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”Adapting Web Service Publish/Subscribe Technologies for use in
NEC C2 Systems”

Track 8: C2 Technologies and Systems, Track 7: Network-Centric
Experimentation and Applications, Track 2: Networks and
Networking

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Abstract:

Web Services (WS) are in widespread use on the Internet today, and COTS products are readily available. WS are being considered as an enabling technology for NEC, and seem well suited since they provide both push/pull communications as well as the asynchronous publish/subscribe paradigm. Push communication allows orders to be disseminated to troops; pull can be used by the troops to retrieve additional information on-demand. Publish/subscribe is suitable for sending updated track data and improving situational awareness.

The challenge lies in using WS over so-called “Disadvantaged Grids” (DG), i.e., networks with low available bandwidth and high error rates. Tactical communication systems can often be classified as DG, and are therefore usually not well suited for WS. In this paper we present our ideas for adapting WS to DG. Proxy servers can be used to minimize the number of messages traversing the links, and can thereby improve both push/pull and publish/subscribe communications. We will discuss push/pull briefly, but the main focus of this paper is publish/subscribe. Furthermore, we present techniques for reducing the publish/subscribe communications by adapting the representation of the information that is being transmitted.

1. Introduction

The NATO NEC feasibility study (NNEC FS) presents considerations for NEC, and contains a roadmap for its implementation. In this study, IP is presented as the universal communications protocol, and it is discussed how “EoIP”, everything over IP, will facilitate interoperability between systems. Furthermore, the study mentions that IP should be used for all systems that can benefit from it. In Network Based Defense (NBD), the Norwegian equivalent of NEC, we anticipate the use of IP in all systems. Indeed, research has shown that using IP is feasible even over tactical communications systems such as the Harris HF radio [5].

The first step towards NEC/NBD is to integrate legacy strategic and tactical systems into a common network. For such integration the modular concept from Service Oriented Architectures (SOA) is essential. Each legacy system can be viewed as a separate module that needs to be interconnected with others. In order to get the different modules to cooperate one needs a common standardized means of communications between them. On the network layer the IP protocol has been chosen, but one needs to decide on a protocol for the application layer as well. In NBD we are investigating the possibility of using WS for this purpose. WS use the XML-based SOAP protocol for information exchange, and are in widespread use on the Internet today, with COTS products readily available. Thus, it makes sense to attempt to utilize this technology for military purposes. This is acknowledged not only in Norway for NBD, but seems to be a general trend in NATO countries as the Network Centric Operations Industry Consortium [1] supports the WS standards. Thus, it is useful to study the use of WS both in strategic and tactical systems.

Previously, we have performed experiments with web services in a multi-national scenario at CWID 2006 [4]. In these experiments, we showed that WS, including publish/subscribe, could be used to exchange track data (with end-to-end security) between nations. We used the object-oriented XML-version of the C2IEDM (Command and Control Information Exchange Data Model) from the MIP (Multilateral Interoperability Program), and exchanged XML-based messages using SOAP over HTTP. Using the WS-notification standard [2], nations could subscribe to track updates from each other, and thereby establish a common operational picture. Our experiments showed that the utilization of WS in NEC is feasible, but it also revealed several challenges [3], some of which are addressed in this paper.

Furthermore, in these experiments web services were used at the strategic level, where bandwidth is abundant. For full-fledged NEC/NBD we need to integrate tactical communications into the network as well. We discuss the challenges that arise in this context below, along with our ideas for overcoming some of the obstacles.

2. Background and motivation

- two communications paradigms; push/pull and pub/sub
 - o pub/sub important for
 - track updates,
 - building COP, and
 - creating situational awareness.
- challenges when using web services over tactical communications links
 - o low bandwidth
 - o high error rates

3. Related work

- existing web services standards (and their shortcomings)

4. Our ideas and suggestions:

- optimizing pub/sub communications for disadvantaged grids
 - o an enhanced pub/sub communications paradigm
 - o adapting the message representation
 - referentially complete objects versus referentially incomplete objects
 - o proxy servers
 - filtering
 - deliver only relevant and necessary information
 - unicast/multicast gateway
 - utilize the underlying transmission medium
 - subscriptions on behalf of clients
 - reduce network traffic
 - increase scalability

5. Conclusions

6. References

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- [4] Coalition Warrior Interoperability Demonstration (CWID) 2006 home page
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