Next Generation Fixed-Wireless Converged Access Networks

Alexandros Stavdas
University of Peloponnese, Greece

ack to my colleagues: C. Matrakidis, V. Kosmatos and T. Orphanoudakis
Convergence of bits, data, networks and processing in Access

Introduction to HYDRA

An e2e system

Testbed and potential

Feedback to SRIA
Challenges

- AI/Robotics, IoT, M2M, Smart City/Remote control
  - Convergence of AI – Telecom- DSP Processing and Storage technologies creating new means of production
  - Remote Control/Monitoring liberating humans from “localization” (so we don’t “have to” be there…)
  - Embedding “managed” intelligence in all social interaction forms
  - A new agrarian revolution based of Modern precision farming and autonomous vehicle control of robotic applications blurring the distinction between intellectual and labor work
  - … (possibilities that we cannot even imagine at this moment)

- To do so without centralized information processing & forwarding
  - In this way, capacity crunch is avoided
  - Latency limitations in mission critical apps is guaranteed
Heterogeneous Last-mile Systems

Converged, Shared (5G) Infrastructure

- Lower CapEx
- Lower OpEx

Mobile 4G
Fixed-line PON
Business ptp
IoT/M2M
Fixed-line Copper

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Hybrid Long Reach Access (HYDRA)

μ-Datacentre and Virtual Network Functions (BRAS etc)

Traffic aggregation via SDN programmable and virtualized h/w
HYDRA: HYbriD long-Reach fiber Access

- Where is the **ARN** located?
  - The ARN is located where DSLAMs/Cabinets are today
  - Distances typical are 2-3 km (up to 10 km) from the end-user

- ARN is **a gateway** to **heterogeneous** last mile systems
  - Residential and Business users, MBH/MFH, IoT or other wireless communities, M2M communities
  - The ARN **transports the aggregated traffic** directly to the core network

- **Independent of physical channel properties**; the lowest cost/power consumption technology available is used
  - Short-range PONs, or ptp Ethernet links
  - G-fast, xDSL
  - 4G, wireless RRU for MFH, WiFi
A closer look to the ARN

- Data processing for NFV
- μ-DC functions (commodity multi-core processors and VMs)

Lowest Latency

Highest Bandwidth

SDN
Programmable Forwarding & processing

ARN

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PRN: Passive Shared Infrastructure

Primary Operator Interface Point

\[ \lambda_{1,1} \ldots \lambda_{1,n} \]

Competitive Operator Interface point (or future upgrade)

\[ \lambda_{i,1} \ldots \lambda_{i,j} \]

Passive Remote Node (PRN)

AWG-like Passive Shared infrastructure

\[ \lambda_{1,1}, \lambda_{k,r} \]

filter1  filter2

ARN
HYDRA: System-level

- **Primary Operator**
- **Second Operator** (or future upgrade)
- **Metro-Core Node**
- **PRN**
- **Up to 200 km**
- **Up to 100 km**
- **Up to 2-3 km**
- **λ₁-λ₂₀₀**

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The potential of HYDRA

- Significant **CapEx/OpEx advantages** compared to current fixed-line alternatives
  - T. Orphanoudakis et al, NOC 2015

- Potential use-case for **short-range PONs** for even lower cost/power consumption in ONUs and OLTs.

- A **converged** platform for all fixed and wireless LANs and Datacentre facilities.
  - Optimal balance between centralization and distribution of computing power.
  - Potential for full “virtualisation” for the ARN
GPON OF abstraction for a standard OF Controller using the ALU 7330 ISAM
HYDRA: Service/Application-level

Application/Content server/Centralized DC

Core/Cloud services

Network controller

Access/Edge

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HYDRA: Service delivery model & components

- **Public information/Healthcare services**
- **Smart City Monitoring & Control Center**
- **SDN Network controller**
- **Local DNS, Routing/Bridging, Reconfiguration**
- **RTK Data**
- **video/image processing**
- **Big-Data storage & analytics**
- **e-Presence/e-Learning services**

**HYDRA**

- Service delivery model & components

**ARN**

**Big-Data storage & analytics**

**e-Presence/e-Learning services**

**SDN Network controller**

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Feedback to Strategic Research & Innovation Agenda

- A unified “Digital Environment” for bits, bytes and machines: Integrate networks, processing, storage and control
  - Integration of fixed-wireless; no primacy to a specific technology (nor fixed neither wireless). Exploitation of a technology-agnostic last drop infrastructure. **No more “partially/locally optimised” platforms!**
  - Integration of network infrastructures and any form of Datacenters; further integration with AI (robotic) entities and “machines” of any kind
  - An operating system based on “open s/w” to orchestrate these dissimilar OSs.

- **Performance-oriented** (than technology oriented) objectives
  - e2e “critical” service-oriented KPIs

- Research at system/sub-system level for a truly low-cost/power consumption technology. Primacy to bandwidth than distance (access)

- Shift the interest from leisure-time to the economic activity (production)
  - Faster integration of the “digital environment” across the entire stake-holder chain for a faster adoption of innovation