# Mobile System & Telecom Group
# Research Activities

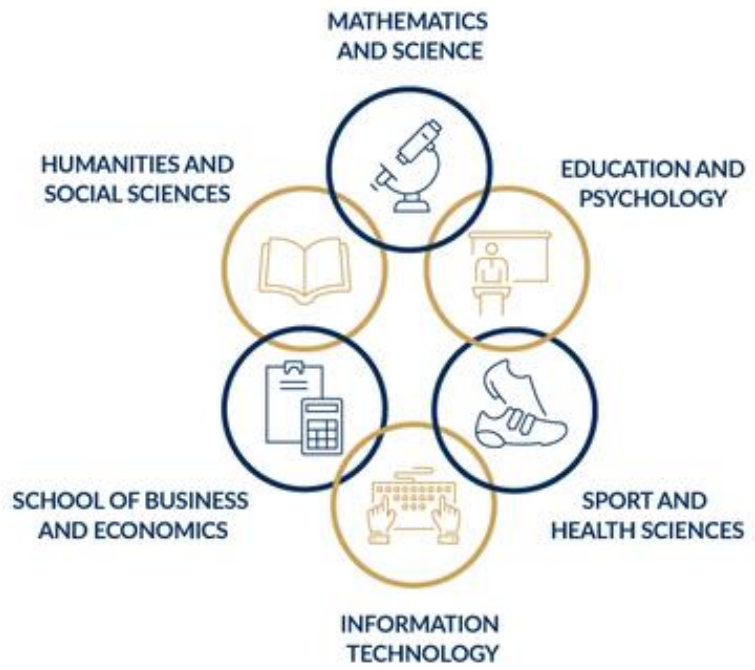
**University of Jyväskylä**
**IT- Faculty**
Prof. Timo Hämäläinen

# JYU Key Figures

**JYUnited SCIENCE.**
Since 1863.

2017

| | |
|---|---|
| 2 500 STAFF TOTAL | 800 RESEARCHERS |
| | 700 TEACHERS |
| 3 300 PUBLICATIONS | 1 800 OPEN ACCESS |
| 204 M€ FUNDING | 72 M€ SUPPLEMENTARY |
| 4 CENTRES OF EXCELLENCE | 3 ACADEMY PROFESSORS '2018 |




https://www.jyu.fi/tilastot/fi/qap/tutkinnot

# IT Faculty

## JYUnited SCIENCE.

Since 1863.

**83** RESEARCHERS

**166** STAFF IN TOTAL '2016

**48** TEACHERS

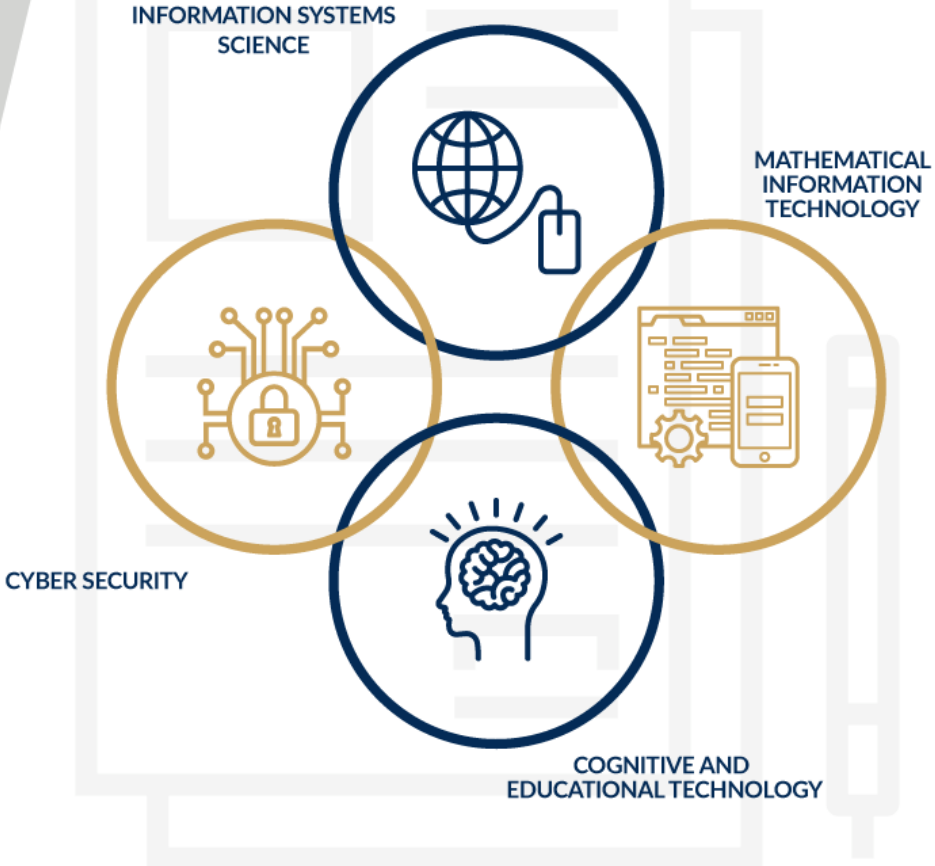
**2243** UNDERGRADUATE STUDENTS

**2358** STUDENTS IN TOTAL '2017

**142** DOCTORAL STUDENTS

**263** PUBLICATIONS '2016

**23** OPEN ACCESS




https://www.jyu.fi/it/en/research

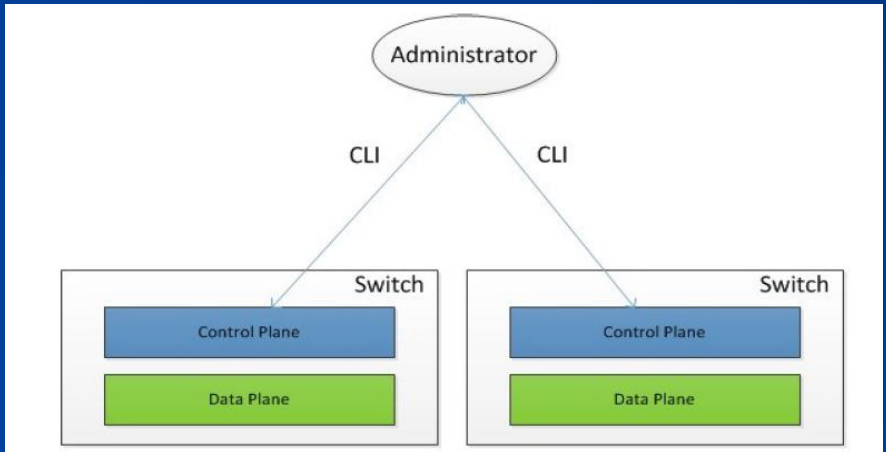
# MSTG- Research Group

**Members of the group:**

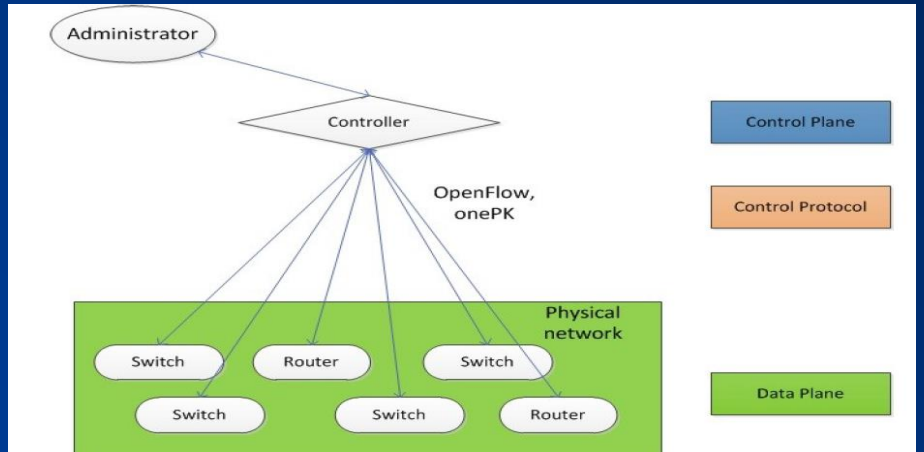
- Professors: T. Hämäläinen and T. Ristaniemi
- Post Docs/Docents: A. Viinikainen, Z. Chang, M. Zolotukhin, A. Costin, A. Sayenko, D. Petrov
- Several PhD. and MSc. students involved to the research activities and projects all the time
- The group has achieved a significant position in the IT Faculty's research and PhD&MSc. trainer
- Produced +50 PhD dissertations and +200 Master theses since year 2000.

# Goals of the research:

- Group's actvities focuses on the resource management on both wired and wireless telecommunication systems (technology developments with the industry and standardization work).
- Developing methods for monitoring and analysing network traffic (issues like QoS, security etc.)
- Mobility and resource management, and optimization of the limited network resources, the link and system-level performance etc..
- Networking security, developing methods for monitoring and analysing network traffic, user and service management methods of the future networks (IoT issues).
- Above issues are researched in Software Defined Networks (SDN)



Kuva 1: Verkkolaitteen perinteinen hallinta ja toiminta



Kuva 2: SDN-verkon toimintamalli

# Research Results

- **Tens of common research projects with companies and other universities:**
  - Developed anomaly detection methods for different kind of attacks (zero day, Denial-of-Service, Man-in-the-Middle, Compromised-Key, Sniffer etc.)
  - Developed Virtual Resource Allocation methods in SDN- based Cellular Networ
  - Developed Adaptive Access and Relay Link Resource Allocation Methods
  - Developed Energy-efficiency methods for the multi-flow transmission
  - Developed network simulator WINSE: WiMAX NS-2 Extension
    - Performance analysis of the 4/5G networks (cell size optimization, optimal relay deployment)
  - Results contribute to standardization (IEEE, 3GPP and IETF)

- **Publishing activity:**
  - + 100 journal papers
  - + 300 conference papers
  - Patent contributions with the companies

- **Invited talks and given conference presentations:**
  - Several presentations in IEEE's and ACM's conferences

# Research projects with companies:

- “IoTLi- business growth from IoT”, participants: Etteplan, Metsä Group, AGCO/Valtra, Vapo, Ficonic Solutions, city of Jyväskylä
- "Lipa, mobility and services in IP networks", participants: Metso Paper, Ixonos, Cynetkey, Resolute and Elisa.
- “Tiepal, Mobile service development to Open IMS service platform, participants: Anvia, Arena Interactive, Digita, Kilosoft, Metso Paper
- Laila, "Service management in multi-access networks", participants: Nokia, Digita, SysopenDigia, Arena Partners, and WTS.
- NGNAP, "Developement and use of next generation network architecture in process automation industry", participants: Metso Paper, Telia Sonera, Liqum.
- "WIMALE Phase I (IEEE 802.16 development)", participant: Nokia RD
- "WIMALE Phase II (IEEE 802.16 development ", participant: Nokia RD
- "WINSE", participant: Nokia RD
- "End to End QoS and IMS ", JKL Innovation
- "Imola, IMS and Mobile services", participants: Vaasan Läänin puhelin, Digia, Digita, KOAS, JYY.
- "WINSE- extension (WiMAX development)", participant: Nokia Simens NBetwork,
- "Tiepal, new mobile services and management in Open IMS", participants: Vaasan Läänin puhelin, Digita, ArenaInteractive, Kilosoft, KOAS, JYY..
- "ISSM- Intelligent Systems for Security Management", participants: Ixonos, TUT.
- Alomo, open source project, participant: JKL Innovation.
- "JymoreI, Resource management solutions for future HSDPA and next generation networks ", participant: Nokia Siemens Networks.
- Novel Radio Resource Management Methods and Network Planning, Senior researcher T. Hämäläinen, Academy of Finland.
- "Jymore II, Resource management solutions for future HSDPA and next generation networks ", participant: Nokia Siemens Networks.

# Some Ongoing Research Topics:

## Network resource management:

- Virtual Resource Allocation in SDN- based Cellular Network
- Adaptive Access and Relay Link Resource Allocation Methods
- Energy-efficiency methods for the multi-flow transmission

[1] D. Zhang, Z. Chang, F. Yuy, X. Chenz and Timo Hämäläinen:"Double Auction based Multi-flow Transmission in Software-defined and Virtualized Wireless Networks". IEEE Transactions on Wireless Communications, 16 (12), 2017.
[2] A. Sayenko, M. Zolotukhin, T. Hämäläinen,"Multi-hop Relays for High Frequency Next Generation Wireless Systems", 24th International Conference on Telecommunications, (ICT 2017).
[3] A. Sayenko, M. Zolotukhin, T. Hämäläinen, ``Simulation and Performance Analysis of Frame Structures for Multi-hop Relay Systems'', IEEE Conference on Standards for Communications and Networking (IEEE CSCN 2017)

## Networking security:

- Mitigation of DoS attacks in SDN cloud environments
- Detection of saturation attacks against SDN controller
- Collaborative filtering for multi-stage attack prediction
- Detection of malicious data exfiltration over DNS tunnels
- Mobile device malware analysis (Android etc.)

[1] M. Zolotukhin; E. Ivannikova; T. Hämäläinen, "On Detection of Network-Based Co-Residence Verification Attacks in SDN-driven Clouds", The 17th International Conference on Next Generation Wired/Wireless Advanced Networks and Systems, (NEW2AN 2017)
[2] E. Ivannikova, M. Zolotukhin and T. Hämäläinen, "Probabilistic Transition-Based Approach for Detecting Application-Layer DDoS Attacks in Encrypted Software-Defined Networks", 11th International Conference on Network and System Security, (NSS-2017)
[3] E. Ivannikova, G. David, T. Hämäläinen, ``Anomaly Detection Approach to Keystroke Dynamics Based User Authentication'', 22nd IEEE Symposium on Computers and Communications, (ISCC'17)

If you are interested in development of the future networks and services in our national/international projects, contact us !

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