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Improving the performance of Web Services in Disconnected, Intermittent and Limited Environments

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Abstract

In this thesis I investigate different techniques to improve the performance of Web services in typical tactical network environments.

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Part I
Introduction

Military units may operate under conditions where the reliability of the network connection is low. They operate far from existing communication infrastructure and rely only on wireless communication. Such networks are often characterized by unreliable connections with low bandwidth and high error rates making communication difficult. In a military scenario it is necessary for units at all operational levels to seamlessly exchange information across different types of communication systems. In NATO, this concept is referred to as Network Enabled Capability(NEC). Furthermore, in a feasibility study, NATO identified the Service Oriented Architecture and Web Services as key enablers[1].

Web services is well tested in civil environments where the network is stable and the bandwidth is abundant. In contrast military tactical networks may suffer from high error rates and low bandwidth.

Different optimization techniques can be applied to reduce application overhead aswell as using specialized transport protocols, can overcome the challenges of mentioned networks. Expensive to alter and build own properary solutions, better to use commercial off-the-shelf software. Therefore, by putting the optimization in proxies, the client and services can remain unchange while the proxy handles the optimalization.

In this thesis I investigate optimalization techniques implemented in a proxy pair.

1 Background and Motivation

1.1 Web services

NATO has chosen Web services as the technology for achieving interoperability with respect to machine-to-machine information exchange in NATO. The World Wide Web Consortium has defined Web Services as[2]:

A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format (specifically WSDL). Other systems interact with the Web service in a manner prescribed by its description using SOAP-messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards.

However, there also exist other types of Web services which does not follow this definition. RESTful web services let users manipulate data using a set of stateless operations. REST services have gained a lot of traction in the civil industry in the latest years.

1.2 Tactical networks

Mobile tactical networks are characterized by that the units use tactical communication equipment which includes technologies like VHF, UHF, HF, tactical broadband and satellites. Examples of such units are mobile units like vehicles, foot soldiers and field headquarters. These types of networks have low bandwidth, possibly high delay, high error rates and frequent disconnections. They are often called disadvantaged grids or DIL. NATO studies has identified such networks to have the following characteristics:

> *Disadvantaged grids are characterized by low bandwidth, variable throughput, unreliable connectivity, and energy constraints imposed by the wireless communications grid that link the nodes*[3].

These constrains of mobile tactical networks are central in order to understand the problem at hand, and I will therefore explain the concepts here:

Bandwidth and throughput The terms bandwidth and throughput are used interchangeably in the networking community and refers to the data transfer rate; how fast data can be transported from one point to another in given time period. This is often expressed in bits per second.

Unreliable connectivity Units that are participating in a tactical network are highly mobile and may disconnect from a network either voluntarily or not. Unplanned loss of connectivity can be due to various reasons, such as loss of signal or equipment malfunction.

Energy constraints imposed by the wireless communication grid The battery capacity and the transmission range of the communication equipment for mobile units may be limited. Another issue is that in some cases military units are required to enter radio silence in order to avoid being detected by the enemy. During radio silence units may only receive data and not send any.

Theese constrains imposes some challenges when employing Web services in tactical networks. In paper X, tree areas that need to be addresses are identified[4].

1.2.1 End-to-end connections

1.2.2 Network heterogeneity

1.2.3 Web Service overhead

2 Problem Statement

Most of the Web Service solutions used today are aimed for civilian use and does not necessarily perform well in military environments. In contrast to civilian

networks where bandwidth are abundant, mobile tactical networks may suffer from high error rates and low bandwidth.

In my master thesis I will investigate different optimization techniques that can be applied to improve communication. In order for the clients and services to remain interoperable the optimization techniques will be placed in proxies.

The Web Services will communicate with his counter part over HTTP as regular, with all traffic going umerkelig through the proxy. The Web Service itself does not need to pay attention to the bad connectivity, the proxy will choose the appropriate protocol and configuration.

3 Premises

Ikke endre web-servicene.

4 Scope and Limitations

Snevre inn oppgaven.

5 Research Methodology

6 Contribution

The outcome of this thesis is an reccomandation regarding which optimizations techniques which can be used in DIL to enhance the performance of Web services.

7 Outline

Hvordan er resten av oppgaven strukturert.

Part II
Background

In this part, I will present relevant technologies.

8 Related Work

Diskuterer eksisterende arbeid.

Requirement	Priority
Receive and forward HTTP 1.X requests	1
Allow modifications on the payload	1
Allow configuration of HTTP timeouts	1
asd	1
Support protocol X and y	2

Table 1: Proxy requirements

9 DIL

Disconnected, Intermittent and Limited environments (DIL) definer hva DIL er og hvilke begrensninger det legger.

10 Optimization techniques

Web services enabels interoperability betweens system, but also increase the information overhead, requriering higher data rate demands. By using proxies, we can freely choose the communcations protocols and configurations between the proxy pair without altering the Web Services themself. In this thesis I will investigate different techniques in order to optimize the communcation between a Web Service and a Web Service client.

10.1 Compressing the payload

Compress the payload using GZIP and forward it to the other proxy.

10.2 Reducing overhead of SOAP

HTTP/TCP is the most used transport protocol for SOAP messages, but since SOAP is transport protocol agnoistic diffrent protocols can be used.

11 Requirement Analysis

Diskutere CPU-bruk vs compression.

12 Summary

Part III
Design and Implementation

13 Overall Design

14 Proxy

14.1 Squid

Squid is a fully-featured HTTP/1.0 proxy.

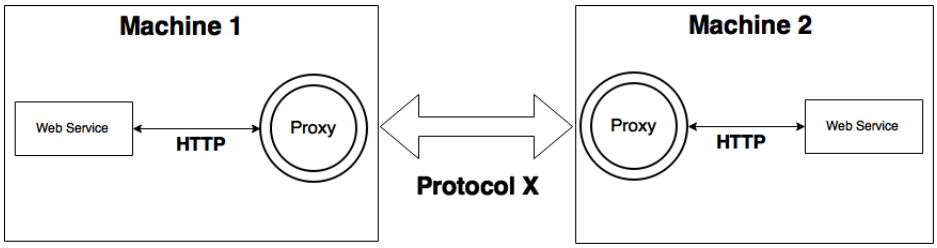

Figure 1: Architectural overview of proposed design

References

[1] P. Bartolomasi et al. *NATO network enabled capability feasibility study.* 2005.

[2] Hugo Haas and Allen Brown. *Web Services Glossary.* `http://www.w3.org/TR/ws-gloss/\#webservice`. Accessed: 2015-05-06.

[3] A. Gibb et al. "Information Management over Disadvantaged Grids". In: *Task Group IST-030/ RTG-012, RTO-TR-IST-030* (2007). Final report of the RTO Information Systems Technology Panel.

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