Glasgow Network Functions:
From Data Centres to Unmanned Vehicles

Richard Cziva | University of Glasgow | Richard.Cziva@glasgow.ac.uk | NFV WORLD CONGRESS’18 | San Jose, California
About Netlab, University of Glasgow

• University of Glasgow, United Kingdom
  • Fourth oldest university in the English-speaking world and one of Scotland's four ancient universities. Founded in 1451.

• Networked System Research Laboratory “Netlab”, School of Computing Science
  • Website: https://netlab.dcs.gla.ac.uk
  • Team: 3 academics, 4 researchers, 7 PhD students
  • Director: Dr. Dimitrios P Pezaros

• Research on SDN, NFV, mobile edge, network security and data plane programmability, resilient infrastructure ...

• Project partners include:
Number of connected devices

Source: Ericsson IoT forecast
Increased expectations

- Future networks are expected to support
  - Context-aware
  - Ultra-reliable
  - User-specific network services

- Connected by
  - High-bandwidth and
  - Low-latency connections

Example services: video content caches, user-specific firewalls, DDoS mitigation modules, etc.
Opportunities with Edge NFV

One way to solve these challenges is to bring Network Function Virtualization to the Network Edge

- **Network Function Virtualization**
  - Decoupling network services from hardware and running them in software
  - Used in data centers, in the core of the network
  - *Lacks latency-optimal service orchestration*

- **Multi-Access Edge Computing**
  - Compute infrastructure at the edge of the network
  - Also known as “fog computing”
  - Close proximity to the user => low latency connectivity
  - Services at the edge save utilization for the core
Edge NFV Architecture

Richard Cziva - Dynamic, Latency-Optimal vNF Placement at the Network Edge

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Container vNFs

- Lightweight “virtualization”
- Fast create/start/stop/delete
- High performance: small delay, high throughput, low memory footprint
- Reusable / shareable
- Traditional software environment
- Micro-services architecture
- Runs (almost) anywhere!
Glasgow Network Functions (GNF)

Main characteristics:

1. Container-based
2. Minimal footprint
3. Support for vNF roaming
4. End-to-end, SDN-based transparent traffic steering
Idea: vNFs on unmanned IoT infrastructures

- Focus on: unmanned robots, moving vehicles, sensor nodes
  - Challenges
    - Securing data transmission, malicious activity, fault detection
    - Moving of devices increases complexity of management
    - Networking is hard with moving devices (radio or WiFi?)
  - Opportunities
    - Distributed, closed-loop, low-latency data processing
    - Privacy enhancement (data doesn’t have to be transferred to the cloud)
    - Peer-to-peer, ad-hoc networking
    - Increased computational power in the devices (e.g., conventional CPUs, memories)

- RAWFIE (Road-, Air-, and Water- based Future Internet Experimentation) is a project funded by the European Commission (Horizon H2020 programme) under the Future Internet Research Experimentation (FIRE+) initiative that aims at providing research facilities for Internet of Things (IoT) devices.
RAWFIE resources: nodes that can run vNFs

PlaDyPos

Robotnik

Flexus

Vamos

Niriis

Base station
GNFUV: Glasgow Network Functions for Unmanned Vehicles

• **Identify & Investigate** the opportunities of the Network Edge by experimenting with our lightweight, container-based NFV platform: Glasgow Network Functions (GNF)

• **GNF** will be adopted to run and orchestrate virtual Network Functions (vNFs) in the form of container namespaces onto the RAWFIE constrained UxV network;

• **Showcase** the capabilities of different UxV Devices through GNF to support distributed edge-computing inferential analytics, e.g., outliers detection and predictive regression.
Use-Case: DDoS mitigation in sensor networks

• Imagine sensor nodes being compromised with e.g., Mirai malware, generating malicious traffic
• DDoS mitigation vNFs (e.g., firewall container vNFs) can be deployed in close proximity of these sensors (or on the sensors themselves)

Use-Case: Distributed information processing

• Data generated by various devices can be consumed, analysed, aggregated on nearby devices without transferring data to the cloud
• This saves battery, network utilisation and maintains a fast feedback loop
• vNF allocation can be managed to equalise battery levels
Experimentation has started
Publication (so far)


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Thank you for your attention!

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