
Future Internet Deployment: The Path Ahead

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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 to 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)
- Polytechnic 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)

FI-WARE
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)
 - **S**upport of **M**obile Sessions with High **T**ransport **N**etwork Resource Demand (SMART)
 - **C**arrier-grade software **RE DE**fined **N**etworking **C**ontrol **E**nvironment (CRENCE)
 - ETArch PILOT
 - Future Internet Innovation Laboratories (FIILAB)
 - **A**rquitetura **A**daptável para **R**edes **CON**vergentes (A2RCON)
 - ETArch Routing
 - FI-GUARDIAN Evolution

Themes for research collaboration

- ❑ Experimentally driven research based on real use cases considering telecommunication service provider and smart cities 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 funding opportunities

Thank you!

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