Report on the ITC Special Interest Group (SIG) on Information Centric Networking (ICN)
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Information Centric Networking (ICN) is based on the principle that users are interested in obtaining content and are agnostic as to how or from where it is delivered and has emerged in recent years as a promising candidate paradigm for the future Internet architecture. Although existing and popular approaches such as P2P systems and CDNs also provide a user interface that is based on the name of the desired content, they depend on a name-to-location translation function in the network to then find a path to the requested content. While these systems reduce the burden on the user to know the location of the content, they still impose considerable limitations on the services that may be built on top of them. E.g., Publish/Subscribe services and the ability to query the information repository for a piece of content are still the responsibility of servers and end-systems, which poses scalability and efficiency challenges. ICN is expected to exploit the network capability for information delivery services. Below is a summary of some of the activities in which SIG members have been active in and some activities that would take place in the near future.

- Dagstuhl Seminaar (2016) -

Dagstuhl Seminars and the Dagstuhl Perspectives Workshops aim to bring together internationally renowned leading scientists for the purpose of exploring a cutting-edge informatics topic. The friendly and open climate at the conference center promotes a culture of communication and exchange among the seminar participants. The following were the ICN related Dagstuhl seminars held in this period:

1) The Dagstuhl Seminar titled Information-centric Networking and Security was held from 19th June to 22nd June, 2016. The focus of the seminar was security for ICN.
2) The Dagstuhl Seminar titled Aware Machine-to-Machine Communication was held from 28th August to 2nd September, 2016. It was co-organized by Mayutan Arumaithurai. The goal of the seminar was to discuss the role future networking paradigms such as ICN could play in the advancement of machine-to-machine (M2M) interactions such as Internet of Things (IoT), wearables, vehicular networks and smart homes.

- ICN Research group (ICNRG) -

IRTF ICNRG was started in July 2012 in the Internet Research Task Force (IRTF) to deal with issues concerning scalable naming, addressing, routing, resource control, access analysis and access management in Information Centric Networks. The ICNRG currently has 4 RFCs and many other drafts in different stages of progress. The ICNRG had its latest interim meeting at IETF-97, Seoul, South Korea.

- Asia Future Internet Forum -

Asia Future Internet Forum (AsiaFI) was founded to coordinate research and development on Future Internet among countries in Asia as well as with other continents. In order to coordinate the research and development, AsiaFI has working groups to coordinate on specific activities such as Future Internet architecture, mobile and wireless networks, and testbeds. Moreover, they host co-located conferences and workshops during conferences held by ACM, IEEE and etc. Additionally, they provide short courses as well as coordinate joint research activities.

- CUTEi Testbed -

To develop and evaluate diverse ICN protocols and applications, large-scale and extensible testbeds that facilitate realistic evaluations must be designed and deployed. NICT, a national research institute in Japan, has been developing a Linux container-based ICN testbed called CUTEi. CUTEi enables testbed users to run applications and protocols for ICN in two experimentation modes using two different container designs: (1) application-level experimentation using a “common container” and (2) network-level experimentation using a “user container.” CUTEi also implements an “on-filesystem cache” to allocate caching data on a UNIX filesystem and share the cached data with multiple containers. Thus far, the CUTEi testbed has deployed on nine sites in AsiaFI and international research organizations. The brief introduction of CUTEi was given in “5th EU-Japan Symposium on ICT Research and Innovation.” This study also appeared in IEEE Network Magazine [1].

[1] Hitoshi Asaeda, Ruidong Li, and Nakjung Choi, “Container-Based Unified Testbed for Information-Centric Networking”, **IEEE Network Magazine (to be appeared), 2014**.

- NSF Projects -

Named-Data Networking (NDN) project aims to develop a new Internet architecture that can capitalize on strengths — and address weaknesses — of the Internet's current host-based, point-to-point communication architecture in order to naturally accommodate emerging patterns of communication. By naming data instead of their locations, NDN transforms data into a first-class entity. The project studies the technical challenges that must be addressed to validate NDN as a future Internet architecture: routing scalability, fast forwarding, trust models, network security, content protection and privacy, and fundamental communication theory. The project uses end-to-end testbed deployments, simulation, and theoretical analysis to evaluate the proposed architecture, and is developing specifications and prototype implementations of NDN protocols and applications. The NDN project was funded by NSF in September 2010 as one of the four projects under NSF's Future Internet Architecture Program.

- EU projects -

-- ICN2020: Advancing ICN towards real-world deployment through research, innovative applications, and global scale experimentation. July 2016 – June 2019 –

The ICN2020 project is a EU-Japan collaborative project funded by the Horizon 2020 and NICT with a total funding on 2.6 Million Euros. The project has recently started with the goal of performing large scale experiments of ICN on realistic scenarios in order to make the vision of ICN a reality.

-- GreenICN: EU-JAPAN ICN project, April 2013 – March 2016 --

The GreenICN project which is part of the EU-Japan collaborative projects with a total funding on 3 Million Euros was recently completed. The project had made great progress and had approximately 41 peer reviewed conference publications, 20 journals, 21 workshops and 16 Poster/Demonstrations (see http://www.greenicn.org/deliverables/publications/ for the complete list). Some of the venues include Infocom 2016, IFIP Networking, ICN 2014, CONEXT 2013, Globecom 2013, Computer Networks, TPDS, TIFC, CCR, HotNets 2014, CHANTS 2014, INFOCOM NOM 2014 and ICN 2013. Noteworthy is that the project won 3 Best paper awards. The public deliverables of the project can be found in here.

- Chinese projects -

-- Smart and Cooperative Future Internet Architecture : Jan. 2013 – Aug. 2017

The Smart and Cooperative Future Internet Architecture project was founded by the Ministry of Science and Technology of the People's Republic of China under its well-known "973 Program", with a total funding of 36 million RMB. The project aims at proposing a future Internet architecture that can address many drawbacks of the current Internet such as poor security, poor scalability, poor support for mobility and multi-homing, and energy harvesting. The project has made good progress and has published many peer reviewed publications.

-- ICN related Events (Where SIG members contributed) --

-- 3rd ACM conference on Information-Centric Networking (ACM ICN 2016) --

Prof. Xiaoming Fu had successfully co-organized the ACM 3rd International Conference on Information Centric Networking (ICN 2016) in Kyoto, Japan, September 26-28, 2016. It was a joint effort with colleagues at University of Tokyo, KDDI Labs, Osaka University and University College London, key contributors of two consecutive EU-Japan projects GreenICN (2013-2016) and ICN2020 (2016-2019). The conference attracted more than 100 attendees from all over the world, with an exciting technical program composed of 15 full papers, 8 short papers, 8 posters and 10 demonstrations selected from open call submissions, in addition to 2 panels and an affiliated workshop on Information Centric Networking for 5G (IC5G 2016). SIG ICN members had 2 accepted papers.

-- Workshop on Information Centric Network Solutions for Real-World Applications (Co-located with Globlecom 2015), San Diego, U.S.A

The Workshop on Information Centric Network Solutions for Real-World Applications (ICNSRA) was held in conjunction with IEEE Globecom 2015, San Diego, U.S.A. The ICNSRA focused on Real-world applications and how ICN could be applicable there. SIG ICN members had an accepted paper at the workshop and were also part of the TPC. The workshop will also be held in conjunction with Globecom 2016.

-- The Workshop on Name Oriented Mobility (INFOCOM NOM 2016), San Francisco, U.S.A –

The INFOCOM NOM 2016 workshop was held in conjunction with the 35th Annual IEEE International Conference on Computer Communications (INFOCOM'16) on 11th April, 2016 in San Francisco, U.S.A.

-- National Institute of Standards (NIST) Workshop on Named Data Networking (May/June 2016), Gaithersburg, MD, U.S.A. –

The two-day NIST Workshop on Named Data Networking took place on the NIST campus in Gaithersburg, MD on May 31-June 1, 2016. NIST has ongoing efforts in Cyber-Physical Systems, Internet of Things and Big Data. This workshop gathered representatives from industry, government, and academia to discuss the role that the NDN future internet architecture can play in support of these critical network environments, as well as future content delivery over mobile networks (e.g., augmented reality).

Future internet architectures based on the information-centric networking (ICN) paradigm propose to address ongoing challenges in supporting modern applications with IP, especially in networks of diverse and intermittent links. To do so, they effectively bring Web-like semantics to the network layer, directly supporting dissemination of named, signed data. Named Data Networking (NDN) is one such architecture that has a growing community of interest.