SAVI Testbed; Ready for Apps

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November 2014
Outline

- SAVI Introduction
- Software-Defined Infrastructure
- SAVI Testbed
- SAVI Application Examples
What is SAVI

• Smart Applications on Virtual Infrastructures

• An NSERC Strategic Research Network
  – Natural Sciences and Engineering Research Council of Canada

• Research and Testbed on Application Platforms

• 10 Universities

• 15 Researchers & 50 graduate / postgraduate students

• 20 Industry Partners
SAVI Research Scope

- **A multi-tier cloud** includes *smart edge & virtualized access*
- **Smart edge** provides *virtualized heterogeneous resources* for low-latency, high-bandwidth applications
- **Integrated wireless/optical access** controlled by the smart edge
- **Applications** leverage high bandwidth access, low-latency services
- **Control & management system** of SAVI Testbed provide researchers with slices of converged virtualized resources for *future Internet and applications experimentation*
Software-Defined Infrastructure

- Infrastructure with **open interface** for:
  - **Control and manage** converged heterogeneous resources (software programmability)
  - Access infrastructure **resource information** such as topology, usage data, etc.

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SDI Management Architecture

Resource Controllers: Cloud, SDN, Access, Wireless, WAN, etc.
SDI Implementation

SAVI Node

Cloud Control

OpenStack

SDI Manager (Janus)

Module Manager

Module 1  Module 2  ...  Module n

Topology Manager (Whale)

Monitoring

OpenFlow Controller

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SAVI Testbed

- A experimental platform for SAVI research themes
- Two-Tiered Cloud
  - Core nodes, Smart Edge nodes across Canada
- Implemented SDI in the SAVI Testbed
  - OpenStack for Cloud
  - OpenFlow for SDN

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SAVI Dedicated L2 Network

- In order to experiment with Future Internet protocols, SAVI uses a Layer 2 substrate in its clusters as well as in its backbone
- 1GE Layer 2 Links Connecting Four Ontario Universities
  - Toronto, York, Waterloo, (Carleton)
- Used for At-Scale experimentations with Future Internet Projects
  - OpenFlow, CCN, etc.
- Soon: UVic Edge connection to SAVI Dedicated Network
  - through CANARIE and BCNet
SAVI Testbed Infrastructure

- ~1000 Cores
- 12+ FPGA Systems
- 6+ GPU Systems
- 50+ TB storage
- 10/1 GE fabric
  - OpenFlow
- 1GE Dedicated backbone
  - ORION/CANARIE
SAVI Hands-on Workshop

- One-day event; July 7, 2014
- 60+ Researchers and Engineers
  - Universities and Industry Partners
- Hands-on experience working with SAVI Testbed
  - Basic Testbed Usage
  - Monitoring and Measurements and Alarms
  - Orchestration
  - Hadoop Big Data
  - pWeb
SAVI Design Camp

- 24 SAVI Researchers in 6 groups
- One-Week event; Aug 2014
- First Day: Advanced SAVI TB Hands-on
- 3-Day Projects
- Projects presentations and demonstrations

- Winner selected by an industry panel
- TELUS Galaxy S5 for winning team
- Bell $200 Gift Cards for runner-up team
- Google this!
  - savi design camp Aug 2014
SAVI Applications
Wireless Virtualization

- Virtualize wireless access points connected to Smart Edges in SAVI Testbed

Current McGill Edge Node

- Intel i7-3770
- 32GB RAM
- 3TB HD

mg-agent-1

SAVI Edge Controller (x1)
- Intel i7-3770
- 32GB RAM
- 3TB HD rackmount
- Public IP: 132.206.260.130

Edge Compute Node (x1)
- Intel i7-3770
- 32GB RAM
- 3TB HD

Wireless Access Points
- PC Engine Alix 3d2

WARP Radio Nodes
- 802.11a/g
- Virtex-4 x1

OpenFlow Switch (Pronto 3290 48x)

Port 32
Port 42
Config port
Port 30
Port 36
Port 48

Under Development

Projected

Multi-dimensional virtualization framework
Software-Defined Wireless Network

- Utilizing Software Defined Radio to run any Wireless Access technology on-demand
  - LTE, 3G, 2G, WiFi, etc.
- SDR units deployed as Access Points
- SDR software deployed on SAVI Smart Edges
  - On shared virtualized resources
  - Closer to Access Point
  - To satisfy radio level Round-Trip-Time requirements
    - e.g., < 4ms depending on technology
- Signaling SW run on CORE nodes
- Proof-of-Concept demonstration:
  - OpenBTS: open-source GSM
Demonstration

- Open-source openBTS SW
  - Analyzed and divided to two main parts:
    - Transceivers and Controllers
- Open-source SIP server SW
- SDR units
- Unlocked mobile phones
- Test SIM Cards
- Along with other main elements in Janus Data Center
  - OpenFlow switches, Servers, VMs, etc.
Live Service Migration

- Live Migration of services
  - (e.g., Video Streaming Server) to an Edge closer to end users.

- Live Migration of some resources (VMs) used in a distributed application
  - From one EDGE to CORE nodes or other EDGE nodes

- Smooth migration of TCP/IP sockets
  - No disruption of service for end users or other resources involved in the distributed application

- Can be used in variety of applications
  - Providing services closer to end users
  - Follow the sun/wind deployments
Security NFV on SAVI SDI

- Designing a flexible, on the spot scalable solution implemented using
  - Software Defined Networking and Virtualized Security Appliances
  - On SAVI SDI

- Utilizing NFV to perform DPI: to identify attackers

- Utilizing SDI to blocking malicious traffic originating inside or outside the SDI

- Redirecting suspicious traffic to Honey Pot for more analysis
Security NFV Demonstration

SDN Manager

Attacker

Monitoring and Measurement

Security Policy Manager

Request to Block

Inspection results, Log & Alert

Virtualized Security Function (DPI)

Attacked

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Emergency Response Management

- Need to deploy multiple systems
- Public information (website, App)
- Command and Control Center
  - Wordpress, emergency notification
- Real Time Applications (SDN)
- Need localized deployment
- Event notifications (App, SMS, Twitter)
Projects running on SAVI Testbed

- Reconfigurable Hardware Virtualization (FPGA)
  - Presented at Tridentcom 2014, Next Apps @10GE

- Orchestration and Measurement & Monitoring
  - Heat & Ceilometer: Infrastructure & Application Layer M&M

- Big Data Analysis
  - Apache Hadoop cluster
  - Apache Spark cluster

- Content Delivery
  - Content Centric Networking (CCN)
    - Running CCN on SAVI and improve performance
  - X-CCN
    - Extended CCN to support long term subscription
    - MobilityFirst Next

- Connected Vehicle and Smart Transportation (CVST)
Connected Vehicles and Smart Transportation
Demo:

- CVST Map of GTA Traffic
  - http://www.cvst.ca/

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SAVI SDI in the Future CO

- Smart Infrastructures
- Transportation safety and management
- Smart grid control and management
- Health monitoring
- Emergency response
- Smart City....
Conclusion

- SDI promises to provide flexibility, performance, and cost effectiveness, especially in the smart edge of a multi-tiered cloud

- SAVI Testbed
  - Two-Tiered Cloud
  - Implements SDI architecture
  - Has Heterogeneous Resources

- SAVI Exploring Applications!
Thank you!

Questions?