

Use Case

ONOS E-CORD Proof of Concept Demonstrates Open Disaggregated ROADM

Fujitsu collaborates with industry partners on next-generation central office architecture

ON.Lab recently announced developments for CORD, the Central Office Re-architected as a Data Center, plus a new open reference implementation. CORD uses the Open Networking Operating System (ONOS), XOS, and OpenStack to bring the simplicity of the data center and the flexibility of the cloud to the central office environment, which has long been dominated by closed systems and tightly coupled hardware and software. CORD was created initially as a use case for ONOS to drive the adoption of software-defined networking, network functions virtualization, and the cloud. The open reference implementation expands CORD, bringing it to enterprises and carriers in a model that can be more easily deployed.

New Open Reference Implementation

The new reference implementation of CORD defines a general and extensible platform for network operators based on merchant silicon, white box hardware, and open-source software platforms such as ONOS, OpenStack and XOS. The new implementation increases the pace at which network operators and equipment vendors are able to test and deploy CORD by offering hardware specifications, platform software, and services that are specific to each CORD domain—enterprise, mobile, and residential.

The open reference implementation will be used for research and trials with an eye toward future deployments. Participants include service providers, vendors, and collaborators:

- Service provider partners are AT&T, China Unicom, NTT Communications, SK Telecom, and Verizon
- Vendor partners are Ciena, Cisco, Ericsson, Fujitsu, Huawei, Intel, NEC, and Nokia
- Collaborators are Accton, AirHop, Broadcam, Cavium, Celestica, Ciena, Cobham, Flextronics, NetCracker, PMC Sierra, and Radisys

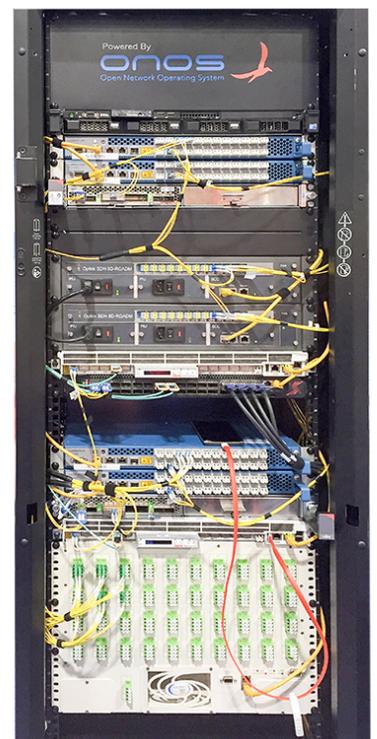
CORD has rapidly matured into an important systems platform for service providers, thanks to the support, collaboration, and contributions from companies like Fujitsu.

— Guru Parulkar, Executive Director, ON.Lab

Enterprise CORD

New use cases for CORD were on display at the Open Networking Summit and OFC Conference in March 2016. One of the featured use cases, Enterprise CORD (E-CORD), builds on the CORD infrastructure to support enterprise users. E-CORD is designed for service providers delivering SD-WAN and MEF Carrier Ethernet services. Beyond simple connectivity services, E-CORD also makes it possible to include on-demand network functions and service composition and to deliver disruptive cloud-based enterprise services. In turn, enterprise users can leverage E-CORD to create multisite virtual networks rapidly between any number of endpoints or company branches. Users can also run network functions such as firewalls, WAN accelerators, traffic analytic tools, and virtual routers as on-demand services.

The E-CORD project is a collaborative effort among leading service providers and prominent networking vendors. The E-CORD proof of concept consists of a packet optical metro network with three central offices as CORD sites. The network's user portals and GUIs configure enterprise services, interact with operational parameters, and perform virtual provisioning. Significantly, the proof of concept demonstrates a groundbreaking disaggregated ROADM—it replaces a closed, chassis-based, proprietary, and vertically integrated ROADM with a white box model using open interfaces and protocols.



E-CORD proof of concept equipment rack

Multivendor Disaggregated ROADM Becomes a Reality

Vendor partners supported the E-CORD proof of concept by contributing cutting-edge hardware devices and control agents based on open interfaces and standards:

- Transponders are Fujitsu 1FINITY™ T100 and Ciena Waveserver platforms
- WSS or degree nodes are Lumentum and Oplink SDN ROADMs
- Backplane is a Calient 3D MEMS-based fiber switch

The E-CORD proof of concept incorporates these open components:

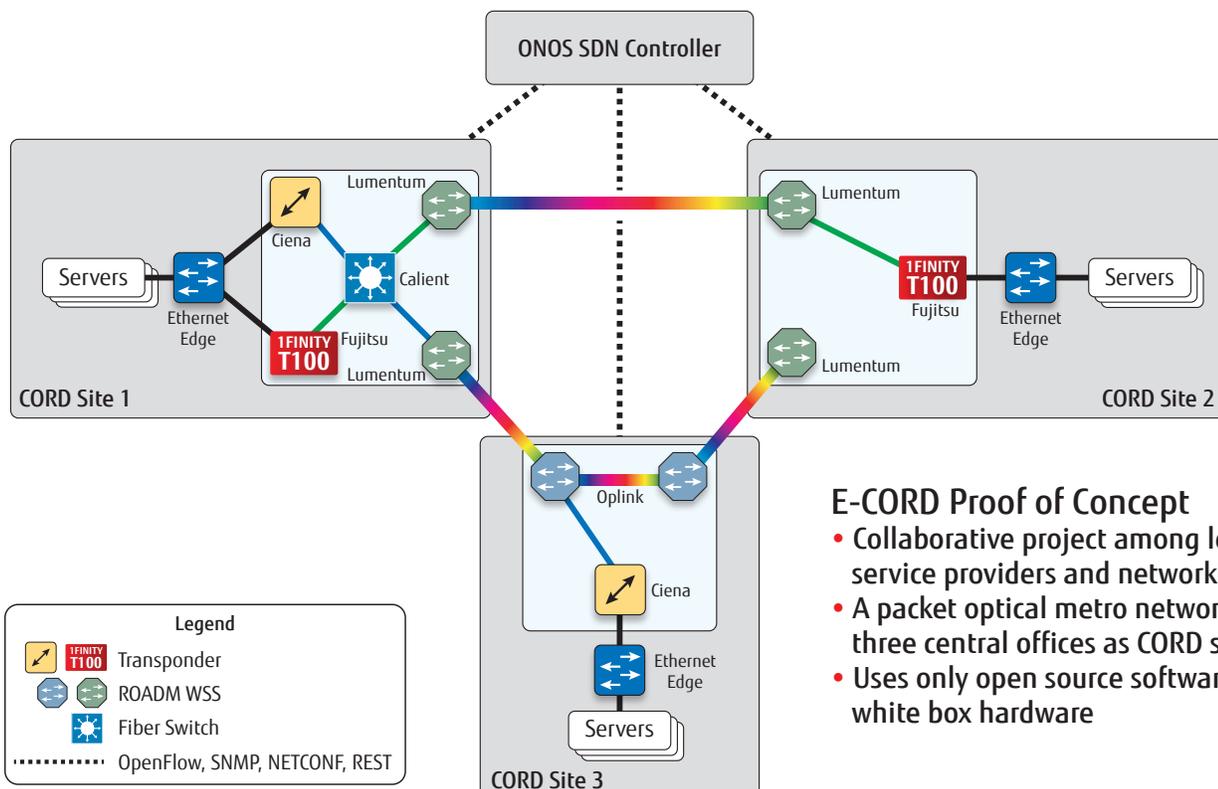
- OpenStack, providing a base IaaS capability and responsible for creating and provisioning virtual machines and virtual networks
- ONOS, the network operating system that manages the white box switches and software switches in each server
- XOS, the framework for assembling and composing services
- Atrim, the software stack that runs on each white box switch

Using the ONOS network controller within the disaggregated ROADM network configuration, the proof of concept demonstrates valuable benefits:

- Multivendor network management
- Multivendor optical and E-Line provisioning across the network
- On-demand service enablement
- Intelligent traffic mapping
- Centralized optical restoration

The proof of concept addresses significant technical challenges. First, software-defined control of a converged packet optical WAN requires innovative multilayer and delegated control primitives. Second, carrier-grade connectivity services have elaborate service model specifications, and deploying these services on white boxes introduces hardware support issues. Third, control and configuration of a disaggregated ROADM platform needs careful design of abstract interfaces. Finally, an open challenge is maintaining high performance levels for transmission and signal integrity in the optical white box model.

E-CORD disaggregated ROADM



E-CORD Proof of Concept

- Collaborative project among leading service providers and networking vendors
- A packet optical metro network with three central offices as CORD sites
- Uses only open source software and white box hardware

Fujitsu Supports Open Architectures

Conclusion

The ON.Lab E-CORD combines NFV, SDN, and the elasticity of commodity clouds, bringing data center economics and cloud agility to telco central offices. E-CORD is the first initiative of its kind to offer enterprise connectivity services over metro and wide area networks using only open-source software and commodity hardware. This fills a critical need for network operators responding to ever-increasing bandwidth demands and ever-higher service expectations.

Fujitsu is a founding director of ONOS and a key contributor to CORD and the E-CORD proof of concept. Open disaggregated ROADMs, like those in the E-CORD demonstration, require control and data plane interoperability among vendors. The key to achieving this open, modular, scalable, and programmable network is disaggregation. The Fujitsu 1FINITY platform used in the E-CORD proof of concept is designed for software control, and it embraces openness in architecture, optics, and APIs. Fujitsu is committed to the open source community and looks forward to additional CORD enhancements and field trials.

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