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 (2014) -

The [3rd Dagstuhl seminar](#) on Information Centric Networking was held from 13th July 2014 – 16th July 2014. 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 Dagstuhl ICN seminar was attended by 37 renowned scientists well known for their contributions in the ICN space. Earlier Dagstuhl seminaars in ICN was held in 2010 and 2012.

- 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. ICNRG has had 13 meeting till date and the latest meeting took place in Paris, in September immediately after the first ACM ICN conference. ICNRG currently has 6 working group documents that deal with topics such as survey, research challenges, baseline scenarios, evaluation methodology, video distribution and IoT. Some of these documents are in the final stages and will soon be sent to the RFC review

process. The next meeting is planned to be co-located with IETF 91 at Honolulu, U.S.A, which will held from 9-14 November 2014.

- **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.

- 1st **HoTICN Seminaar, China**   -

The 1st Chinese [HotICN](#) seminar on Information Centric Networking was held on 7th December 2013 in Peking University, Beijing. HotICN is sponsored by CCF (China Computer Federation) and the national high-tech (863) project "Future Network Architecture and Innovation Environment", and is hosted by Peking University. HotICN aims to bring together young leading scientists of China for the purpose of exploring the cutting-edge ICN topic. The HotICN seminar was attended by about 100 researchers from China, USA, and promotes a good communication and exchange among the participants.

- **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 will be also appeared in IEEE Network Magazine.

- 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   -

-- 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 has recently crossed the half way mark. The project has made good progress and has approximately 17 peer reviewed conference publications, 11 journals, 10 workshops and 5 Poster/Demonstrations (see http://www.greenicn.org/deliverables/publications/ for the complete list). Some of the venues include ICN 2014, CONEXT 2013, Globecom 2013, Computer Networks, TPDS, TIFC, CCR, HotNets 2014, CHANTS 2014, INFOCOM NOM 2014 and ICN 2013. A paper co-authored by GreenICN members and SIG members won the "Best Paper Award" at ICN 2014 for their paper titled "Exploiting ICN for Flexible Management of Software-Defined Networking".

--SAIL : EU project (Completed in February 2013) --

The EU SAIL project organized a co-located workshop that included the final demo of the SAIL project on the 13th of February. With the final demo, the EU project SAIL came to a successful end.

- Chinese projects   -

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. Some of them are listed below:

1) Hongbin Luo, Zhe Chen, Jianbo Cui, Honeke Zhang, Moshe Zukerman, Chunming Qiao, "CoLoR: An Information-Centric Future Internet Architecture for Innovation," **IEEE Network Magazine**, vol. 28, no. 3, June 2014, pp. 4 - 10.

2) Hongbin Luo, Honeke Zhang, Moshe Zukerman, Chunming Qiao, "An Incrementally Deployable Network Architecture to Support Both Data-centric and Host-centric Services," **IEEE Network Magazine**, vol. 28, no. 4, July/August 2014.

3) Hongbin Luo, Yi Lin, Honeke Zhang, Moshe Zukerman, "Preventing DDoS Attacks by Identifier/Locator Separation," **IEEE Network Magazine**, vol. 27, no. 6, Dec. 2013, pp. 60 - 65.

4) Hongbin Luo, Hongke Zhang, Chunming Qiao, "Optimal cache timeout for identifier-to-locator mappings with handovers," **IEEE Transactions on Network and Service Management**, Jan. 2013, vol. 10, no. 2, June 2013, pp. 204 - 217.

5) Zhe Chen, Hongbin Luo, Jianbo Cui, Mingshuang Jin, "Security Analysis of a Future Internet Architecture," in **Proc. IEEE ICNP workshop on Secure Network Protocols (NPSec'13)**, Gottingen, Germany, Aug. 2013.

6) Hongbin Luo, Zhe Chen, Jianbo Cui, Hongke Zhang, "An Internet Architecture for Efficient, Accurate, and Timely Estimation of Traffic Matrices," in **Proc. IEEE INFOCOM Workshop on Global Internet**, April 2014, Toronto, Canada.

7) Hongbin Luo, Jianbo Cui, Gong Chen, Zhe Chen, Hongke Zhang, "On the applicability of software-defined networking to large scale networks," in **Proc. IEEE ICCCN 2014 Workshops**, Aug. 2014, Shanghai, China.

8) Hongbin Luo, Jianbo Cui, Zhe Chen, Mingshuang Jin, Hongke Zhang, "Efficient integration of software defined networking and information-centric networking with CoLoR," **in Proc. Of IEEE GLOBECOM'14**, Dec. 2014, Hawaii, USA.

9) Shuai Gao, Yujing Zeng, Hongbin Luo, Hongke Zhang "Scalable Area-based Hierarchical Control Plane for Software Defined Information Centric Networking," In **Proc. of IEEE ICCCN Workshops**, Aug. 2014, Shanghai, China.

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

-- 1st ACM conference on Information-Centric Networking (ACM ICN 2014) --

ACM ICN 2014, 1st ACM conference on Information-Centric Networking was held in Paris from the 24th-26th September. The conference received a large number of submissions of which 17 were selected for full paper (acceptance ratio: 17%) and 8 were selected for posters. The conference also had a demonstration session with 10 demos. SIG ICN members had an accepted paper that won the "Best Paper Award" at the conference.

-- International Workshop on Quality, Reliability, and Security in Information-Centric Networking (Q-ICN 2014)

The International Workshop on Quality, Reliability, and Security in Information-Centric Networking (Q-ICN) was held in conjunction with the 10th International Conference on Heterogeneous Networking for Quality, Reliability, Security, and Robustness on 20th August 2014 in Rhodes, Greece. The Q-ICN workshop focused on architectures, models, algorithms, and protocols for supporting quality, reliability, and security in Information-Centric Networking. The program included 8 full paper presentations and 5 work-in-progress presentations. The program included diverse work related to measuring the quality of ICN architectures, the application of ICN to wireless/mobile networks and the Internet of Things, naming and information exposure, content replication and caching, and content adaptation and accounting. SIG ICN members had an accepted paper at the workshop.

-- The 2nd Workshop on Name Oriented Mobility (INFOCOM NOM 2014), Toronto, Canada –

The INFOCOM NOM 2014 workshop was held in conjunction with the 33rd Annual IEEE International Conference on Computer Communications (INFOCOM'14) on 28th April, 2014 in Toronto, Canada. The workshop had 12 papers and 2 key notes. SIG ICN members were part of the steering committee, TPC and also had an accepted paper at the workshop.

-- IEEE ICNP 2013, Goettingen, Germany --

The 21st edition of ICNP, ICNP 2013, was held at the Mathematics Institute at the University of Göttingen, October 7-10, 2013. The Project coordinator of GreenICN and member of SIG ICN, Prof. Xiaoming Fu was the General co-chair. Of special highlight was the notion of Information Centric Networking (ICN). ICNP'13 had a specific session on ICN and the panel was centric to "The Future of Information-Centric Networking", where experts from the academia and industry raised various opinions and prospects on this future Internet technology. SIG ICN participants participated in the Demonstration session.

-- ICN industry forum   --

[Prosper Chemouil](#) is the member of the steering committee of the [Emerging Networks Consortium](#). It is an industry forum (Emerging Networks Consortium) that has been created in 2012 under the coordination of PARC (USA) so as to promote ICN in the industry. Founding members include Alcatel-Lucent, BT, France Telecom-Orange, HCL, Huawei, MACH, Panasonic, and Samsung Electronics Co., Ltd**.**

- Publications in peer reviewed recent conferences/Workshops/Journals   -
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♣ Hitoshi Asaeda, Ruidong Li, and Nakjung Choi, "Container-Based Unified Testbed for Information-Centric Networking", **IEEE Network Magazine (to be appeared), 2014**.

♣ Mayutan Arumaithurai, Jiachen Chen, Edo Monticelli, Xiaoming Fu, K.K. Ramakrishnan, "Exploiting ICN for Flexible Management in Software-Defined Networks",**in Proceedings of 1st ACM Conference on Information-Centric Networking (ICN-2014),** 24-26 September 2014. (Best Paper Award, Acceptance Ratio: 17%)

♣ Nicola Blefari Melazzi, Andrea Detti, Mayutan Arumaithurai, K.K. Ramakrishnan, "Internames: a name-to-name principle for the future Internet", **Q-ICN workshop (in conjunction with Q-SHINE), Rhodes, Greece, August 2014.**

♣ Edo Monticelli, Benno M. Schubert, Mayutan Arumaithurai, Xiaoming Fu, K.K.Ramakrishnan, An Information Centric Approach for Communications in Disaster Situations, **the 20th IEEE LANMAN workshop, May 2014.**

♣ Ioannis Psaras, Lorenzo Saino, Mayutan Arumaithurai, K.K. Ramakrishnan, George Pavlou,**Name-Based Replication Priorities in Disaster Cases**, **The 2nd Workshop on Name Oriented Mobility (NOM 2014) in conjunction with the IEEE INFOCOM 2014,** Toronto, Canada, April 28 2014.

♣ Mayutan Arumaithurai, K.K.Ramakrishnan, Toru Hasegawa, Information Centric Networking: The Case For An Energy Efficient Future Internet Architecture, **Book on Green Communication, Chaper titled "Information-centric and cloud networking", Wiley**, to be published in late 2014.

♣ Jiachen Chen (University of Goettingen), Mayutan Arumaithurai (University of Goettingen), Xiaoming Fu (University of Goettingen) and K.K. Ramakrishnan (AT&T Labs-Research, U.S.A), Reliable Publish/Subscribe in Content-Centric Networks, *the 3rd ACM SIGCOMM Workshop on Information-Centric Networking (ICN'13),* Hong Kong, China, August 2013.

♣ Jiachen Chen (University of Goettingen), Mayutan Arumaithurai (University of Goettingen), X. Fu (University of Goettingen) and K.K. Ramakrishnan (AT&T Labs-Research, U.S.A), **CNS: A Content-centric Notification Service**, *the 21st IEEE International Conference on Network Protocols (ICNP 2013),* **Demo session,** October 2013.