OpenIreland: end-to-end testbed for network disaggregation using open source and open hardware

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Cork Smart Gateway webinar on 5G, 17th June 2021
The Open Movement

• Software Defined Radio introduced in 1992 by Mitola in IEEE journal

1. Moving from hardware to software is the first step for opening up a system
   • Software can be copied, downloaded, etc. and can be worked on by anyone.

2. The second innovation in 2008 was the separation of control and data planes.
   ➔ It means providing an open interface (OpenFlow / SDN) so that the hardware and software could communicate across a distance
Opening the base station

• For over 10 years we have been able to do this: run a 4G (now 5G) base station from a server or laptop

Next step is to bring this concept to proper commercialization (actually replacing current large vendor base stations)

• Define one specific split (called 7.2) and start defining interfaces so that vendors can start producing the different parts
Opening the central office

- Over the past 10 years the concept has evolved from academic research and individual devices, to telecoms network scale.
- The central office is being “Softwarised” or “Cloudified”. Started in 2015 with the Central Office Rearchitected as a Data Centre (CORD), from Stanford and AT&T, then turned into the Open Networking Foundation (ONF).

Most recently evolving to AETHER to integrate with edge cloud
Opening the optical layer

• This is a difficult one!
• Optical transmission is analogue, meaning that different devices have different behavior (unlike digital)
• Nonetheless now there are SDN-controlled ”whitebox” devices, like ROADMs, amplifiers and transponders..
Advantages of Open Interfaces

• Open networking has created a physical separation between the silicon and the software. **And it has standardised and opened the interface between the two.**

• Now vendors are producing low-cost whitebox switches (just hardware, no software): a 3.2 Tb/s switch costs less than €7k! (the same as an entry level iMAC Pro)

• Also.. avoid vendor lock in and enable improved programmability and higher innovation
Open source and research opportunities

- Disaggregation enables anyone to get involved in real system development.
- Open source real enabler for low cost testbed setup/maintenance and ability to develop new ideas... create new startups
  - SONiC for control of switching hardware; Goldstone for control of optical transponder hardware
  - OAI or SRS (coming soon) for 5G RAN; OAI, Magma, Open5GS for 5G Core
  - ONOS for network control plane
  - OpenStack for cloud control
  - OSM for orchestration
  - CORD/SEBA for central office virtualisation
  - AETHER for edge cloud...

- Opens up many research opportunities:
  - Intelligent (AI-based) network control for both wireless and optical systems
  - Network customisation
  - Telemetry for monitoring quality of transmission and quality of service to meet Service Level Agreements
  - Use of distributed ledger technology to implement smart contracts
Open Ireland: Ireland’s Open Networking Testbed

- Testbed for research on end-to-end: wireless-optical-cloud based on open interfaces and open source
  - Investigate end-to-end operation of OpenRAN, Cloud Central Office and Disaggregated optical systems.
- Investigate intelligent control plane, technology and protocols and to enable 100X scalability:
  - Capacity, Latency, Availability, Energy, Automation...
Worldwide reach of our testbeds

COSMIC: COSMOS international connectivity (Europe, Brazil, Japan...)

OpenIreland offers fully reconfigurable topology including:

- Metro transmission (ROADMs, Coherent transponders, amplified links ~2000km, channel loading)
- SDR Wireless, including laboratory USRPs and OpenRAN indoor and outdoor small cells
- Edge computing and networking (including P4, etc.)

Key feature: only based on open systems and open source!
We developed Mininet for the optical layer (Mininet-Optical) to test your optical control plane (routing algorithms, ML-based) in large scale emulated networks.

**Key for Access-Metro Convergence**

Example: Machine Learning for quality of transmission estimation

Published at OFC, ICC, ONDM, ACP, PTL.
Development plan

Today

- Optical disaggregation
- ML-QoT experimentation
- EU and Brazil connectivity

October 2021

- Multi-node optical system
  - Remotely reconfigurable topology
    - Indoor SA 5G
    - DCU dark fibre
    - COSMOS connectivity

April 2022

- Remotely controlled testbed
  - Outdoor 5G SA

Future Extensions

- Free Space Optics
  - Open Source mmWave and above
  - Quantum communications

Bring your own technology!

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Thank you

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