L2-L7 BASED SERVICE REDIRECTION
WITH SDN/OPENFLOW

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NoviFlow offers the Highest Performance Switches and Forwarding Plane Products for the SDN and NFV Markets

About NoviFlow

- **Technology**: Innovative use of Network Processors, instead of ASIC or X86
- **Products**:

  ✓ **NoviSwitches**: Pure-play OpenFlow switches based on NPUs
    - Delivering unparalleled OpenFlow throughput, flow table capacity and flow handling capabilities
    - Supports **ALL OpenFlow 1.3 actions, instructions and matching fields, and key OpenFlow 1.4 features**
    - Compatible with the leading controllers and applications, incl. NEC, OpenDaylight, Ryu etc

  ✓ **NoviWare**: Operating Systems for NPU-based SDN and NFV forwarding planes
    - Used in all NoviSwitches
    - Also licensed to OEMs

- **Typical deployments**:
  - **WAN**: Network appliance and router replacement or complement
  - **Data Center**: Gateway switches, aggregation switches or as ToR switches

- **Company**: Founded in 2012 as a spinout of UQAM, offices in Montreal, Sunnyvale and Seattle
The SDN Market is Maturing

Carriers and large data centers

- have been experimenting with SDN and OpenFlow for two or three years now...
- have confirmed the potential for lower costs, increased flexibility and efficiencies that come with SDN and OpenFlow
- Based on this, these are the key requirements for scalable SDN networks:

1. **Full and complete OpenFlow 1.3 specs implementation**
   - ALL OpenFlow 1.3 actions, instructions and matching fields,
   - Fully programmable packet processing pipeline
   - Multiple tables (eg. 10+) each supporting the full OpenFlow specifications

2. **Millions of Flow Entries**
   - Many SDN applications (eg. Router replacement, DC Gateways switches, multi-tenant ToR switches, service chaining, etc) require very large number of Flow Entries

3. **Ability to do match and act on L2 to L7 header fields and payload**
   - Many SDN applications (eg. GTP load balancing, firewalls, network monitoring, service chaining, etc) benefit greatly from the ability to inspect and act upon packet headers and payload

4. **High OpenFlow processing throughput**
   - Hundreds of Gbps of OpenFlow throughput is required

NoviFlow’s NoviSwitch products are specifically designed in response to these issues and meet the needs of carriers and large datacenters
NoviFlow’s Focus: High Performance SDN Infrastructure

SDN Architecture

- Application Layer
- Control Layer
- Infrastructure Layer

SDN applications

- App #1
- App #2
- …
- App #n

Programmable APIs

SDN Control Software

- OpenFlow 1.3/1.4

NoviFlow

Switching made smarter

Internet 2015 Global Summit
The NoviFlow Switching Product Line

**NoviSwitch® 1132:**
- 0.5M flow entries in 1U
- Throughput of 100 Gbps
- Support ALL OF 1.3 actions, instructions and matching fields
- 3,200 flow mods/sec
- Up to 12,000 Group table entries
- Up to 4,096 Meters
- L2-L7 matching and flow-switching functionality
- 10 x 1/10GE and 22 x 1GE ports

**NoviSwitch® 1248:**
- 1M flow entries in 1U
- Throughput of 200 Gbps
- Support ALL OF 1.3 actions, instructions and matching fields
- 3,200 flow mods/sec
- Up to 12,000 Group table entries
- Up to 4,096 Meters
- L2-L7 matching and flow-switching functionality
- 20 x 1/10GE and 28 x 1GE ports

**NoviSwitch® 2128:**
- 1M flow entries in 1U
- Throughput of 240 Gbps
- Support ALL OF 1.3 actions, instructions and matching fields
- 12,000+ flow mods/sec
- Up to 12,000 Group table entries
- More than 4,096 Meters
- L2-L7 matching and flow-switching functionality
- 20 x 1/10GE and 4 x 40GE ports

**NoviNID® 106:**
- 2000 flow entries
- Throughput of 24 Gbps,
- OpenFlow 1.3.x Customer Premise Equipment
- Low power (<25W), fanless operation, MTBF > 18 years
- 6 data plane ports: 2 x SFP/ SFP+ and 4 x 10/100/1000 Base-T
- Maintenance-free operation with remote configuration and provisioning
NoviFlow Targets the Intelligent Edge
NoviFlow Products: Forwarding Plane Software

**NoviWare® 300:**

- *NoviWare 300* is the software running in the *NoviSwitches* including software for data plane EZchip network processors and control plane PowerPC or Intel i7 host CPU
- *NoviWare 300* is also a licensed product
- *NoviWare 300* offers the industry’s broadest support of the OpenFlow standard in the industry

- Key features of *NoviWare 300* include:
  - All OpenFlow 1.3 match fields, instructions, actions and counters
  - Key OpenFlow 1.4 features including Bundles, PBB UCA header field, Eviction, Vacancy Events, etc
  - L2-L7 header and packet payload matching and flow handling
  - Optimized algorithms for pipeline processing with multiple tables, instructions, action sets
  - Groups for complex forwarding including multipath and fast reroute
  - Queues and Meters for quality of service
  - VLAN, MPLS and PBB tag processing (match, push/pop and Set Field)
  - Multiple OpenFlow Controllers and Controller role-changes
  - Enhancements to support specific controllers
  - Hardware abstraction layer to facilitate porting to other forwarding plane hardware platforms
  - Extensive set of O&M features
NoviSwitch O&M Features

- OF-CONFIG 1.1.1/1.2
- CLI for Set/Show configuration for switch, controllers, ports, flow tables, users, meters, etc
- TACACS+/RADIUS for AAA services
- ACL (allowed IP addresses) on management ports
- VLAN on management ports
- CLI Log with accessing IP address for configuration change traceability
- CLI Log export to external Log server
- CLI for status and stats
- Remote installation, update and roll-back of software revisions
- Remote power on/off and reboot
- Switch configuration export/import in binary and text formats
- Automatic periodic switch configuration uploads to an external server for configuration management
- SNMP traps for hardware fault alarms
SDN and NFV Solutions using NoviSwitches
Some SDN Use Cases
NoviFlow Targeted SDN/NFV Use Cases

• NoviFlow WAN Use Cases
  – L2-L7 Load balancing (GTP Load Balancing – CENGN)
  – IP/MPLS SDN Router
  – Smart Traffic Steering
  – Packet Filtering
  – Network Redundancy
  – Service Chaining
  – Network Monitoring
  – DC Gateway Switch
  – ToR Switch
  – SDN Enhanced Security
**SDN Applications (routing protocols)**
- NoviSwitch supports all common routing protocols across the OpenFlow interface
- Key supported protocols:
  - IP: BGP, OSPF, IS-IS
  - MPLS: LDP, RSVP-TE (future)
- Sources of protocol stacks:
  - OEMs`, IP Infusion, Aricent, Metaswitch
  - Open source (Quagga)

**SDN Controllers:**
- NoviFlow will adopt to Customer’s chosen controller/apps
- NoviFlow is involved in six different SDN router projects
- NoviFlow may supply 3rd party controller and applications if required by customers

**SDN Data Plane:**
- One or more NoviSwitch 1132/1248/2128/2116
IP/MPLS SDN Router

• **Solution Components:**
  – OpenFlow controller with protocol stack applications
  – One or more NoviSwitch OpenFlow switches

• **Operator Benefits:**
  – Dramatically lower CAPEX and OPEX
  – Network configuration automation
  – L2-L7 forwarding optimization
  – Deterministic forwarding
  – APIs towards network management

Large Logical SDN Router:
• 8 x NS-2128 “line cards”
• 1 x EX3248 “backplane”
• Size: 9 RU
• Ports: 192 x 10GE
• OF 1.3 processing capacity:
  • 1.9 Tbps
  • 2,400 MPPS
Smart Traffic Steering

**Network Operator Benefits:**
- Low cost hardware and software solution
- IP/MPLS core network off-load
- Admission control to optimize use of IP/MPLS core network
- Fewer visits to the customer premise thanks to remote configurations and upgrades
- L2-L7 filtering and forwarding
- Faster packet forwarding compared to traditional routers
- Low cost NoviFlow optical transceivers or 3rd party optical transceiver

**Customer Benefits:**
- Lower cost traffic forwarding
- Firewall, content filtering, ACL, admission control, enhanced service as a service
Packet Filtering

• **Key Features:**
  – L2-L7 Packet Filtering and modification
  – SDN Controlled Packet Filtering Solution:
    • Dynamic filtering rules managed via OpenFlow controller
    • Multiple packet filtering Nodes per controller

• **Filtering Rules Examples:**
  – Block/allow traffic from certain MAC or IP addresses based on black/white lists
  – Block/allow traffic from certain IP subnets
  – Application black/white lists
  – Obfuscate/redirect traffic
  – Transparent IP address translation for legacy systems
  – Identify and re-direct suspicious traffic to analysis tools

• **Use Cases:**
  – Packet filtering as a service
  – Optimized video traffic handling
  – Filter out undesirable traffic from enterprise network
Network Node Redundancy

- **Key Features:**
  - 4x4, 8x8 or 16x16 matrix
  - Optical data rates from 1Gbps to 100Gbps
  - OpenFlow controlled optical switch fabric

- **Use Case:**
  - Carrier grade 1+1 redundancy solution
Service Chaining

- Pools physical and/or virtual network appliances located north of the GGSN/PGW
- Network appliances are in-stream or mirrored stream
- Each traffic type by service class needs a unique set of network appliances

How it works:
- Rules for each traffic type by service class is programmed into the NoviFlow switch by the application
- Incoming traffic (A) is analyzed and sent to various network appliances according to the traffic rules before it is forwarded to the GGSN/PGW
Network Monitoring

- GGSN Gi service LAN Network TAP:
SDN DC Gateway Switch

- Customer self-provisioning of inter-data center connectivity and bandwidth
SDN DC Gateway Switch

<Self-Provisioning>

DC Network  Inter-DC  DC Network

<Mechanism>

Customer/Operator Portal (UI)
Orchestration Layer
Cloud Controller
SDN Controller

OpenFlow Controller
OpenFlow Switch

Hypervisor
TOR Switch

Use TOR Switch to create multiple virtual tenant networks in the data center

Key Features
- Full isolation between tenants
- IP Mobility/overlapping IP address
- Independent network policy
- Auto-configuration

Benefits
- Optimized Network Utilization
- Elastic Scalability
- No device level configuration
- Complete VM Mobility
- Each virtual tenant has unique network policy
- Reduced Power Consumption
- No location dependencies

Solution Components:
- NEC ProgrammableFlow Controller*
- NoviFlow Switches

* NoviFlow - NEC inter-operability verified since 2013
**Security and SDN**

- **OpenFlow controller for centralized response to network threats**
- **Use separate out-of-band network for OF switch provisioning**
- **Filter incoming traffic based on L2-L7 criteria before it reaches the core Network**
- **Divert suspicious traffic to “scrubbing center” then re-inject “clean” traffic to original destination**
- **Reduced overprovisioning**
- **Use ‘edge switch’ approach for distributed VLANs, Firewalls, Label Switching, etc… via OF apps**

**NoviSwitch unique features for security applications:**
- Up to 240 Gbps OpenFlow 1.3/1.4 throughput for edge capacity
- Up to 1 million flow entries for fine-grain access tracking
- Over 12,000 flow-mods per second for fast response to threats
Dynamic Policy Creation via REST API

- Invoke REST API of the SDN Monitoring Fabric
- Dynamically provision / activate / update the policy
- The Intruder Traffic is now replicated to the malware analysis device
NoviFlow’s Key Messages

1. **The SDN market is maturing**
   - NFV and SDN are forcing a revision in how networks are built and operated
   - Early adopters of SDN are realising that ASIC- and X86-based SDN networking gear have serious shortcomings preventing them from getting the full value of software defined networking

2. **NoviFlow offers High Performance OpenFlow data planes that leveraging NPU technology**
   - Most complete implementation of OpenFlow 1.3/1.4 on the market for highly demanding SDN and NFV applications
   - Up to 1 Million entries in TCAM, for unparalleled performance and flow handling granularity
   - Up to 240 Gbps of full OpenFlow 1.3/1.4 throughput for solutions that scale!

3. **NoviFlow is pioneering Router Disaggregation based on SDN**
Thank You!