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The master's thesis topic proposal
Candidate: Nejc Bizjak

I, Nejc Bizjak, a student of the 2nd cycle study programme at the Faculty of computer and information science, am submitting the thesis topic proposal to be considered by the Committee for Student Affairs.

The thesis working title:

Slovene: **Predpomnjenje v programsko definiranih brezžičnih omrežjih na podlagi predvidevanja konteksta**
English: **Context prediction-based prefetching in software-defined wireless networks**

The mentor:

Name and surname, title: doc. dr. Veljko Pejović
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I would like to write the thesis in English because my mentor is not native Slovene speaker and our communication is done in english.

Ljubljana, ...3.12.2015.....

Mentor signature: Candidate signature:

Proposal of the masters thesis topic

1 The narrow field of the thesis topic

English: computer science

2 Key-words

English: software-define networking, content prefetching, context prediction

3 Detailed thesis proposal

3.1 Introduction and problem formulation

Over the last few years the number of powerful mobile devices has increased drastically. The number of devices connected to IP networks will be three times as high as the global population in 2019. Besides quantity, capabilities of those devices are also increasing. IP traffic per capita will each 22 GB per capita by 2019, up from 8 GB per capita in 2014 [1]. With current backhaul capacity, network congestions will become more frequent and quality of experience will worsen. But the rise of Software-defined networking gives us new opportunities to deal with these challenges. This new paradigm gives us centralized and programmable control over network [4]. We plan to create smart network application which can modify network flows based on predictions about user's movement and content which will be requested. Such predictions can be aquired from the smartphones with different approaches [3, 7]. Additionaly we plan to use content predictions to experiment with network-side content prefetching and caching to serve the content to the user faster.

3.2 Related work

Emergence of a new paradigm called Software-defined networking (SDN) has introduced new possibilities in network management and configurations [4]. Control logic over whole network is centralized and programmable while network devices perform only packet forwarding. This gives us a platform on which new ideas can be introduced in the network through a high-level software program as opposed to using a fixed set of commands in proprietary network devices.

Mobility predictions are popular topic in research community. Recent studies have focused on using client-side mobility prediction to improve video streaming [5, 6]. In the first work mobile device was configured to orchestrate the caching on access points. Although results are good, the solution itself does not scale very well, because it is client-network oriented and network specific. In the second case mobility prediction algorithms have been used to control downloading schedule and buffering on the android smartphone trying to minimize segment lateness and maximize video quality.

Content prediction researh is being driven by increasing number of sensors and capacity of smartphones. Successful attempt has been made to leverage app usage predictions to provide system-wide speedups even without modifications to apps and operating system [7]. Implemented algorithm requires no prior training and provides high accuracy of predictions with little overhead.

Network-side approaches to the problem of improving user experience were also studied. Most significant and relevant is the solution called EdgeBuffer [8]. This platform is part of MobileFirst project which tries to address the drawbacks of traditional networks which were originaly built for static devices. Implemented solution provided significant improvements over static caching strategies.

Although considerable research has been devoted to individual fields of client-side context prediction and network-side optimizations, less attention has been paid to the possibility of merging these fields. We propose an SDN based solution which will explore the possible benefits of using context prediction to dynamically adjust the network to provide better quality of experience.

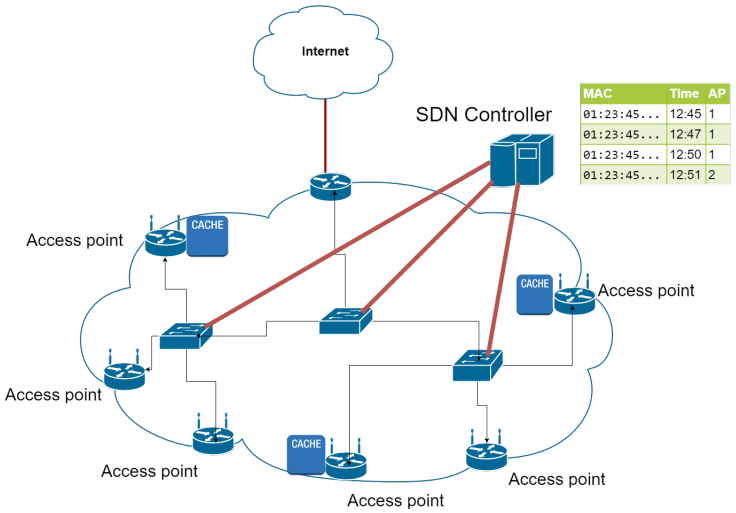
3.3 Expected contributions

- Module for SDN controller,
- caching based on mobility prediction,
- content prefetching based on content prediction,
- result comparison with alternative approaches.

We expect to show that it is possible to use prediction data in SDN Controller to transform a large Wi-Fi network from reactive to proactive. Prediction information on a network level opens up a lot of possible network optimizations which benefit the end users. We intend to implement a module for SDN controller to support the use of prediction datasets for network path reconfiguration, cache modification or content prefetching.

Data aquisition and prediction algorithms are out of scope, but we turn to [5, 3, 7] to study the possible formats and scopes of prediction data. Aditionally we intend to use publicly available datasets containing mobility [9] and network traffic [10] information.

We will build upon existing SDN caching solution [12] using open-source experimental caching platform called OpenCache [11]. This tool should provide us with enough flexibility to implement content prefetching. We will compare our solution to EdgeBuffer [8], as it is the most similar regarding high level goals. Although side by side comparison will be hard, as architectures are completly different, relative comparison of improvements with advanced prefetching methods against traditional caching is possible.



Slika 1: SDN Controller

3.4 Methodology

We will be working on opensource java based SDN controller called OpenDaylight. For network simulation we will be using opensource tool called Mininet. On access points we will measure the latency to get the requested data as crucial factor of quality of experience. We will evaluate general improvements or overhead by measuring $delay \cdot amount$ metric on all network links. Our advanced techniques will be tested against traditional caching without the use of predictions. Simulation will be run based on mocked predictions but we will also use appropriate datasets [10, 9]. We will compare the results gained with prefetching and without. Results will be analyzed and compared with state-of-the-art prediction-oblivious solutions based on different network architectures [8, 12] .

3.5 References

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Ljubljana, 3. december 2015.