Summary of

EuroView2011: "Visions of Future Generation Networks"

Joint ITG and Euro-NF workshop co-located with official G-Lab status meeting

August 1st – August 2nd 2011, Würzburg, Germany

Comprehensive Summary Focusing on the Major Outcomes

The EuroView2011 workshop opened on Monday, August 1st, with an introduction by Prof. Tran-Gia giving an overview on the history of the EuroView event taking place for the eleventh time this year. As well, he gave a short update on the inter-disciplinary Internet Research Center (IRC), recently founded at the University of Würzburg, which combines research activities of computer scientists with scientists from law and psychology.

The technical discussion started with a **keynote talk** by Dr. Robert Kahn *(Corporation for National Research Initiatives (CNRI), Reston, Virginia, US)* on "A Framework for Managing the Digital Object (DO) Architecture". The keynote covered the DO architecture and its applications and described possible framework principles. The architecture consists of three primary components, which are an identifier/resolution system, a DO Repository, and the DO Registries. The resolution system map handles of DOs into state information of DOs. The DO Repository provides a uniform interface to the stored DOs and access to the stored DOs by means of their identifiers. Finally, the DO Registries enable users to determine identifiers based on search criteria such as keywords. The keynote concluded with an outlook how the DO framework could provide a useful model for the coordination of similar capabilities in the future Internet.

The **first session** covered **"Social Networks and QoE"** and was chaired by Ralf Lehnert (Technical University of Dresden, Germany). In this session, three talks presented actual research related to the Quality of Experience of end-users and current topics in social networks. The first talk covered the relationship between quality of experience (QoE) and quality of service (QoS) of the underlying network. The main focus of the talk was the question, how network operators can keep their end-users satisfied while staying in business and minimizing their costs. As an example, the relationship of QoS per mobile end-user in a cellular network to the QoE per mobile end-user was demonstrated. The second talk introduced the modelling of emerging social networks and crowdsourcing as these networks are a driver for the future Internet and hence get more and more important. In detail, the presentation highlighted promising aspects of quantitative studies that incorporate models, abstractions, and perspectives of computer science, mathematics, statistical physics, quantitative sociology, and theoretic biology. The last talk in this session was about a relationship-centric networking paradigm which uses social informatics to determine the trust toward a certain piece of information. This idea was demonstrated via an API for the E-mail program Thunderbird and for the social network Facebook.

The **second session** was dedicated to the **GENI project** which was organized by Mark Berman, being the Experimentation Director for the GENI Program Office (GPO) and Vice President for Technology Development at BBN Technologies. He presented GENI's conceptual design and how it is intended to be used. Another focus of this talk was on future

steps for the GENI project which mainly are a) extending the number of participating university to more than 100 participants and b) to create additional support tools which facilitate experiment design. The second talk was about resilience experiments in the GpENI programmable future Internet testbed. The GpENI testbed provides a programmable control of each layer and hence is the ideal basis for the presented resilience experiments. The talk first gave an introduction to the GpENI infrastructure and then described the resilience research in detail. The third talk focused on Transcloud which is a high-performance cloud architecture across multiple administrative domains. The main motivation of Transcloud is to minimize the communication delay by migrating services near to the location of the consumer. The last talk in this session was on a demonstration of NowCasting, an application providing short-term weather forecasts. The demonstration was an end-to-end demonstration which comprises sensing, networking, and computing resources and the problem how to get the data, required for the forecasts, from the weather sensors to the end-users via a web portal.

The **third session** covered **"Future Internet Initiatives"** and was chaired by Michael Menth (University of Tübingen, Germany). The first talk was an invited talk from Younghee Lee, project manager at the Korea Communications Agency in Seoul, Korea. The focus of the talk was on "The Future Internet Research Plan in Korea". He presented a brief overview of current projects related to future Internet architectures, management, testbeds, and delay tolerant networks. The second talk was about the Polish initiative to develop a laboratory infrastructure for testing future Internet solutions. The project has a funding of 10 Million Euros and in total, 120 researchers are involved in the project. The goal is to allow experiments in parallel virtualized networks where different network and transport layer protocols can be deployed and tested. The third talk, given by Kurt Tutschku, highlighted the Euro-NF vision for future networks and presented the contributions from the Specific Joint Research (SJRP) and Specific Joint Development and Engineering (SJDE) projects. The first part of the presentation was about a systematic and holistic design and engineering approach for smart applications in future networks. In the second part, recent contributions from SJRPs (ASPECTS, EnergyOPAL, VDTN, CAVE-NET) and SJDEs (Multi-Next, VNREAL) were presented and it was shown, how these projects materialize the vision on a short-time scale. The last talk in this session was about the SJDE VNREAL and introduced ALEVIN, a framework for virtual network embedding (VNE) algorithms. VNE is NP-complete and there are different heuristics available to tackle this problem. However currently, there is no mechanism available to evaluate the different algorithms. ALEVIN hence provides a framework to compare different VNE algorithms. As future work, it is intended to optimize the analysis with respect to additional metrics like energy consumption, security, or resilience and to investigate the application in larger test-bed scenarios.

The **fourth** and last **session** on the first workshop day was about **network protocols** and was chaired by Thomas Bauschert (Technical University of Chemnitz, Germany). The first talk presented a solution for the synchronization problem in interconnected metro access and metro core ring networks. The talk presented the mechanism called Common-used Timer Mechanism which is implemented in the hub node in between the interconnected rings. To demonstrate the viability, results from an implementation in ns-2 were shown. The second talk introduced challenges due to machine to machine (M2M) communications in cellular radio access networks. At first, different use cases were demonstrated and with respect to them, the challenges for mobile cellular networks were explained. The third talk then covered an analysis of resilience in virtual networks. The analysis presented challenges and opportunities in terms of resource utilization, service level resilience adaptation and complexity that virtual network operators and the physical infrastructure provider will face

when they want to offer resilience in their networks. The fourth talk was about gaming with COPS, a content centric communication infrastructure for gaming applications. The architecture uses the content centric networking paradigm and extends it with a push-based dissemination system to achieve more efficient transmissions. The fifth and last talk was about Internet-based content delivery traffic management with CDN and P2P overlays. The talk presented properties of current application layer overlays and draw the conclusion that P2P applications need to shorten the transport path to stay competitive with CDNs. With respect to cross layer traffic engineering and load balancing, approaches on CDN/P2P and network layer need to be aware of each other and should be coordinated to achieve a higher gain.

On Tuesday, August 2nd, the second and last day of this year's EuroView took place with three different sessions, as well as the demo and poster session. The day started with a **keynote talk** from **Yanghee Choi** (Seoul National University, Future Internet Forum, Korea) about a "Networking Paradigm for Information Universe". The presentation consisted of two parts. The first part was about big trends in IT and the second part was about the Internet in the remote future (2030) and its requirements from users, devices, and applications. The Internet in 2030 will use realtime as a tool for time shifting, place shifting, or content shifting which requires a very small delay. This requires a paradigm shift for the future Internet because realtime will be a key requirement.

The **fifth session**, the GLAB session, covered the topic of **security and quality of service** and was chaired by Erwin Rathgeb (University Duisburg-Essen, Germany). The first talk was a panel demo and demonstrated a malware analysis in the ToMaTo testbed. A virtual machine was used as victim and several additional components like a fake DNS server were used to analyse the behaviour of the virus. The talk gave a good overview of the usage of ToMaTo and its possibilities and used the virus analysis as use case. The second talk was about HAMcast which implements an exemplary universal multicast service. The major building blocks are a universal service API, extended middleware functionality, and incremental service deployment. The third talk was about a G-Lab application-to-network interface which is the outcome of the GLAB special interest group about functional composition. The basic idea of this work is to shift functionality into the network stack so that the presented API gets the new waist for the hourglass IP model. The fourth talk then was about media processing in the future Internet and the MediaCloud approach. The idea of MediaCloud is to provide a 360 degree panoramic view using several cameras, a camera stitching module, and a service nexus for the service control and media delivery to mobile devices like for instance iPads.

The **sixth session** after the lunch break was about **Future Internet activities in the FP7 framework** and was chaired by Dr. Rüdiger Martin (European Commission, Brussels, Belgium). The firs talk gave an overview of the current funding within the framework program 7 (FP7) and future funding in the EU. The call 8 is currently open and there is for instance a call for projects related to cloud computing. For the remote future, a new framework program is created. The Common Strategic Framework (CSF) for EU research and innovation is scheduled about 2020. A part of the current FP7 is the Future Internet Private Public Partnership. The idea of the FI PPP is to foster research with respect to smarter infrastructure and business processes through tighter integration with the Internet. The following talks will be from the FI PPP. The second talk was about the vision of the FI-WARE project which is to turn the Internet into a global business platform for service economies. The time schedule of the project is from September 2011 to May 2014. During this period, there are two open calls issued and several version of the core platform released.

The purpose of the open calls is to get new project partners which propose ideas how to use the FI-WARE platform. The third talk was about FINSENY which stands for Future INternet for Smart ENergy and was about how key actors from the ICT and energy sector team-up to identify the ICT requirements of smart energy systems. The last talk in this session then was about the INFINITY project which stands for INfrastructure for the Future Internet commuNITY. The goal of this project is to bring together users and infrastructures to enable testing and experimentation of novel future Internet technologies. The idea is that current active infrastructures are catalogued so that it is feasible for users to select the most suitable one for their particular trials.

The **seventh** and last **session** covered **Wireless and Mobile Networks** and was chaired by Jörg Eberspächer (Technical University of Munich, Germany). The first talk was about a performance evaluation of multipath TCP Linux implementations. For the performance evaluation of the different variants, ToMaTo was used to create the topology for the virtual networking testbed. A client program written in C was used to model applications with different bandwidth requirements. The evaluation demonstrates the behaviors of the different variants in different scenarios. The second talk was about application-aware self-optimization of wireless mesh networks with AquareYoum and DES-SERT. AquareYoum makes wireless mesh networks application aware and the concept of AquareYoum was ported to a larger mesh testbed, the DES-testbed. The DES-SERT framework is intended for developing routing protocols for WMNs and this panel demo demonstrated the interaction between AquareYoum and DES-SERT. The third talk then was about a novel threshold-based transmission control scheme for wireless sensor networks. The talk introduced and analyzed a modification of the threshold sensitive energy-efficient sensor network protocol (TEEN) in order to increase the lifetime of a WSN. TEEN is a cluster-based routing protocol for enhanced efficiency in wireless sensor networks. The fourth and last talk covered system enhancements for accessing broadcast services in All-IP networks. The presentation outlined the All-IP network solution and the evolved Multimedia Broadcast Multicast Service (eMBMS) architecture defined by 3GPP and proposed two possible solutions of interworking between the two architectures.

EuroView 2011 in a Nutshell

General Information

Full name of the event: 11th Würzburg Workshop on IP: Joint ITG and Euro-NF Workshop "Visions of Future Generation Networks" (EuroView2011)

Date: 1. -2. August 2011

Place: University of Würzburg, Germany

Number of participants: 143

Quality of the event and main scientific outcomes

The EuroView2011 workshop comprised

- 7 sessions with 3 sessions organized on particular research topics
  - Future Internet Activities in FP7 (organized by Dr. Rüdiger Martin)
  - GENI project in US (organized by Mark Berman)
  - G-Lab project in Germany
- 1 demo and poster session with 8 demos and 11 posters
- 2 keynote talks by Dr. Robert E. Kahn (Corporation for National Research Initiatives (CNRI), Reston, Virginia, US): "*A Framework for Managing the Digital Object Architecture*" and Prof. Yanghee Choi (Seoul National University, Seoul, Korea): "*Networking Paradigm for Information Universe*"
- 30 presentations

Discussion on questions and problems in today's Internet during EuroView2011

- What are use cases for inter-cloud computing? What mechanisms are necessary to ensure secure inter-cloud communication?
- How to extend current cellular networks in order to support Machine-to-Machine (M2M) communication efficiently.
- How to achieve resilience for virtual networks?
- How to change ICT in order to enhance energy efficiency?

Main observations were highlighted and conclusions derived accordingly

- Internet research represents a challenging field of research bringing together various scientific fields
- Interdisciplinary Internet research is required, e.g. combining research activities of computer scientists and engineers with scientists from psychology (e.g. Quality of Experience), law (e.g. E-Government), and social sciences (e.g. social networks)
- Emerging paradigms in the Internet
  - QoE management as new paradigm in the Internet dealing with user perceived Quality-of-Experience of end users instead of Quality-of-Service parameters
  - Presentation of Crowdsourcing as new paradigm which enables delegation of micro jobs to huge number of workers
  - Move applications not data as a new paradigm in the Internet:, move today's network / computing paradigm from app centric (centralized) towards network-aware media centric (distributed).
- Outcome and next steps of GENI project
  - GpENI platform opened for new participants ("ramping up experiments")
  - Development of further experimentation tools
  - TransCloud as experimental cloud application
  - Enhancing email with social networks
  - Realtime online data processing of huge amounts of data with respect to short term weather forecasts
- Current state of further Future Internet initiatives

- o Future Internet research plan in Korea including a detailed overview over the current projects
  - o P-Lab as the Polish initiative for developing the infrastructure for investigating future Internet solutions
- Presentations from the EuroNF network
  - o Systematic and holistic design and engineering approach for smart applications and the Future Internet
  - o EuroNF small projects (SJRP,SJDE) as incubator for new ideas:
    - Future internet architectures
    - Experimental driven research and prototype implementations enhance current methodologies
  - o Presentation of the outcome of such a small project (SJDE Alevin)
- Planning and embedding of virtual networks into the physical infrastructure important for network provider
- Challenges of M2M communications for cellular radio access
  - o High diversity of applications (metering, health care, logistics…)
  - o Different requirements: low power, low latency, high reliability
  - o High number of end devices within one cell
  - o Current standardization activities (802.16p, 802.16m)
  - o M2M communication approaches as possible enablers for the IoT
- Smart grid enabled by the Future internet
- Content Centric Networking approaches as essential part of the future internet. This was reflected in particular by the Keynote speech given by Bob Kahn.
- Service migration towards cloud architectures.

Key technologies / approaches / use cases for the Future Internet are

- Use cases leading to novel technologies/approaches
  - o Media processing in the cloud
    - Live gaming mechanisms
    - Enhanced future video streaming applications
  - o Service Component Mobility Enabled by Network Virtualization
  - o Cross-Layer Security and Functional Composition for a Future Internet
- Key technologies and approaches:
  - o Intercloud communication, Cloud computing
  - o Monitoring of important parameters beyond networking:
    - Capex/ Energy efficiency
    - Quality-of-Experience (QoE)
    - Degree of security
  - o Digital object identifier architectures for Content Centric Networking

Impact on the integration process and relation with other ongoing activities

The EuroView workshop in 2011 was a joint event between Euro-NF and the German Information Technology Society (ITG). The workshop series originated in 2000 and is supported since then by the German Information Technology Society. Since 2006, the workshop series focuses on "Visions of Future Generation Networks" and is called EuroView which is financially sponsored by the Network of Excellence EuroNF (within European

Union Framework Programme 7). This year's event is again co-located with the official G-Lab status meeting. As can be seen from the program, major topics covered among others "social networks and Qoe" and "new network protocols", as well as "security issues", i.e. malware analysis with the help of testbeds, and "wireless and mobile networks". Since the Euro-NF project finished in 2011, the results of this workshop cannot be integrated directly in Euro-NF. However, the observed trends (as discussed in the previous section about the quality of EuroView2011 and its main scientific outcomes) will be reflected in related workshops/conferences/project.

Impact on the spreading of the excellence process

From the list of participants, it can be seen that 75% of the participants are academic, while 15% come from industry and 10% from research initiatives. In addition, the co-location with the G-Lab status meeting attracted several people (from industry and academia) in order to follow the progress in Future Internet research, in particular in getting insights into the G-Lab project and implementation of new ideas as demonstrated in the demo session.

Beside the cooperation with industry, SMEs, and other European projects, the Euro-NF NoE recognizes as a very important activity the liaison with international initiatives. Important international initiatives which follow similar or closely related scientific research directions, in the context of anticipating the Future Internet, are the GENI project (US), The Future Internet Forum (FIF, Korea) and the G-Lab project (Germany). In addition to these initiatives, it is recommended to disseminate the knowledge of the NoE and to collaborate with leading research institutes outside of Euro-NF. To this end, the keynote talk by Dr. Robert Kahn and Prof. Yanghee Choi helped to foster such liaisons and the contacts between members of Euro-NF, FIF and GENI could be strengthened.

Evaluation of the outcomes based on feedback and comments from the participants

The user survey contained four different sections on 1) the quality of the workshop, 2) the organization of the workshop, 3) the personal outcome and impressions, and 4) proposals for improvement. The opinion rating scale is: 5=Excellent, 4=Good, 3=Fair, 2=Bad, 1=Very bad. In the following, the mean opinion scores of the participants are presented:

- General rating of the workshop: 3.94
- Content rating whether the topics are of interest for the participant: 3.59
- Relevance of topics for the Future Internet: 3.85
- Most interesting sessions
    - Demo Session and Poster Session (23%)
    - Social Networks and QoE (20%)
    - Wireless and Mobile Networks (16%)
    - GENI (14%)
    - Security and Quality of Service (9%)
    - Network Protocols (8%)
    - Future Internet Initatives (8%)
    - Future Internet Activities in FP7 (3%)
- Most interesting talks
    - Dennis Schwerdel: "Malware Analysis in the ToMaTo Testbed" (Panel Demo) (21.0%)
    - Barbara Staehle: "Application-Aware Self-Optimization of Wireless Mesh Networks with AquareYoum and DES-SERT" (Panel Demo) (10.5%)
    - Ingo Scholtes: "Modelling of Emerging Internet Services: Social Networks and

Crowdsourcing"

- Most interesting demos
    - Service Component Mobility Enabled by Network Virtualization (47%)
    - Media Processing in the Future Internet (13.5%)
    - Cross-Layer Security and Functional Composition for a Future Internet (13.5%)
- Organization of workshop: pre-workshop organization (3.97), local and on-site organization (4.12), refreshments (4.06), social event (4.22)
- Workshop inspired new ideas for participant's work: 3.45
- Workshop inspired joint projects, development or joint publications: 3.54
- Mix between academia and industry: 3.63 (more partners from industry, network operators are desired)
- 79% of the participants will join another EuroView workshop; 17% gave no answer