Future Internet Deployment: The Path Ahead

Flávio de Oliveira Silva
Faculty of Computing (FACOM)
Federal University of Uberlândia (UFU)
Uberlândia, MG, Brazil
Agenda

- Future ICT
- Our Research
- Concluding remarks
Future ICT

- The Goal
  - Fully mobile and connected society, where the right information is ready to be used by humans, machines and systems

- The Result
  - Smarter cities and societies

- The Requirement
  - Evolve the “C” aspect of ICT
  - Communication technologies that are capable of providing the requirements of users and applications with a smarter and efficient use of resources
Getting Deeper into the Requirements

- The Requirement
  - Evolve the “C” aspect of ICT
  - Communication technologies that are capable of providing the requirements of users and applications with a smarter and efficient use of resources

- In a deeper vision
  - Deploy new network architectures
  - Enable new types of applications based on these new network architectures
  - New network architectures
  - Fully programmable Infrastructure
  - FI Infrastructure Interconnection
Deploy New Network Architectures

- Deploy new network architectures
  - MobilityFirst, Named Data Networking (NDN)
  - eXpressive Internet Architecture (XIA)
  - NEBULA
  - Recursive Inter Network Architecture (RINA)
  - SAIL
  - PURSUIT
  - Novagenesis
  - Entity Title Architecture (ETArch)

- Related Requirements
  - Future Internet Testbeds Federation (GENI, FIBRE, GEANT, etc.)
  - Future Internet Exchange Point (FIXP)
Enable new types of applications based FIA

- The infrastructure and the network means nothing!
- Develop and deploy new types of applications based on the new Future Internet Architectures already prototyped
- Explore these new services bringing innovation to this research area
- Related Requirements
  - Future Internet Testbeds Federation (GENI, FIBRE, GEANT, etc.)
  - Future Internet Exchange Point (FIXP)
New network architectures

- Considering new requirement, new network (clean slate) may arise
  - Tactile Internet

- 5G is an example of a new (clean slate) network architecture
  - Telecommunication area works in a different way
    - Standardization; Providers and Vendors
  - “Clean Slate” with backward compatibility
Fully programmable Infrastructure

- Software Defined...
  - Networking
  - Infrastructure
  - Wireless Networks
  - Data Center
  - Radio
  - RAN
  - Environments
  - Anything

- Network hardware is different from Computing Hardware
  - Different transmission technologies (Optical, Wireless, Electrical)

- “OpenFlow 3.0”?
  - One possible direction: Programming Protocol-Independent Packet Processors (P4)

- Fully programmable Slice
  - Physical aspects, MAC, Queuing, Scheduling, Protocol Stack, etc.
FI Infrastructure Interconnection

- The dawn of the Future Internet
- Bring FI to real life
- We are not far from this...
- Related Requirement
  - Future Internet Exchange Point (FIXP)
Our Research

- MEHAR Program
  - MEHAR (Mondial Entities Horizontally Addressed by Requirements) Program consists of a set of related Projects

- Basic Goal
  - Evolve communication networks in order to make them capable of providing the communication requirements of users and applications with a smarter and efficient use of resources
Resources and People engaged on the program (The MEHAR Group)

- Federal University of Uberlandia (UFU)
  - Professors: Pedro Frosi Rosa; João Henrique de Souza Pereira; Luiz Cláudio Theodoro and Flávio de Oliveira Silva
  - 31 students (undergraduate and graduate)

- Polythenic School, University of São Paulo (USP)
  - Prof. Sergio Takeo Kofuji
  - 2 Ph.D. Students

- Instituto de Telecomunicações Aveiro (University of Aveiro, Portugal)
  - Prof. Rui Aguiar and Daniel Corujo
  - 1 Ph.D. Student

- Federal University of Rio Grande do Norte (UFRN)
  - Prof. Augusto José Venâncio Neto
  - 4 M.Sc. students

- ALGAR TELECOM
  - João Henrique de Souza Pereira and Luiz Cláudio Theodoro
  - 15 associates

- And counting…
Research, Funding and Industry Partners

- Instituto de Telecomunicações Aveiro (Portugal)
- Polytechnic School, University of São Paulo
- Federal University of Rio Grande do Norte (UFRN)
- RNP (Brazilian NREN)
- OFELIA
- FIBRE
- FI-WARE

- FP7
- CAPES
- CNPq
- FAPEMIG
- DATACOM
- ALGAR TELECOM
Future Internet Research and Innovation Lab at UFU

- Research and Development focused on the Future Internet
  - OFELIA Island
  - FIBRE Island (under deployment)
  - FIWARE Lab Node
- Experimentally-driven research (FIRE)
- Connection with Algar Telecom

OFELIA ISLAND (fp7-ofelia.eu)
FIBRE ISLAND (fibre-ict.eu)
FIWARE Node (fi-ware.org)
AID Lab
Faculty of Computing
Federal University of Uberlândia
Algar Telecom
MEHAR Projects

- Past projects
  - FINLAN
  - EDOBRA

- At this moment the program has the active projects
  - Entity Title Architecture (ETArch)
  - Support of Mobile Sessions with High Transport Network Resource Demand (SMART)
  - Carrier-grade softwaRE DEfined Networking Control Environment (CREDENCE)
  - ETArch PILOT
  - Future Internet Innovation Laboratories (FIILAB)
  - Arquitetura Adaptável para Redes CONvergentes (A2RCON)
  - ETArch Routing
  - FI-GUARDIAN Evolution
Themes for research collaboration

- Experimentally driven research based on real use cases considering telecommunication service provider and smart cites based on public open data
- Future Internet Exchange Point (FIXP) that will enable the interconnection of different FI infrastructures currently bringing life the Future Internet
- Carrier grade SDN control layer that encompasses high availability, scalability, high performance, reliability, fault tolerance, security and manageability
- Reconfigurable convergent network architecture based on the network softwarization and virtualization (SDN, NFV, Cloud, etc.), specially in the area of telecommunications
- Multi Protocol stack Future Internet architecture which would enable an *-centric internet based on plethora of different requirements
Concluding Remarks

- ICT must be improved
- Collaboration between the research community and also industry is the key
- Regarding Our research (MEHAR Program)
  - Create networks that fulfill users and applications requirements with a smarter and efficient use of resources
  - Enable a new category of services and applications (IoT, Smart Cities, Smart Environments)
  - Research projects tied with an innovation vision where some results can be deployed
  - ETArch
    - Clean-slate network architecture that naturally matches SDN abstractions
    - Future Internet Architecture related initiative
- As a final statement
  - We must SWITCH our competencies, research and infrastructures
  - Strength collaboration between the U.S. and Brazil
    - Also bring together other efforts to FI across the world
  - Plan the next steps, including fuuding opportunities
Thank you!

flavio@ufu.br
http://mehar.facom.ufu.br
Prof. Flávio de Oliveira Silva, Ph.D.
FACOM - Faculty of Computing
UFU – Federal University of Uberlândia