IBM Israel – HRL Cloud Networking Group

5G PPP PHASE 2 INFORMATION DAY AND STAKEHOLDERS EVENT
June 30, 2016 – Athens – Greece

The control plane challenges in converged 5G networks - scalability, application awareness, multi-tenancy, and more

Expertize Overview and 5G PPP Interest Statement

Who we are

- IBM Research Lab in Haifa, Israel
  - Computing as a Service area
    - Cloud Platforms department
      - **Cloud Networking Group**

      (managed by K. Barabash)

- A stand alone research group
  - Four PhDs in various aspects of computer communications
  - Well aligned with IBM business

Focus: Next Generation Data Center and Cloud Networking Research

- Efficient, SW-based, service-rich networking
  - For Cloud Data Centers and Services
  - For Cloud Edge Connectivity – Mobile, IoT, Fog, Vehicular

Network Control Plane Trends

- We are engaged in building Network Solutions for Data Centers since 2007
  - Distributed overlays – FP7 RESERVOIR VANs
  - Centrally controlled (SDN) overlays – IBM DOVE
  - Interplay between the overlay and the infrastructure layers – FP7 COSIGN
  - Multi-DC Networking – H2020 BEACON
  - Cloud Networking – OpenStack Neutron and extensions
- The trend is towards increasing Data Centers Network scale and geo-diversity
- Single-DC case is challenging
  - Communicating endpoints of different types and varying communication patterns
  - More traffic flows in/out, across different data centers, and inside a data center
  - Multi-tenancy
- Multi-DC case is even more challenging

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Edge inclusion
(mobile devices, things, sensors, vehicles, etc)
will heavily overstress the capabilities of all the known state-of the art solutions!!!

Network Control Plane Challenges at Scale

- Find a 'sweet point' between the distributed and the centralized paradigms
  - Allow autonomous decisions but encounter for them globally
- Take care of workload diversity
  - Devices, communication patterns, data models, KPIs, etc.
- Take care of technological diversity
  - Capabilities, capacities, power requirements, protocols, etc.
- Respect privacy and policies of different authoritative domains
  - While allowing transparent reallocation and reassignment of their resources
- Ensure resiliency and availability of the critical services

Addressing Control Plane Challenges at Scale

Requires new approaches for networking information flow

From the management, through the control, to the data planes – for establishing connectivity

From the data plane, through the data collectors, to the cognitive decision making – for learning, exploration, and adaptation

From the cognitive decision making engines back to the management plane – to complete the feedback loop and improve upon the KPIs

Thank you!

☺

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Back Up

More Information about the Team

Networking Research Assets Summary

- Research Publications
  - The most recent submitted on June 17, 2016 to CoNext'16
  - See backup slide
- Patent Applications
  - The most recent is currently in search
  - See backup slide
- OpenSource
  - Hands on experience and contributions
  - See backup slide
- EU projects
  - Continuous engagement starting with 2007
  - See backup slide

Open Source Projects

Hands on experience and contributions

- Network virtualization and SDN projects
  - Experience – OVS, Ryu, mininet
  - Contributions – OVN, OpenDaylight

- Cloud Management – OpenStack Project
  - Experience – Nova, Ceilometer, Heat, Horizon, Keystone, Swift, …
  - Contributions – Neutron, Octavia

- Network Monitoring and DevOps projects
  - Experience – sFlow, vagrant, devstack, …
  - Contributions (planned) – SkyDive

EU Involvement

- FP7 RESERVOIR – Resources and Services Virtualization without Barriers
  - We have developed Virtual Application Network (VAN) infrastructure
- FiWare – we have contributed Distributed Overlay Virtual Ethernet (DOVE)
- FP7 CloudWave – Agile Service Engineering for the Future Internet
  - We contribute Elastic Load Balancer Service based on OpenStack Octavia
- FP7 COSIGN – Optics and SDN for Next Generation Data Center Networks
  - We contribute hybrid network topology research and SW architecture for combining the overlay and the underlay controllers
- H2020 BEACON – Interconnecting heterogeneous clouds
  - We contribute multi Data Centre SDN architecture
- 5G PPP Association membership and active involvement
  - Specific interests are 5G architecture, SW orchestration, verticals (in particular transportation)

Selected Papers

- EnforSDN: Network policies enforcement with SDN. **Y Ben-Itzhak**, **K Barabash**, R Cohen, A Levin, **E Raichstein**; Integrated Network Management (IM), 2015 IFIP/IEEE International Symposium
- NoEncap: overlay network virtualization with no encapsulation overheads. **S Guenender**, **K Barabash**, **Y Ben-Itzhak**, **A Levin**, **E Raichstein**, **L Schour**; Proceedings of the 1st ACM SIGCOMM Symposium on Software Defined Networking
- Networking architecture for seamless cloud interoperability. **A Levin**, **K Barabash**, **Y Ben-Itzhak**, **S Guenender**, **L Schour**; 2015 IEEE 8th International Conference on Cloud Computing, 1021-1024
- HNOCS: modular open-source simulator for heterogeneous NoCs. **Y Ben-Itzhak**, E Zahavi, I Cidon, A Kolodny; Embedded Computer Systems (SAMOS), 2012 International Conference on, 51-57
- Partition/aggregate in commodity 10g ethernet software-defined networking. R Birke, D Crisan, **K Barabash**, **A Levin**, C DeCusatis, C Minkenberg, 2012 IEEE 13th International Conference on High Performance Switching
- A route-control mechanism for improving the performance of transport protocols in a MANET. R Cohen, **A Levin**; 2009 IEEE 34th Conference on Local Computer Networks, 546-553
- To drop or not to drop: On the impact of handovers on TCP performance. R Cohen, **A Levin**; INFOCOM Workshops 2008, IEEE, 1-6
- Architecting the Next Generation DCN for Flexibility and Scale with Optics and SDN. **K Barabash**; Optical Fiber Communication Conference, M2H. 3
- Datacenter applications in virtualized networks: A cross-layer performance study. D Crisan, R Birke, **K Barabash**, R Cohen, M Gusat; IEEE Journal on Selected Areas in Communications 32 (1), 77-87

Selected Patent Applications

- FAST RENDERING OF WEBSITES CONTAINING DYNAMIC CONTENT AND STALE CONTENT United States Patent Application 20160026611
- ENHANCED TECHNIQUES OF TCP ACK TRANSMISSION IN UPLINK United States Patent Application 20150215218
- LIVE MULTI-HOP VM REMOTE-MIGRATION OVER LONG DISTANCE United States Patent Application 20110145380
- Bandwidth Control in Multi-Tenant Virtual Networks United States Patent Application 20150040121
- CONTEXT-AWARE NETWORK SERVICE POLICY MANAGEMENT United States Patent Application 20160173535
- Distributed Address Resolution Service for Virtualized Networks United States Patent Application 20130107889
- APPLICATION LEVEL MIRRORING IN DISTRIBUTED OVERLAY VIRTUAL NETWORKS United States Patent Application 20150195343
- Propagating a Flow Policy by Control Packet in a Software Defined Network (SDN) Based Network United States Patent Application 20150312142
- Reducing encapsulation overhead in overlay-based networks United States Patent Application 20150312054
- Reducing network and appliances load through cooperative control plane decisions United States Patent Application 20150365327

Additional Relevant HRL Assets

IBM Israel – HRL Cloud Networking Group

Additional Relevant teams in Haifa Research Lab

- Cloud Data Services Group
  - Analytics, Big Data, etc
  - DALIT@il.ibm.com

- Cloud Storage Group
  - Object storage, block storage, deduplication, compression, and more
  - RONENKAT@il.ibm.com

- mmWave Technologies group – DANNYE@il.ibm.com
  - Focuses on chip and antenna development for mm-wave frequency range communication, radar and imaging
  - Involved in transceiver chip design for 5G
  - 60GHz phased array antenna-in-package for >16Gbps data rate with highest ETSI class 6L
  - V-band fixed beam for >16Gbps data rate, E-band fixed beam >10Gbps data rate
  - Passive imagers for W-band and THz band and E-band FMCW radar imaging