

<p style="text-align: center;">Campaign 2010 Description of the PHD</p>

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Location: Lannion (22) - France

PHD title: Ensuring Quality of Service for Content delivery in Information Centric Networks

Global context and state of the art

The Internet was designed with much less ambitious objectives than what it is now able to provide, with in mind a simple client-server approach. Nowadays, with its success, many features have been added to offer QoS, mobility, security, NAT traversal, load and data distribution, web pages ranking, etc., making it very complex. The first idea of Internet was to connect hosts (client and server) to get contents. The quality of the communication is assured by minimum cost routing and a certain level of over-provisioning to keep low queueing delay and overload.

However, it is now widely admitted that the current Internet has many drawbacks or limitations and that networks should move from a host centric approach towards a content centric approach. A recent literature on content-based networking, called Content Centric Networks (CCN) or also Information Centric Networks (ICN) rethinks globally nowadays networking with the ambition to answer to a large number of unsolved networking problems. Content centric networking focuses on named data that is recognizable by nodes directly from names written into packet headers. In ICN, the naming, addressing and routing of data plays a more important role since the way how contents are identified have a big impact of its distribution; the routing is based on the named data and no longer on the IP address of the machine, hosting the contents. Several research teams investigate this field and propose several solutions based on publish/subscribe mechanisms and/or DHT-extended systems (CCN, PSIRP, NetInf, DONA.....) but they are still in their early stage and do not address all features the future Internet should provide. One of them is a mechanism to ensure quality of service in the content delivery in such ICN, while the context may be different from one user to another one. Indeed, none of the solutions clearly address this issue. Some just argue that the quality will be better because the content will be retrieved from closer sources; others say that ICN will improve QoS but without detailing why and how. The study proposed in this thesis is to find a satisfactory solution to ensure quality of service in ICN, depending on the context: This might be based in defining a new identification scheme that could allow to embed QoS (and possibly context) information in content Identifiers and allow its routing in the ICN. It could also be integrated with routing/queueing/caching mechanisms that enable the delivery with respect to the required QoS. Dynamic routing solutions based on the naming of the content as well as using network topology or other criteria may also be used to help in the distribution of information with the required Quality of Service.. The PhD student will have to design this new system and validate it (via simulation or prototype & tests).

PHD objectives / Expected results / Scientific challenges / Key Issues

The overall objective of the thesis is to design and validate a solution, relying on a new naming scheme associated with its addressing and routing functions that could allow to ensure quality of service in ICN networks, depending on the current context.

The approach should be validated by simulation and eventually by a prototype, which will be a proof-of-concept of the solution and tested in real-life configurations.

The technical challenge is about guarantying QoS in such ICN, where contents are replicated, distributed and may be accessed from many sources (possibly from different access networks, having different capabilities) via many different paths, passing through ICN routers...

Methodological approach proposed by the supervisor

The methodology will be quite classical. The PhD student will make an exhaustive bibliography related to ICN and QoS existing works. Then after identifying lacks, limitations or possible improvements, the student will design his solutions and evaluate it.

The PhD student will be localised in Lannion, within the team that will supervise him and that works on this topic. Frequent discussions and exchanges will allow presenting the work, to brainstorm about ideas and to make progress in the work. Others teams in Orange Labs work on similar topics and meetings will be set up between teams to exchange about proposals, ideas.... Additional seminars could also be organised where the student could present his work to Orange people or even external research scientists.

Frequent meetings will also be held with the academic supervisor to monitor the progress of the work, to drive the work and eventually propose new research directions.

Finally, the PhD student will have to publish his works in international well-known conferences, in journals, books, etc.

The PhD Student should have a good knowledge of IP protocols (IP, TCP, UDP, HTTP, Mobile IP, QoS...) and about Internet more generally speaking.

Having a good knowledge of DHT-based systems would be a plus.

The PhD Student should be fluent in English (reading, writing, speaking). A native-English spoken candidate would be preferred.

Global schedule

During the first six months, the PhD student will make a state-of-the-art of the topic, based on an existing survey done by the Orange team and including also existing quality of service mechanisms. After this first phase, the PhD Student should have identified research items (limitations of existing solutions, improvement to existing solutions, new concept/mechanism to design and integrate, new ICN system, etc.).

The second phase will be about the research work, defining one (or several) new solution(s) in order to guarantee quality of service in ICN networks. The second phase will last between 1 year and 2 years

The third phase will be about the evaluation of the proposed approach. Depending on the solution, the evaluation could be simulations of the system (extending simulator tools and making tests) and could be an implementation of the system (proof-of-concept) and tests to prove the efficiency of the solution. The evaluation phase will be about 1 year.

The second and third phase could be made in the same time (e.g., the student designs a solution, implements and tests it, refine, adapt the solution, re-tests it, etc.).

Finally, the PhD student will write the thesis document.

Additional contributions

Contribution to collaborative (national or European) projects

Some references

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2. 4WARD D-6.1, "First NetInf architecture description," <http://www.4ward-project.eu/>.
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4. Future Content Networks Group, "Why do we need a content-centric future Internet? Proposals towards content-centric internet architectures," Future Internet Assembly, Prague, Position Paper, May 2009.
5. V. Jacobson, "Introduction to content-centric networking," *Invited plenary course, Future Internet Summer School 2009*, June 2009.
6. V. Jacobson, "A new way to look at networking," *Google Tech Talk*, Aug. 2006.
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7. V. Jacobson, D. Smetters, J. D. Thornton, M. Plass, N. Briggs, and R. Braynard, "Networking named content," in *Proc. of ACM CoNEXT*, 2009.
8. PARC, "Project CCNx," <http://www.ccnx.org/>.
9. T. Koponen, M. Chawla, B.-G. Chun, A. Ermolinskiy, K. H. Kim, S. Shenker, and I. Stoica, "A data-oriented (and beyond) network architecture," in *Proc. of ACM SIGCOMM '07*, 2007, pp. 181–192.
10. S. Paul, R. Yates, D. Raychaudhuri, and J. Kurose, "The cache-and-forward network architecture for efficient mobile content delivery services in the future internet," in *Proceedings of the First ITU-T Kaleidoscope Academic Conference on Innovations in NGN: Future Network and Services*, 2008.
11. "Publish-subscribe internet routing paradigm," <http://psirp.hiit.fi/>.