Nokia Bell Labs

Internship @ Nokia Paris Saclay – UPMC master RES (M2)
• Natalya Rozhnova, Marc-Olivier Buob
• Bell Labs
• 23-10-2017
Outline

1. Nokia Bell Labs – General presentation
2. Internships in Algorithms
3. Internships in Networks
4. Internships in Internet of Things
5. Conclusion
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“Through research and innovation, Nokia Bell Labs is changing the way people connect with the world”

https://www.bell-labs.com/
Nokia Bell Labs – General presentation
Bell Labs History: Unparalleled disruptive innovation
Nokia Bell Labs – General presentation
Bell Labs Scope & Scale: A global innovation engine

95% Focused on 5+ year future

1000+ Innovators

1 Game-changer per lab/year
Nokia Bell Labs – General presentation
Nokia Paris-Saclay

• **Paris-Saclay location**
  – 20 km south of Paris, Nozay, Essonne
    (*Paris-Saclay agglomeration*)

• **Research activities**
  – Network
  – Algorithms
  – Analytics
  – **IoT Control**
  – Security
  – III-V devices
  – Optical networking & transmission
  – Radio & end-to-end mobile networks

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Internships in the Algorithms Teams
Team #1 Machine Learning for Networks

1. People
   • Gérard Burnside
   • Calvin Chen
   • Élie de Panafieu
   • Nidhi Hegde
   • Dimitrios Milioris

2. Focus
   • Theoretical Analysis
   • Algorithm Design

3. Applications
   • Augmented intelligence
   • Resource management in Networked systems

Graph/Hypergraph (based on experts interaction, time, location, topology)
Internships in the Algorithms Teams
Team #2 Stochastics & Networks

1. People
• Amira Alloum
• Anne Bouillard
• Marc-Olivier Buob
• Fabien Mathieu
• Alonso Silva

2. Focus
• Graphs
• Game theory

3. Applications
• Future Networks Optimization
• Intelligence for Large Datasets
Internships in the Algorithms Teams
Potential topics for internships

1. Robust Graphs, Partition Exploration and Binary Trees (**requirements**: solid background on graph theory)
   **Contact**: Elie de Panafieu elie.de_panafieu@nokia-bell-labs.com

2. Toward Efficient Pattern Matching (**requirements**: language theory, Python, Git)
   **Contact**: Anne Bouillard anne.bouillard@nokia-bell-labs.com

3. SDN Forwarding Table Checking (**requirements**: graphs and sets theory, Python, Git, opt. C++)
   **Contact**: Marc-Olivier Buob marc-olivier.buob@nokia-bell-labs.com

4. Inference of Information Cascades in Social Networks (**requirements**: statistical learning, graphs, Python)
   **Contact**: Nidhi Hegde nidhi.hegde@nokia-bell-labs.com
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Internships in the Networking Team
Network Protocols & Systems Research

1. People
   • Zied Ben Houidi
   • Roger Boislaigue
   • Massimo Gallo
   • Samir Ghamri-Doudane
   • Fabio Pianese

2. Focus
   • Networks & Protocols
   • Distributed Systems

3. Applications
   • New Approaches to Network Function Virtualization
   • Extracting Relevant Insights from Network Data
Internships in the Networking Team
Potential topics for internships

1. Click Virtual Interfaces for a High-speed Modular Software Switch (requirements: C++, systems programming, Linux)
   Contact: Massimo Gallo massimo.gallo@nokia-bell-labs.com

2. Secure Unikernels for Trusted NFV Execution (requirements: systems programming, Intel SGX, security)
   Contact: Fabio Pianese fabio.pianese@nokia-bell-labs.com
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Internships in Internet of Things
General context of IoT

Internet of Things (IoT) growth …

- Unprecedented growth of connected devices:
  20~46 billions(*) devices expected in 2020
  
(*) The Future X Network book, §11 – The future of the Internet of Things

- Promise of a new era of digital services

… but limited usage of IoT devices

- People buy connected devices for a limited experience

- Standard users do know:
  1) How to configure the network to use them properly;
  2) What services they can offer together;
  3) Which software to get the best service experience.

How to better leverage available connected devices in personalized services?
Internships in Internet of Things
IoT control & service management

Need for digital assistance in IoT!

1. Communication control between IoT devices
   • Need for flexible network configuration layer
   • Software-Defined LANs = on-demand, dynamic & secure dedicated micro-networks for devices

2. IoT service recommendation
   • Universal description of IoT service classes to guide end-users in finding the right objects in the right spaces for their requested IoT services
     – Focus on physical functions and their interactions
   • Coupling with the network configuration layer:
     – Demo @ Nokia Campus Event, Paris-Saclay, Oct. 2017
Internships in Internet of Things
Some of our publications…

7. Ludovic Noirie, Michel Le Pallec, Nesrine Ammar, Towards Automated IoT Service Recommendation, demo paper ICIN’17 - http://dx.doi.org/10.1109/ICIN.2017.7899397
8. Nesrine Ammar, Michel Le Pallec, Ludovic Noirie, Algorithme de Caractérisation des Services IoT: Évaluation des Performances, Algotel 2017 - https://hal.archives-ouvertes.fr/hal-01515597
Internships in Internet of Things
Potential topics for internships (I)

- **Implementation of a high-speed traffic generator for SDN-based network node** *(requirements: Java or/and C/C++, OpenFlow, networking)*: design either in Java or in C/C++ a traffic generator which can be deployed as a Virtual Network Function (Cf. ETSI VNF) to easily load a SDN-based network (e.g. on-field traffic load test or SLA verification).

  **Contact**: Dinh Thai Bui dinh_thai.bui@nokia-bell-labs.com

- **Automated recommendation of APIs to make IoT service work**: Creation of a large API database related to connected devices, assessment and optimization of API methods classification algorithms (both actuators and sensors). Final objective: automatic recommendation of API ( / APPs) related to any IoT service instance

  **Contact**: Michel Le Pallec michel.le_pallec@nokia-bell-labs.com

- Deep analysis of a very large database of IoT devices to build a large catalog of IoT device models with the information about their capabilities (IoT, data analysis, programming)

  **Contact**: Ludovic Noirie ludovic.noirie@nokia-bell-labs.com
Internships in Internet of Things
Potential topics for internships (II)

• Interconnection between non-IP devices and IP networks (*requirements*: C/C++, networking, Linux, Android)
  
  **Contact**: Natalya Rozhnova natalya.rozhnova@nokia-bell-labs.com

• User-authentication and security of a back-end server in charge of the administration of a fleet of IoT devices and their interconnecting LANs (*requirements*: java/web/js)

• Prototyping of a test environment to validate a large scale of policies controlling the connectivity between a fleet of IoT devices. (*requirements*: java/linux)

• Modification of software suit embedded in home routers, and the tunneling towards the lab cloud (*requirements*: linux)

  **Contact for the three previous internships**: Pierre Peloso pierre.peloso@nokia-bell-labs.com
Internships in Internet of Things
Potential topics for internships (III)

• Study and Prototype Generalized OpenFlow for bitstream network
  
  **Contact**: Richard Douville richard.douville@nokia-bell-labs.com

• IoT device network monitoring and behavioral analysis: relying on an existing SDN-based home gateway, analyze traffic traces in the home, find a way to compare such traces with respect to expected network traffic from various classes of IoT devices and report possible deviation (*requirements*: network monitoring, Java or/and C/C++)
  
  **Contact**: Nicolas Le Sauze nicolas.le_sauze@nokia-bell-labs.com
  
  Mathieu Boussard mathieu.boussard@nokia-bell-labs.com

• **PhD thesis**: *Control of adaptive systems applied onto software defined IoT platform*  
  Full description: [http://people.rennes.inria.fr/Herve.Marchand/These.pdf](http://people.rennes.inria.fr/Herve.Marchand/These.pdf)
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• **How to know about Nokia internships?**
  – Nokia web site => “careers”:
      (URL may change with Nokia integration…) (look at English ad French proposals)
    • Note: internship proposals, thesis proposals (CIFRE), etc…
  – The presenters
    • Natalya.Rozhnova@nokia-bell-labs.com
    • Marc-Olivier.Buob@nokia-bell-labs.com
  – And your professors…
    • They have contacts with several Nokia Bell Labs researchers…