# Multiaccess NetInf: A Prototype and Simulations

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**Abstract.** This work presents operation and the results obtained in an information-centric multiaccess content distribution prototype using both real laboratory environment tests and simulation experiments with OMNeT++. We present the basic objectives and mechanisms of our solution and evaluate it against a standard BitTorrent. The results show that our prototype based on an information-centric approach can reach high performance gains in both static and mobile scenarios, is scalable and can reduce the amount of inter-network traffic.

**Keywords:** multiaccess, network of information, content distribution, BitTorrent, information-centric.

## 1 Introduction

Network of Information (NetInf) [1][2] is an information-centric networking approach being developed by the FP7 4WARD project (see www.4wardproject.eu). The aim of the NetInf project is to provide a communication infrastructure that is more suitable to content distribution applications than the current client-server model. In an information-centric approach the users generally do not care where the information is located, as long as the information is valid. The information should not be tied to specific locations but it could reside anywhere in the network. It is also anticipated that the Future Internet supports mobility and multiaccess.

We implemented and evaluated a new BitTorrent [3] based content distribution system, namely Multiaccess NetInf [4], for showing the benefits of using several network accesses simultaneously (multiaccess). Our prototype provides also a method for downloading content locally from own network. These characteristics should be supported even while moving across several overlapping wireless networks, such as Wi-Fi, 3G or WiMAX. The prototype is evaluated both in a static and mobile scenario and simulation experiments are used to show the scalability of the solution. The content is distributed using the BitTorrent protocol, as a reference, and in the mobile scenario multiaccess NetInf is compared against BitTorrent over Mobile IPv6 [5]. The results show that a multiaccess NetInf solution can reach high performance gains, reduce the amount of cross-network traffic and is also scalable.

## 2 Operation and Evaluation

Basic scenario of Multiaccess NetInf is illustrated in Fig. 1. The scenario involves three different networks: Core Network and two access networks, which both have

T. Magedanz et al. (Eds.): TridentCom 2010, LNICST 46, pp. 605–608, 2011.

wireless access points (Wi-Fi). In the scenario, Global NetInf name resolution point takes care of local name resolution points, whereas local resolution point maintains a list of local content sources. A NetInf node represents our content downloader and it can be connected to one or more wireless networks. Employment of NetInf Notification Service (NNS) enables indication of new access networks, while NetInf node is moving across different wireless networks. In this prototype implementation NNS was realized by using the trigger management framework [6].

The system operates as follows. NetInf node requests global name resolution from a global resolution point, which responds with the location of local name resolution point(s). When the node makes a content request to local resolution point(s), they report the location of the local sources and the NetInf node can ask content locally from them. After the node detects a new network where it is connected to, it asks for the existence of a local copy of the content from the Global resolution point through NNS. The global resolution point responds with the location of the local resolution point. Node can now request sources from it and also start the content retrieval from the sources located also in the new network.

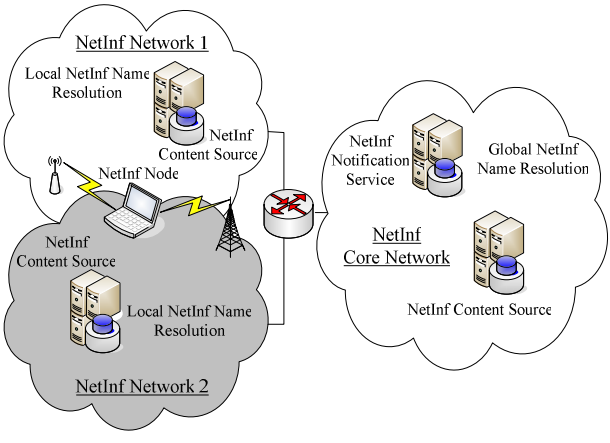


**Fig. 1.** Basic scenario of Multiaccess NetInf content distribution

We compared single access standard BitTorrent and Multiaccess NetInf in a real laboratory environment and also with simulations. The NetInf node was connected, in this static scenario, to two networks over two interfaces simultaneously. In laboratory experiments, the setup was exactly the same as in Fig. 1, but in simulations the number of access networks and NetInf nodes was larger, as is certain. Simulations were made with OMNeT++, INET framework [7], OverSim [8], and a BitTorrent module [9].

Table 1 shows outperformance of multiaccess NetInf. In laboratory experiments reduction in download durations was 41 %, when comparing multiaccess NetInf to single access BitTorrent. Respectively in simulations, the portion was 32 %. Moreover, we reduced inter-network traffic very drastically: decrease of inter-network traffic was almost 100 % in prototype measurements and 98 % in simulations.

**Table 1.** Outperformance in download durations and in Cross-Network traffic

| Reduction in median (ten runs): | Prototype: | Simulations: |
|---|---|---|
| Download Durations | 41 % | 32 % |
| Inter-Network traffic / Packets in Backbone routers | 100 % | 98 % |

In addition, we evaluated the performance of our prototype implementation in low mobility scenario with laboratory experiments. Comparison was made between Multiaccess NetInf and BitTorrent over Mobile IPv6. The scenario was the same as in Fig. 1, but the user movement affects to the availability of different access points in the following way. NetInf node is connected the first 15 s only to network 1. From 15 s to 25 s it is connected to both networks and during the rest of the download only to network 2.

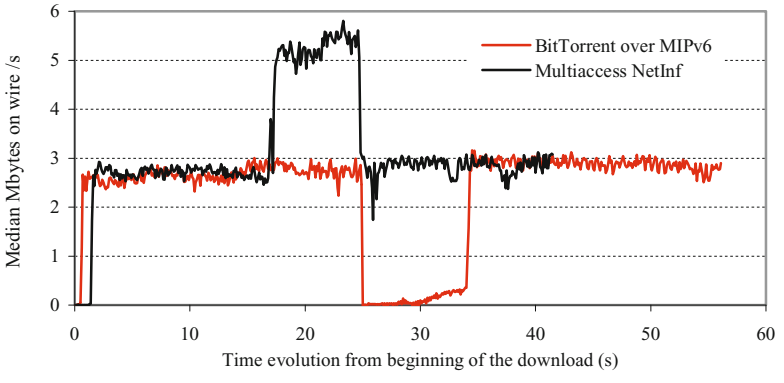


**Fig. 2.** Throughput in mobile and multiaccess scenario

Again, our system was faster than standard BitTorrent (29 % reduction in median download duration). Also inter-network traffic was decreased almost to none; total reduction was almost 100 %. Evolution of median throughput in both experiments (with BitTorrent and Multiaccess NetInf), represented in Fig. 2, provides an explanation for the superiority of the prototype; it can use two interfaces simultaneously in the middle of the download (from 15 s to 25 s).

## Conclusion

This short paper described briefly the results and the testbed of the laboratory experiments and simulations. Results and evaluation showed clearly the outperformance of multiaccess NetInf comparing to single access BitTorrent. In static scenario, reduction of median download duration was 41 % with prototype and 32 % in simulations. Also we reduced inter-network traffic almost by 100 % in both

evaluations. Respectively, our prototype implementation outperformed BitTorrent over MIPv6 in mobility scenario; reduction in median download duration was 29 % and inter-network traffic was reduced almost by 100 %.

## Acknowledgement

The work covered in this paper has been sponsored by VTT Technical Research Center of Finland, the ICT 7th Framework Programme Integrated Project 4WARD (partially funded by the Commission of the European Union) and TEKES as part of the Future Internet program of TIVIT (Finnish Strategic Centre for Science, Technology and Innovation in the field of ICT).

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