking, rendering)
 - **Security primitives** (e.g., signing, verification, encryption, group mgmt)

Objectives

- Exploit hardware to speed up AR and NDN security
- Reduce effective latency from network and compute
- Harness heterogeneous wireless link technologies seamlessly

Security

App Desires

- 1) Decentralize security and avoid cloud dependence;
- 2) Consistent and expressive new primitives to developers;
- 3) Spectrum of support for powerful devices to IoT devices

Idea

- 1) NDN provides signing/verification of each packet as a building block.
- 2) Security relationships expressed in data names (schematized trust; name-based access control)
- 3) Named data provides a consistent way to share keys, certs, and context.

Objectives

- Provide scalable trust management in a coherent framework
- Localize the impact of security compromises

Conclusion

Model of AR

- ◇ Web of named data to be browsed
- ◇ (decentralized) Multiparty context-content exchange
- ◇ Security built in; privacy as contextual integrity.

Role of AR applications

- ◇ Drive NDN architecture development for wireless edge networking

ice-ar.named-data.net