EVALUATION OF WAP NETWORK CONFIGURATION SUPPORTING ENHANCED SECURITY

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ABSTRACT

In this paper the performance of a WAP network configuration supporting end-to-end security is evaluated under varying wireless and Internet conditions. A baseline configuration that does not support end-to-end security is also evaluated for comparisons. Based on the results, recommendations are made for choosing a particular configuration for providing WAP services.

INTRODUCTION

The popular Internet protocol stack, TCP/IP, is not suitable for low bandwidth, high latency first and second generation wireless networks. Degradation of TCP throughput in wireless channels due to signal fading and handoffs has necessitated the development of alternative protocols such as the Wireless Applications Protocol (WAP) for providing efficient means of transmitting Internet contents over cellular wireless networks. For ease of display on small cell-phone screens, the contents are usually encoded in wireless markup language (wml). The WAP network can be set up in different configurations. In this paper two WAP network configurations (Figures 1.a and 1.b) are evaluated. The standard configuration (SC) depicts how a WAP network would normally be set up, with the WAP gateway interconnecting the wireless data network to the Internet and providing protocol conversions between WAP over the wireless data network and TCP/IP over the Internet. In SC, client to server connection is not secure in an end-to-end manner since encrypted data is temporarily exposed in the WAP gateway's memory [1]. The alternate configuration (AC) provides end-to-end security support by relocating the WAP gateway on to the content provider's (CP) intranet. In this case the scope of the WAP stack is extended from the wireless data network over the Internet to the CP intranet.

SIMULATION MODEL

The two WAP network configurations are evaluated under varying Internet and wireless conditions. We employ a model of the IS-95 CDMA wireless channel. Maximum user data transmission rate is 9600bps. The channel is assumed to be fast faded and errors are modelled by a uniform Frame Error Rate (FER) parameter. Go-Back-N ARQ error recovery is employed at the link layer (LL). Internet delay is modeled by an M/D/1/n queue. Varying degrees of Internet congestion creates different packet drop rates and average per packet delays. The Internet congestion is classified into three categories – good, average and bad. Performance parameter is the client perceived access time (AT) for a sample wml file. AT is the time difference between when the client makes a request and when it receives a reply from the server.

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EFFECT OF VARYING WIRELESS CONDITIONS

The performance results for varying wireless conditions are indicated in Figure 2. For different wireless conditions simulated, AC has better performance than SC except when the FER is high (44%). AC's performance degradation is due to premature timeouts and redundant retransmissions from the server. The WTP specifications [5] specify a 7 second reply timer to be used at the WAP server for IP based bearer services. In AC, latency experienced by the wireless transfer protocol (WTP), the WAP layer responsible for reliable data delivery, is high, consisting of a 2 second propagation delay on the Internet, congestion on the Internet queue and delay introduced by the Go-back-N LL protocol. When the FER is high, several timeouts occur at the server causing redundant retransmissions from the server. Another reason for the timeouts is the delaying of client acknowledgements due to bad channel conditions. Redundant retransmissions amount to several kilobytes of data. On a congested wireless channel this results in long packet queues thus delaying useful data packets and degrading AC's performance. SC has better performance under bad wireless conditions. This is because the problem of redundant retransmissions is not significant in SC. The latency experienced by WTP is only of the wireless channel; therefore high FER (44%) has a small effect on SC's performance.

EFFECT OF VARYING INTERNET CONDITIONS

The performance results for varying Internet conditions are shown in Figure 3. The performance of AC is better than SC under all Internet conditions evaluated, except when the wireless condition is bad. AC employs WTP over the Internet. WTP requires lesser bandwidth and lesser overhead to transmit a file than TCP and unlike TCP the WTP timers at the server end do not increase in response to congestion on the Internet. SC's performance degrades under increasing congestion on the Internet because when Internet conditions are degraded, TCP implements

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congestion control and decreases its throughput. TCP's bandwidth requirement is also much larger than WTP.

RECOMMENDATIONS

It is concluded from the study that AC can be employed unless the wireless channel conditions are frequently bad with throughput well below 1000bps. It is to be noted that AC performs adequately even with wireless throughput as low as 3000bps. SC performs better than AC on bad wireless conditions, but its throughput is instead severely limited by degradations in Internet conditions. Note that bad Internet conditions are, however, not very common [7].

REFERENCES

[1] WAP Forum, "WAP Architecture", http://www.wapforum.org/what/technical.htm

[2] http://www.isi.edu/nsnam/ns/

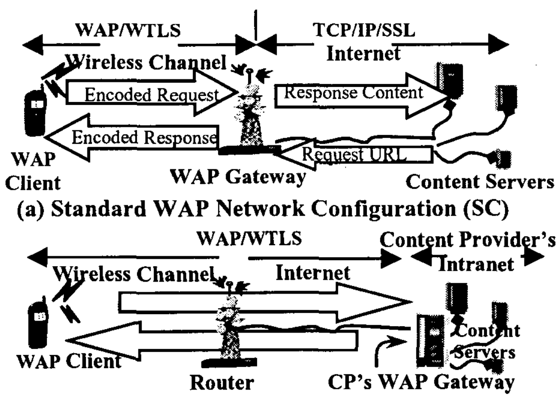
[3] Vern Paxson, "End-to-End Internet Packet Dynamics", *ACM Computer Communication Review*, vol. 27, no. 4, pp. 139-152, October 1997.

[4] Wap Forum 2001, "Wireless Transaction Protocol specifications", http://www.wapforum.org/what/technical.htm

[5] Wap Forum 2001, "Wireless Session Protocol specifications", http://www.wapforum.org/what/technical.htm

[6] Wap Forum 2001, "Wireless Transport Layer Security specifications", http://www.wapforum.org/what/technical.htm

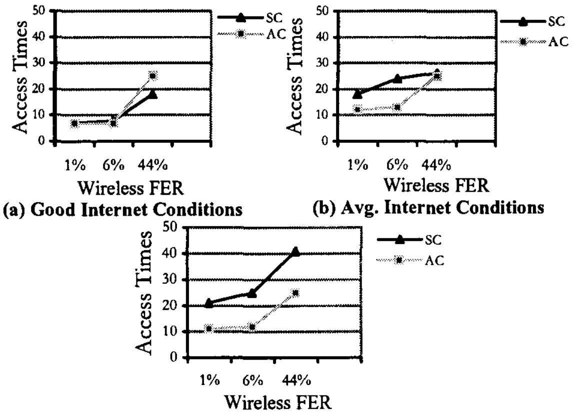
[7] http://www.internettrafficreport.com/



(a) Standard WAP Network Configuration (SC)

(b) Alternate WAP Network Configuration (AC)

Fig. 1. WAP Network Configurations



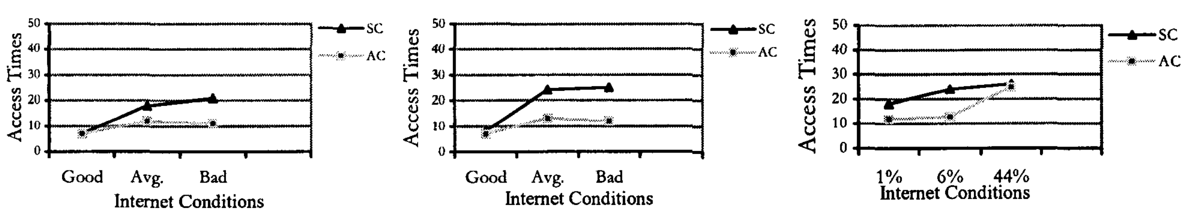
(a) Good Internet Conditions **(b) Avg. Internet Conditions** ***(c) Bad Internet Conditions***

Figure 2. Effect of Varying Wireless Conditions

Table 1. Performance of AC and SC

Internet Condition	Internet Parameters: Avg. Wait time UL	Avg. Wait time DL	Drop-rate UL	Drop-rate DL	Wireless Channel FER	Access Time (secs.)	95% Conf. Int.
Standard Configuration							
GOOD	0.02	0.015	0.06	0.1	1%	7	± 1.5
	0.017	0.024	0.07	0.11	6%	8	±1.5
	0.017	0.012	0.08	0.08	44%	18	±1
AVG.	0.04	0.045	0.28	0.33	1%	18	±1.5
	0.031	0.041	0.22	0.35	6%	24	±3
	0.035	0.036	0.23	0.28	44%	26	±2.5
BAD	0.046	0.032	0.27	0.37	1%	21	±5
	0.038	0.045	0.26	0.33	6%	25	±5
	0.044	0.053	0.33	0.36	44%	41	±14
Alternate Configuration							
GOOD	0.019	0.023	0.04	0.06	1%	7	±1.5
	0.014	0.016	0.11	0.07	6%	7	±1.5
	0.043	0.015	0.04	0.06	44%	23	±5
AVG.	0.037	0.033	0.28	0.15	1%	12	±4
	0.044	0.041	0.38	0.16	6%	13	±1
	0.045	0.042	0.24	0.28	44%	25	±3
BAD	0.045	0.037	0.19	0.36	1%	11	±0.5
	0.048	0.051	0.26	0.35	6%	12	±0.4
	0.039	0.042	0.28	0.36	44%	26	±3

UL- Client to Server Uplink **DL- Server to Client Downlink**



(a) Wireless FER 1% **(b) Wireless FER 6%** **(c) Wireless FER 44%**

Figure 3. Effect of Varying Internet Conditions