Named-Node Network (3N) based Disaster Application Demonstration

Xin Qi† Zheng Wen† Jairo LÓPEZ‡ Yingshuang Du† Daichi Nozaki†
Koki Okamoto† Toru Mochida† Keping Yu* Takuro Sato†

† Graduate School of Computer Science and Communication Engineering, Waseda University
‡Systems Engineering, Center for Technology Innovation, Research and Development Group, Hitachi Ltd.
*Global Information and Telecommunication Institute, Waseda University, Japan
E-mail: †{samqxxx@akane, robinwen@fuji, dyshuang@toki, daichi.0423@akane, okaxile111111@ruri, moti1001@ruri}.waseda.jp, t-sato@waseda.jp ‡jairo.lopez.uh@hitachi.com *keping.yu@aoni.waseda.jp

Abstract In this work, we present an IoT Device Naming Network Architecture based on Information-Centric Network (ICN). The architecture is evolved from Named-Node Network (3N). The demonstration includes a disaster scenario which utilizes 4K cameras, weather sensors and radiation monitors as IoT devices. Part of the system is realized by ad-hoc network via drones and the IoT devices can push contents by a device name based routing.

Keywords Information-Centric Network (ICN), Internet of Things (IoT), Named-Node Network(3N), naming, disaster, drone, ad-hoc, seamless

1. INTRODUCTION

It is expected to use ICN network architecture for IoT application and disaster scenario because of the low latency and robustness. Existing ICN application (CCNx) has been developed featuring contents downloading. Our approach to mobility support in the ICN architecture has been to return to a fundamental mapping-based network naming structure. We created two completely new and independent namespaces to the network architecture. The resulting network architecture was the Named-Node Network (3N) [1] and here in the demonstration is IoT Device Network Architecture (IDNA).

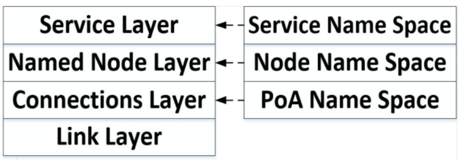

Fig. 1 Name Space architectures

The IDNA application approaches ICN based communication and enhance seamless mobility on a physical machine rather than through simulation. This new application supports seamless mobile IoT devices handoff and content push by assigning names to specific devices in the network. Furthermore, we proposed a Content-Oriented IoT solution with a new content naming mechanism and routing ability.

The application demonstrates a disaster scenario for 4K camera monitoring data transfer and the IoT device mobile applications with seamless handoff procedure using 3N architecture.

2. APPLICATION ARCHITECTURE & IMPLEMENTATION

2.1. Network Architecture & IoT Devices

In the work, we premise the IDNA for demonstrating the disaster scenario [2] emulated in figure 2. An alternative to the original ICN network, assigning names to the IoT devices offers the possibility to designate content packets with or without requiring interest packets. In the seamless mobile applications, the content packets will be efficiently redirected to the valid named client when the client obtains a new node name. Also, a device name based routing realizes content packets pushing from named data sources to named clients. This architecture effectively raises the goodput rate and reduces the bandwidth consumption. The filed network situation has a part of ad-hoc based network [3] utilizing drones.

In the IPC architecture [4], Distributed IPC Facility (DIF) is used to transmit data that written to it and the IPC Processes are initialized between every device to assemble the ICN DIF. The IPC Processes are based on current TCP/IP protocol to communicate.

The IoT devices we utilized in the IDNA are abstracted from a disaster scenario, which focuses on gathering live environmental data and evacuation information.

There are two kinds of information that vital in a disaster scenario, the development of the situation and the states of the evacuation. We implement weather sensors and radiation detectors for the live data of the disaster situation, and 4K cameras for live human flow data.

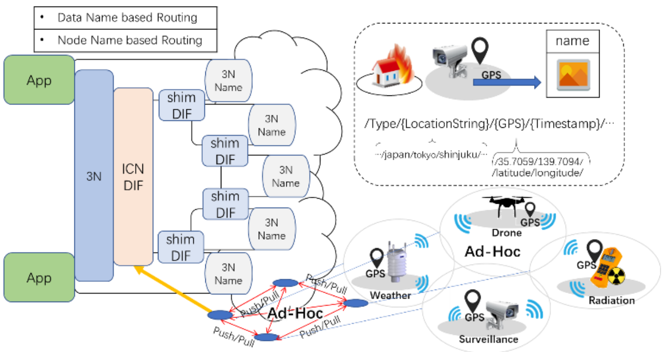

Fig. 2 IDNA Overview

2.2. Naming Architecture & IoT Devices

In, the disaster demonstration application, we handle 4K camera and weather sensor on the ICN network so that users send the interest packet to request the contents from the 4K camera and the weather data immediately at the time a disaster happens. The interest packet is required to the construct naming structure from the client requests.

In this naming mechanism, morphological analysis was performed using NLP (Natural Language Processing). It uses a Conditional Random Field (CRF) for modeling to determine origination costs and concatenation costs. CRF is a technique of sequence labeling, which is a standard chain model that outputs a corresponding sequence label when sequence data is given.

Resulting in the naming format showed in figure 2, to describe where there is a disaster happening, the content name formed into a combination of type, location string, GPS data, time stamp etc. If the IoT devices detect a disaster happening, an emergency content will be created with certain format and sent to the emergency center which is named the same way as devices.

3. DEMO SCENARIO & SETUP

To showcase the proposed architecture, we undertook a use case scenario with a simulated lab environment showed in figure 3. The demonstration has 3 goals, seamless handoff procedure, high-speed file transfer and IoT sensor data naming and retrieving.

The 4K camera monitors the human flow of a certain area, the evacuation route during a disaster, and the weather sensor maintains a live weather data feed for the area. Meanwhile, a mobile client is performing a seamless handoff procedure from one wireless section to another. During the procedure, the content packets which failed to be delivered to the old device name will be redirected to the new device name after the very device obtains a new device name. Ideally, this procedure will greatly decrease the timeout packets and raise the goodput rate of the network.

Another showcase is to demonstrate our prototype system is able to transfer large video file in high-speed. The file will be transferred from the content container to the router and then to the client. This prove that the IDNA is ready to stream high definition content such as 4K videos. With the IoT devices attached into the system, the last demonstration proves that by giving devices names, content pushing is positive using device name based routing.

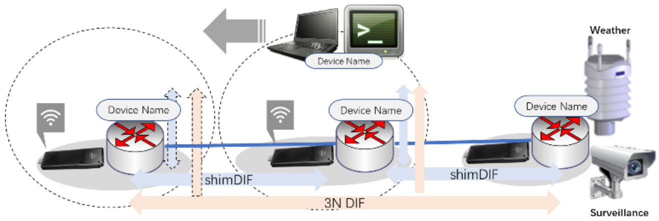

Fig. 3 Demo Scenario

4. CONCLUSIONS

In this work, the IDNA is presented. Using the proposed device naming mechanism, the system could realize content push and seamless mobility. A high-speed data transmission rate was also achieved by the system.

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REFERENCES

[1] Jairo LÓPEZ, Takuro SATO. 2017. SEAMLESS MOBILITY IN ICN FOR MOBILE CONSUMERS WITH MOBILE PRODUCERS. IEICE Transactions on Communications, Article ID: 2016EBP3435. DOI: http://doi.org/10.1587/transcom.2016EBP3435

[2] Zheng WEN, Di ZHANG, Keping YU, Takuro SATO. 2015. Information Centric Networking for Disaster Information Sharing Services. IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences, Vol. E98.A (2015) No. 8 pp. 1610-1617. DOI: http://doi.org/10.1587/transfun.E98.A.1610

[3] Zheng WEN, Di ZHANG, Keping YU, Takuro SATO. 2017. Node Name Routing in Information-Centric Ad-Hoc Network. IEICE Transactions on Fundamentals of Electronics, Communications and Computer Sciences, Vol. E100.A (2017) No. 2 pp. 680-687. DOI: http://doi.org/10.1587/transfun.E100.A.680

[4] S. Vrijders, D. Staessens, D. Colle, F. Salvestrini, E. Grasa, M. Tarzan and L. Bergesio. 2014. Prototyping the recursive internet architecture: the IRATI project approach. IEEE Network, Vol. 28, no. 2, March 2014. DOI: https://doi.org/10.1109/MNET.2014.6786609