## EIT Digital – Industrial PhD position proposal

## PhD thesis information

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| PhD Thesis – Title |  | New traffic handling solutions for the Next-generation networks |
| PhD Thesis – Short summary | Max 100 words | In order to allow a better network management, new cooperative solutions can be leveraged to improve the efficiency of protocols and applications, providing a better QoE and flexible SLAs for the existing and new network services. This thesis aims to explore the potential of the communication protocols and mechanisms, e.g., the re-consideration of Transport Layer semantics and cooperation between the network and the endpoints. The goal also includes studying potential enhancements to current end-to-end solutions and algorithms, as well as exploring new cross-layer designs. |
| Rationale/challenge – *describe the problem and why it is relevant* | Max 200 words | Communication mechanisms in today’s networks are far from being optimal. For example, one of the most important features in transport protocols is the congestion control mechanism used to avoid congestion collapse by adjusting sending rates. Numerous new TCP versions were suggested and research groups also proposed new alternative transport layer protocols to make the Internet faster. However, these processes are very slow to evolve and especially slow to deploy. In the middlebox-heavy Internet, the transport layer gets squeezed between two evolving domains: the application layer and the network layer, where IPv6 is largely in deployment. This makes the inflexibility of today’s solutions even more problematic and calls for means to facilitate both transport layer evolution and optimized cross-layer approaches. |
| Innovation – *describe what is the intended solution and the advance w.r.t. the state-of-the-art* | Max 250 words | The goal of this thesis is to provide enhancements to current traffic handling solutions. Potential means include:   * re-consideration of transport layer semantics * cooperation between the network and the endpoints on the resulting transport sub- layers * implementation of a specific Transport Layer Performance Enhancing Proxy (PEP) functionality * studying and improving the interplay between the solutions above and other existing mechanisms (ECN, AQM, L4s, etc.) * development of new communication mechanisms   This could enable efficient multi-domain congestion control, a much needed innovation in today’s heterogenous networks. The TAPS working group of the Internet Engineering Task Force is currently working on optimizing the interactions between applications and the network; an approach that complements the proposed innovation in the thesis in an interesting way.  The proposed work needs to consider the interest of all actors involved: users, application developers, network operators, equipment and operating system vendors. |
| Research focus/topics – *describe how you are going to solve the problem* | Max 200 words | After a review of state-of-the-art related work, the proposed new concepts will be prototyped and studied in comprehensive simulation scenarios and potentially in real networks. The simulation results will also provide valuable feedback to the design of the concepts and algorithms. The scenarios are based on real industry use-cases. Special emphasis will be placed on deployability of the concepts, and to avoid contributing to the ossification of the transport layer. The proposed solutions shouldn’t require client side modifications. This way, the solutions should achieve compatibility with the current Internet and also enable future innovation.  Solving these problems will require intensive cooperation with Ericsson and possibly with other European university research groups. |
| Deadlines/milestones (Gantt chart) | M6 | Review on state-of-the art, identify and design the scenarios based on Ericsson plans in 5G offering. |
| M12 | Publish a concept paper at an international conference and gather feedback from the community (both industry and academia). Design and implementation of prototypes of the solutions for the simulations to be run in Ericsson labs interfacing with their existing 5G simulators. |
| M24 | Analysis of the concept in comprehensive simulations. Deployability studied taking into account industrial plans and constraints through strong interaction with Ericsson business and manufacturing teams. |
| M36 | Optimization of the algorithms, real world verification with an Ericsson client. Compare end-to-end methods with the new cooperative solutions from the perspective of all involved actors. The evaluation is done in cooperation with Ericsson and should cover all main aspects of deploying the solutions in real next-generation networks with the involvement of a Network Operator to test the algorithms in the real network. Publish the findings in a journal paper. |
| M48 | Summarize the results and complete the PhD thesis. |
| Expected outcome – *describe the expected results of the PhD* | Max 100 words | The expected results of the PhD are new solutions to enable and leverage cooperative traffic handling in Next-generation networks and thus improve performance and efficiency. The results shall include:   * Working, verified prototype of the new concepts * Detailed analysis of the impact on network performance and deployment considerations * Published papers describing the findings in high-quality academic journals * Potential patents, working in close cooperation with Ericsson Hungary |

## Relevance for the Action Line (section to be filled out by the Action Line Leader)

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| Action Line | AL | Digital Infrastructures |
| Alignment with Action Line – *statement from the Action Line Leader indicating the relevance for the AL from his perspective* | Max 150 words | The Action Line Digital Infrastructure is focusing on networking incl. IoT, cloud computing big Data and aAI and cyberseceurity.  Focusing on real-time properties e.g. to support data processing or future 5G is very much in line with the focus of the AL. In particularly focus on real-time networking to support vertical segments like connected cars based on 5G is very important to make these verticals to happen. Improvement of QoS/E is of course very significant.  Since this area is important for the AL I would like to see an interaction between the AL and the proposed PhD position so that we can have talks at AL meetings and potentially some investigations in the same area when needed by Innovation Activities by the PhD student. |
| Relevant IA – *List any relevant Innovation Activity (if applicable)* | Max 100 words | The HII ACTIVE on IoT platform is partly about real-time networking and need for better SLAs. |

## Partnership/financial information

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| Action Line Leader | Name | Henrik Abramowicz |
| Industrial partner |  | Ericsson Hungary Ltd. |
| Industry advisor – *name and short bio* | Max 100 words | Attila Mihály is a senior researcher at Ericsson Research. **He received his Ph.D. in 1998 in physics.** Since 1999, he has been working at Ericsson Hungary first in software development and then in research in the area of wireless communications, QoS, transport protocols, content delivery and caching. His current research interests include core network architecture, Internet protocols and network features. He has published over 70 research articles and patents, and supervised 4 master thesis students. |
| Academic/research partner |  | Budapest University of Technology and Economics (BME) |
| Academic/research supervisor – *name and short bio* | Max 100 words | **Sándor Molnár is an Associate Professor at the Department of Telecommunications and Media Informatics, Budapest University of Technology and Economics (BME). He received his Ph.D. in 1996 in electrical engineering and his habilitation in 2013 in computer science from BME. He was the BME project leader of the Gold Award winner 2009 CELTIC EU project titled “Traffic Measurements and Models in Multi-Service networks (TRAMMS)”. Dr. Molnár is serving in the editorial board of international journals and is working in the TPC of several IEEE/ACM/IFIP conferences. He is an author of over 170 scientific publications. His research interests include teletraffic analysis and performance evaluation of modern communication networks.** |
| HEI granting the title |  | Budapest University of Technology and Economics (BME) |
| DTC location | Node | Budapest |
| Geographical mobility plan |  | KTH Royal Institute of Technology |
| No. of PhD positions | [#] | 1 |
| PhD duration | [#years] | 3 years |
| Co-funding percentages:  - Industry  - Academia  - EIT Digital | [%] | 20% |
| [%] | 30% |
| [%] | 50% |