WAP via ORBCOMM

Andrew R Cardoza, Sias Mostert

E-mail: acardoza@ing.sun.ac.za, mostert@eng.sun.ac.za

Electronic Systems Laboratory,
Department of Electrical and Electronic Engineering,
University of Stellenbosch
South Africa,

ABSTRACT

The ORBCOMM Satellite Constellation has provided global two-way wireless messaging services for the past number of years. ORBCOMM applications are limited by the network's low-bandwidth and its high latency. WAP is designed to deliver Internet Services to applications using a variety of low-bandwidth, high latency bearer services. WAP's objective is to unify the different wireless networks to provide access to different Internet Services. The current ORBCOMM user base may benefit from these WAP Services as well. WAP messages may be tunnelled in ORBCOMM globalgrams or messages which are delivered as normal E-mail to a dedicated E-mail Server / WAP Gateway acting as the gateway to the Internet. This report discusses the satellite and terrestrial network architecture to support mobile WAP-ORBCOMM communication. It looks at the technology, the viability of such a project and makes suggestions to shortcomings and advantages.

1 Introduction

The ORBCOMM Satellite Constellation has successfully provided global, two-way wireless messaging services now for the past number of years. ORBCOMM harnesses e-mail technology to transport data between their wireless network and the wired network to reach their end-users.

WAP (**W**ireless **A**pplication **P**rotocol) has appeared in the wireless communication arena as a formidable role-player that deliver Internet Services to a variety of wireless networks and their associated devices. Included are the more widely available networks such as GSM, TETRA, IS-136, CDMA, PDC, FLEX and ReFLEX, DataTAC, DECT, etc.

WAP have thus far dramatically made its mark on GSM mobile phone networks. WAP implementations on the other mentioned wireless networks are still lagging GSM WAP implementations.

The ORBCOMM network is not included in the variety of bearer services that are specified to support WAP. This report looks at using WAP Technology to deliver Internet Services to ORBCOMM Wireless Terminals and the issues involved to make the ORBCOMM Network Architecture a WAP bearer service.

The ORBCOMM Network Architecture is first discussed followed by the WAP Architecture.

A discussion on possible third-party WAP implementations on the ORBCOMM Network follows. This is followed by a second more economically viable option followed by the conclusion.

2 ORBCOMM Network

ORBCOMM is the first commercial operator to provide global, wireless two-way messaging services. This section discusses the different ORBCOMM network components involved to deliver these services to subscribed users. This is followed by a discussion on ORBCOMM's globalgram / messaging services which is followed by an example.

2.1 Network Components

The ORBCOMM Network consists of two main sections, namely:

- Wireless Network Components, and
- Wired Terrestrial Network Components

All these components are illustrated in Figure 1.

2.1.1 Wireless Components

The Wireless Network Components consists of:

- 36 **LEO** (**L**ow **E**arth **O**rbiting) MicroStar micro-satellites giving close to 24-hour global coverage,
- **SCs** (**S**ubscriber **C**ommunicators) which are digital transceivers that can transmit/receive messages to/from any one of the orbiting micro-satellites.

2.1.2 Wired Terrestrial Components

The wired terrestrial network components consist of:

- **GES**s (**G**ateway **E**arth **S**tations) which are fixed satellite gateways that are strategically distributed around the globe to relay messages between the satellites and the rest of the wired network;

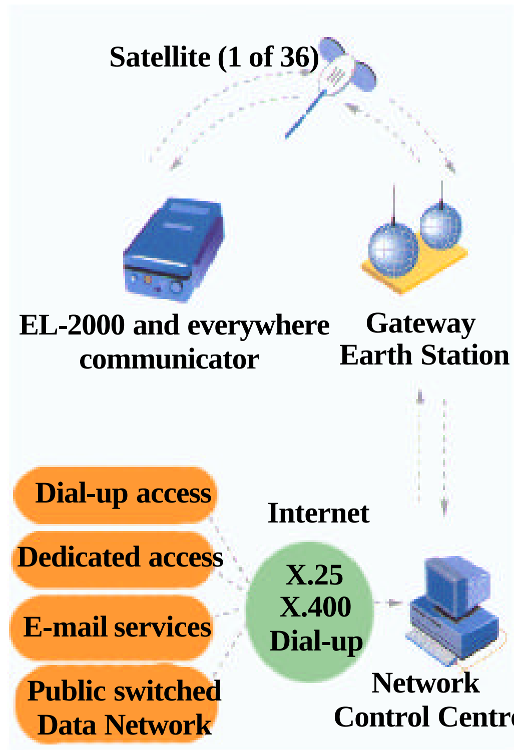

Figure 1 : ORBCOMM Network Architecture

- **NCC** (**N**etwork **C**ontrol **C**entre) and **GCC** (**G**ateway **C**ontrol **C**entre) which form the ORBCOMM/Internet Gateway that transport messages between the end-users connected to the Internet and the ORBCOMM Network.

2.2 Globalgram Services

ORBCOMM globalgram services are provided to those users who are not situated in the proximity of a GES. Globalgrams contains therefor enough information to instruct the different intelligent ORBCOMM network components the route that must be followed up to its destination.

2.3 Communication Example

When a wireless terminal wants to transmit messages, it sends the information via a specified ORBCOMM Serial Protocol Interface to the SC. The SC stores the messages until an available ORBCOMM Satellite is in direct-line-of-sight. The SC transmits these messages to the first available satellite. The satellite stores these messages until it is in direct-line-of-sight of the specific GES. The GES will then download all relevant messages from the satellite and forward them to the GCC. The GCC captures the globalgram data into E-mail messages and sent to the relevant users via the Internet.

When an end-user wants to transmit messages to a specific wireless terminal, it sends E-mail messages to NCC. Every SC is assigned a unique E-mail Address. The NCC translates this into a message containing the unique serial ID of the SC.

3 WAP Architecture

WAP defines a set of transport, session and application layer protocols that operate over wireless, narrow-band high-latency networks. This section discusses details regarding the WAP Protocol stack, the WAP programming model and an example of such a network.

3.1 WAP Protocol Stack

The WAP architecture provides a scaleable and extensible environment for application development on mobile communication devices. This is achieved through a layered design of the entire protocol stack (Figure 2).
Other services and applications may utilise WAP features by using the set of well-defined interfaces to each of the layers in the WAP Stack.

3.1.1 Wireless Application Environment

WAE's (**W**ireless **A**pplication **E**nvironment) objective is to establish an interoperable environment allowing applications and services to efficiently reach a wide variety of different wireless platforms. At its core is a micro-browser environment with the **WML** (**W**ireless **M**ark-up **L**anguage), WMLScript and **WTA** (**W**ireless **T**elephone **A**pplication) services and programming interfaces and content formats.

3.1.2 Wireless Session Protocol

WSP (Wireless Session Protocol) provides connection-orientated and secure/non-secure connectionless datagram services[4].

3.1.3 Wireless Transaction Protocol

WTP (**W**ireless **T**ransaction **P**rotocol) is a light-weight, transaction-orientated protocol suitable for implementation in "thin" clients. It is geared to efficiently operate over secure and non-secure wireless datagram networks. Standard features are unreliable one-way requests, reliable one and two-way requests, concatenation, delayed acknowledgement, asynchronous transactions, etc.

3.1.4 Wireless Transport Layer Security

WTLS (**W**ireless **T**ransport **L**ayer **S**ecurity) is optimised for use over narrow-band communication channels. WTLS is based upon the industry-standard **TLS** (**T**ransport **L**ayer **S**ecurity), formerly known as **SSL** (**S**ecure **S**ockets **L**ayer). Features include data integrity, privacy, authentication, denial-of-service protection support, secure communication between terminals, etc.

3.1.5 Wireless Datagram Protocol

WDP (**W**ireless **D**atagram **P**rotocol), WAP's transport layer protocol, offers a consistent service to the upper WAP layers which communicate transparently over available bearer services. A consistent interface and basic features allows for global interoperability using mediating gateways.

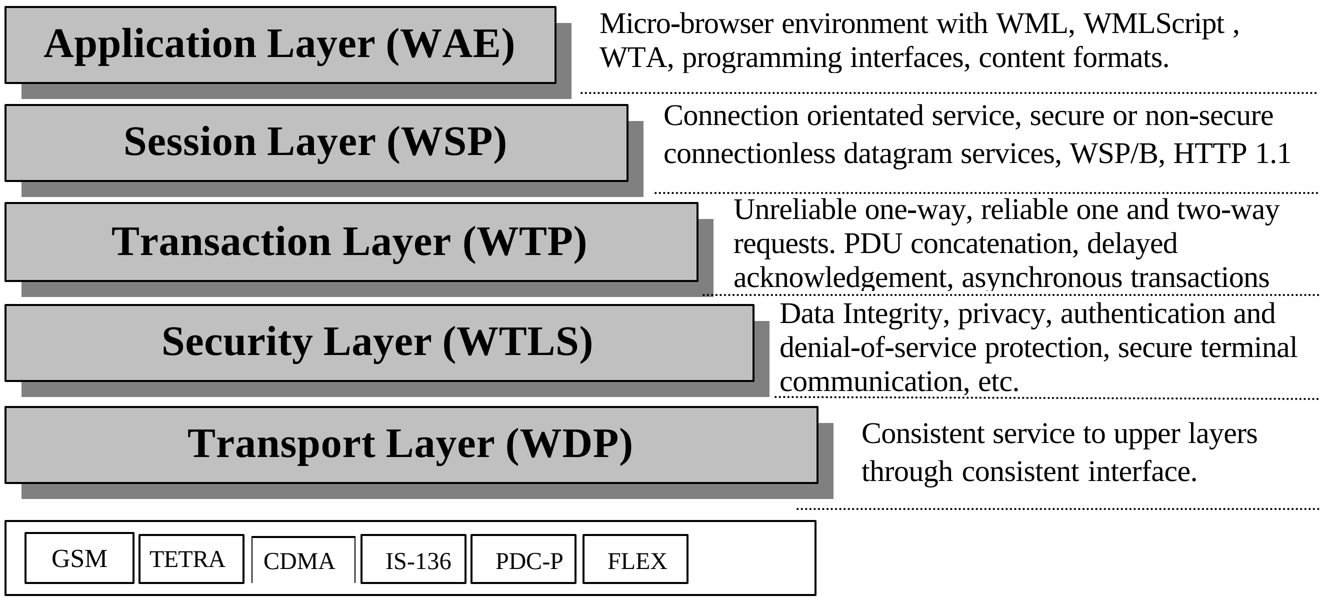

Figure 2 : WAP Protocol Stack

3.2 The WAP Model

The WAP Programming model is similar to the WWW Programming model. Application developers benefit from the familiar programming model, a proven architecture and the ability to leverage existing tools. Optimisations and extensions match the characteristics of wireless environments.

The standard set of components include:

- Standard naming model: WWW-standard URLs identify WAP content and WWW-standard URIs identify local device resources.
- WAP Content typing is consistent with WWW typing. This allows for WAP user agents to correctly process content-based types.
- WAP Content Formats are based on WWW technology. It includes display mark-up, calendar information, electronic business card objects, images, etc.
- Standard protocols communicate browser requests from the mobile terminal and to the network web server.

WAP Proxies connect the wireless domain with the WWW. WAP Proxies are comprised of:

- Protocol Gateways which translates WAP Protocol Stack requests (WSP,WTP, WTLS and WDP) to the WWW Protocol Stack (HTTP and TCP/IP);

- Content Encoders and Decoders which translate WAP content into compact encoded formats to reduce the amount of data transported over the network.

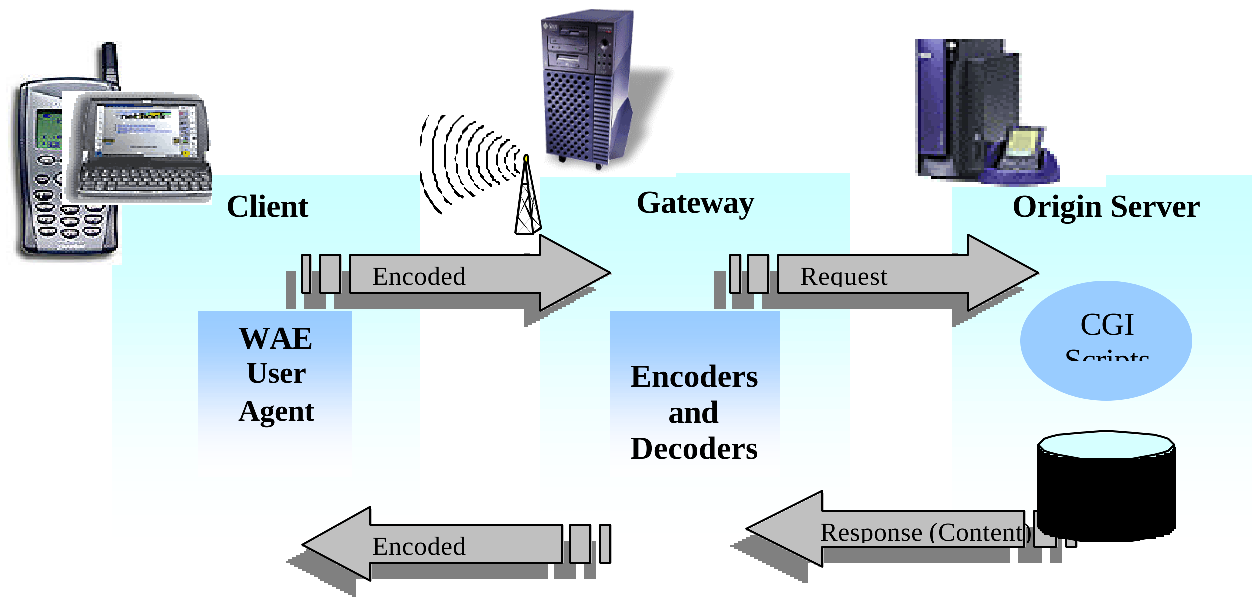

Figure 3: WAP Programming Model

3.3 WAP Example

In the following example the WAP Client communicates with two servers in the wireless network. The WAP proxy translates WAP requests to WWW requests, thereby allowing the WAP client to submit requests to the web server. The proxy encodes web server responses into the compact binary format understood by the client.

If the web server provides WAP content (e.g., WML), the WAP Proxy retrieves it directly from the web server. If the Web server provides WWW Content (e.g., HTML), a filter is used to translate the WWW Content into WAP Content.
The WTA (Wireless Telephony Application) server is an origin or gateway server responding to requests directly from WAP Clients. The WTA servers are used to provide WAP access to features of the wireless network provider's telecommunications infrastructure.

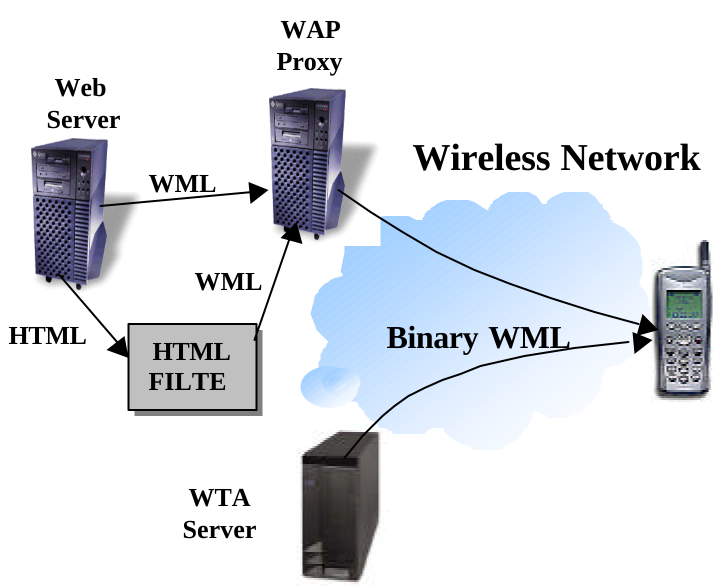

Figure 4: WAP Communication Example

4 WAP via ORBCOMM

This section discusses a third-party solution to providing WAP Services to the ORBCOMM user base. The architecture of the WAP/ORBCOMM network is briefly look at. The functionality of the additional servers is discussed. This is followed by a short example and concluded with remarks on network performance and viability.

4.1 WAP/ORBCOMM Architecture

The WAP/ORBCOMM Architecture is illustrated in figure 5. The ORBCOMM Network is utilised as transport medium for WDP **PDU**'s (**P**rotocol **D**ata **U**nits) that is transmitted by the WAP mobile unit on the far right. This WAP mobile unit is able to communicate to the SC through the standard SC Protocol Interface.

WDP Data is contained with the PDU's transmitted to the SC.

Globalgram and messages are delivered via one of the thirty-six satellites to the GES and GCC from where it is forwarded to a remote, third party E-mail server.

This WAP E-mail Server may be used exclusively to process ORBCOMM e-mail or may be used in a hybrid fashion, namely to process WAP or e-mail containing non-WAP data.

When the third-party server acts as a WAP Server, it will directly respond to the WAP/SC mobile unit's requests.

The third-party server may act as a WAP Proxy Server. In this scenario a TCP/IP link is established to another WAP or HTTP Server. The HTTP Server is shown in the far-left corner of figure 5.

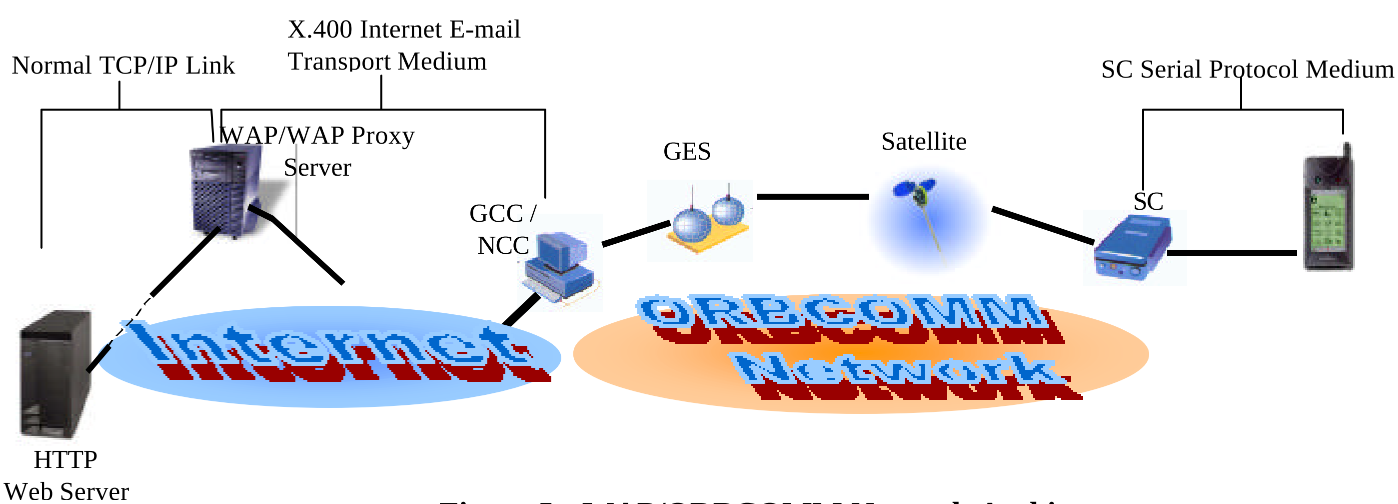

Figure 5 : WAP/ORBCOMM Network Architecture

4.2 WAP/ORBCOMM Proxy Server

The WAP/ORBCOMM Proxy Server acts as mediator between a WAP or HTTP Server and the NCC. The WAP server exchanges WML data with the WAP Proxy. The HTTP Server exchanges HTTP1.1 which must be translated to binary WML before data is retransmitted to NCC.

As illustrated in figure 5, the WAP/ORBCOMM Proxy server is a third-party service. This WAP service provider presents these services independent of ORBCOMM.

4.3 ORBCOMM SC Addressing

There are several addressing mechanisms used within the ORBCOMM Network. The two of interest are the:

- ORBCOMM Speed dials or indicators, and
- E-mail Addresses.

Speed dials or indicators consist of a set of numbers that are associated with a specific e-mail address. This association is specified at SC registration time at kept on record at the NCC. When speed dial indicators are used, data may be transported to only one of a few predetermined addresses.

When E-mail addresses are used the mobile client has a greater flexibility since it may determine the data's destination at any given time.

4.4 WAP/Globalgram Example

The following example examines the PDU that are issued to a SC by a mobile WAP unit. Figure 6 illustrates the tunnelling process. The globalgram PDU structure is shown at the far left. A normal globalgram uses address indicators and not complete E-mail addresses. This result in a saving of several bytes.

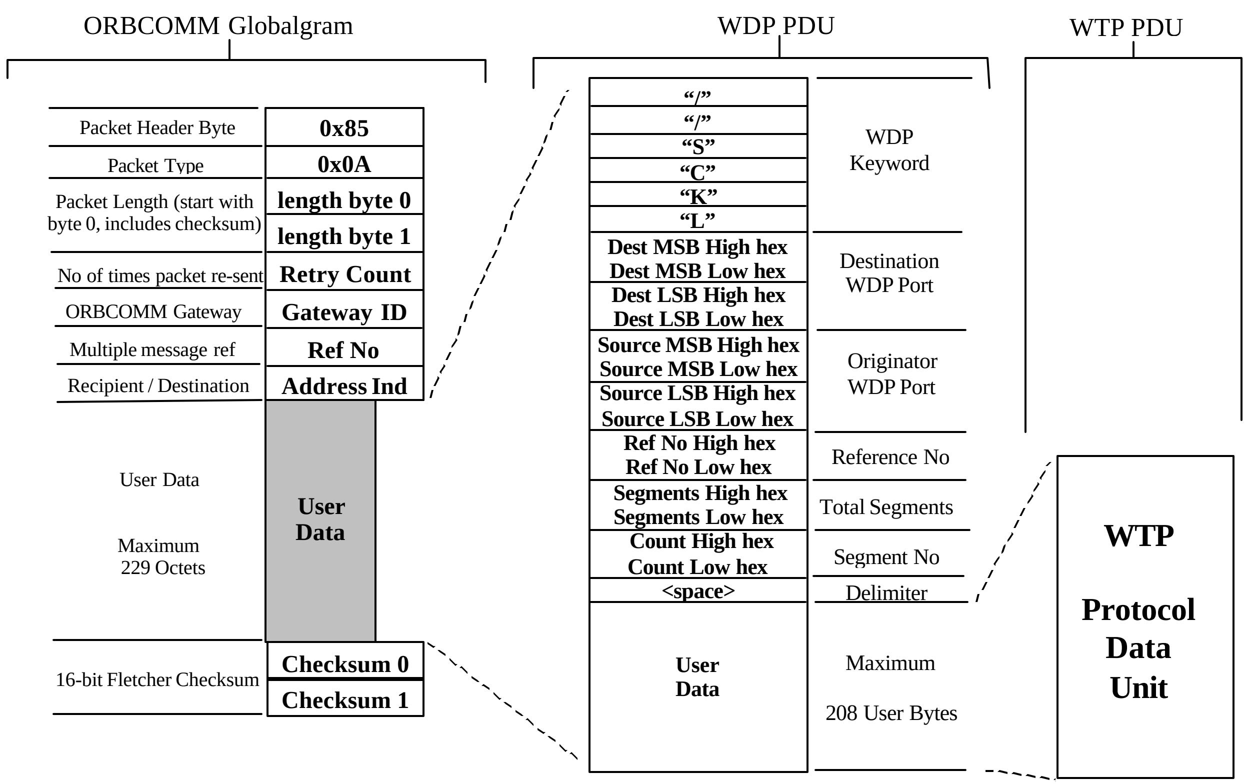

Figure 6: SC Protocol Data Units (PDU).

The mobile WAP unit issues the globalgram with the user data containing WDP information. ORBCOMM data is delivered as E-mail messages whose contents are restricted to 7-bit data bytes. GSM Phase 1 Networks have the same limitation.

The WDP format, as shown in the middle of figure 6, is specified for use on GSM Phase 1 networks. The complete WDP body contains characters from a limited expanded alphanumeric set.

Globalgram may contain a maximum of 229 user bytes. The WDP header consists of a maximum of twenty-one bytes, which leaves a 208 WDP characters or 104 octets to be transmitted by the WDP.

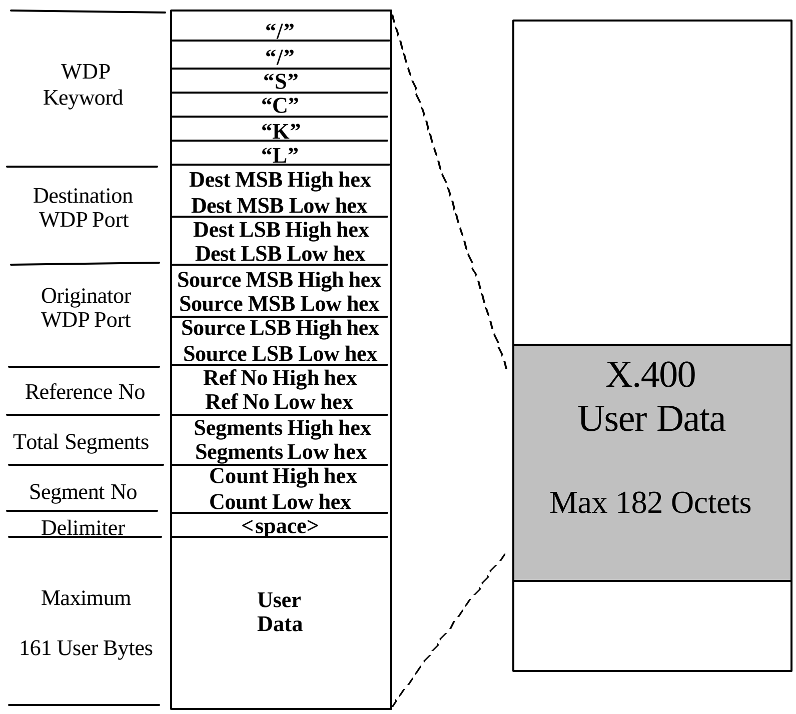

Figure 7 : E-mail content submitted to NCC

The WAP Proxy or WAP Server has a further restriction namely the size of E-mail messages to be submitted to the NCC for delivery to the SC. Only 182 octets may be used with the body of the E-mail message. With 21 WDP header bytes, only 161 alphanumeric bytes (or 80 real octets) can be contained in the WDP.

4.5 Disadvantages

In the architecture discussed thus far (illustrated in figure 5) a third party provide specific customers with WAP/WWW services via a WAP Proxy or WAP server. This is not the most ideal solution, because:

- WAP Proxy Servers are introduced that are physically separated from the GCC/NCC; This adds additional delay and to a longer communication path.
- The Internet is used to carry WAP content in E-mail messages to the third party WAP Proxy Server.

- Globalgrams services in most cases introduce a considerable delay where mobile units are not in close proximity of a gateway.

5 Alternative Architectures

An alternative architecture exists which totally removes the need for a third-party service provider. This architecture assumes that these services are directly provided by ORBCOMM to its users. Figure 8 illustrates such the alternative architecture.

This result in a shorter communication path and the extra delay introduced when data is forwarded via the Internet from the GCC/NCC to a third-party WAP Proxy is removed.

SC manufactures may add additional messages to the standard ORBCOMM message set that accepts WDP messages. A greater number of WAP bytes can therefor be transmitted to the SC which result in a more efficient use of bandwidth.

These solutions discussed in the previous paragraphs involve both ORBCOMM and SC manufactures.

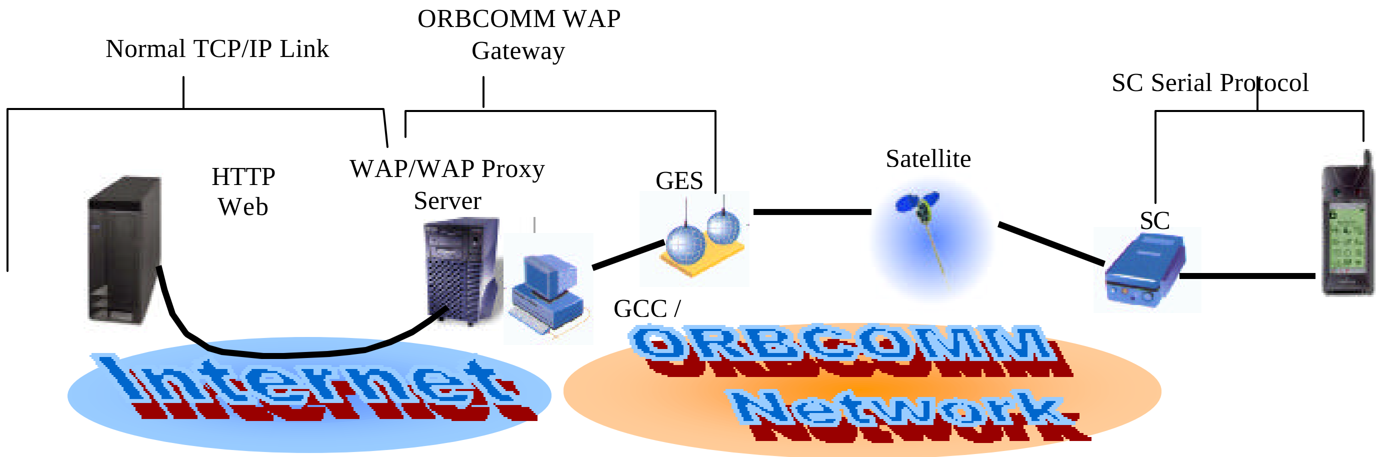

Figure 8: Alternative WAP/ORBCOMM Architecture

5.1 Advantages

- These suggestion result in more efficient use of bandwidth between the mobile unit and the SC.
- The communication path and the delay is between the mobile unit and WAP Proxy server is decreased with the introduction of a server with the ORBCOMM Network,
- The new WAP/ORBCOMM Proxy server may be tuned to efficiently integrate with the rest of the ORBCOMM Network,
- A one-stop service may be provided by ORBCOMM to its customers. No third-party service provider is involved.

5.2 Viability

The WAP Forum must publish a bearer adaptation specification for the ORBCOMM network. This will result in WDP containing data specific to the ORBCOMM network that will result in a further efficient use of bandwidth.

Delay, between submission of a message to a SC and the delivery to end-users, in certain regions of the world may be a number of hours. In such instances an interactive WAP service cannot be provided to these subscribers.

ORBCOMM subscribers that are in close proximity of a GES may use effectively use these WAP services. Here delay may be reduced from hours to seconds.

The ORBCOMM network was originally designed for low-bandwidth applications. WAP enhanced SCs may add extra load to the network not originally designed for.

Currently data are delivered at one U.S cent per byte. A greater number of data will be transported using WAP/ORBCOMM and might not be economically viable to a large portion of the ORBCOMM subscribers.

6 Conclusion

WAP Technology discussed in this report looks to be a promising opportunity to give ORBCOMM Subscribers access to Internet Services. WAP is designed to efficiently use low-bandwidth potentially high-latency wireless networks. The ORBCOMM Network definitely falls into this category.

The third party WAP service provider solution is not the ideal solution to provide WAP and Internet services to ORBCOMM subscribers. Different role players such as ORBCOMM itself and the SC manufactures need to get involved to make it a viable technology. SC equipment, such as Stellar, may provide down-loadable software on Internet to upgrade existing equipment to transform SC's into WAP enhanced SCs. Success of such a WAP Services are dependant on whether ORBCOMM thinks it a good service to provide to subscribers, reducing delay between when a SC accepts a message and when a message is delivered to the MSC and the pricing scheme for data.

References

[1] WAP Forum, “Wireless Application Protocol: Architecture Specification”, 30 April 1998, Url: http://www.wapforum.org.

[2] WAP Forum, “Wireless Application Protocol: Wireless Datagram Protocol Specification”, 5 November 1999, URL: http://www.wapforum.org.

[3] WAP Forum, “Wireless Application Protocol: Wireless Transaction Protocol Specification”, 11 June 1999. Url: http://www.wapforum.org.

[4] WAP Forum, “Wireless Application Protocol: Wireless Message Control Protocol Specification”, 4 August 1999, Url: http://www.wapforum.org.

[5] ORBCOMM Global, L.P. “ORBCOMM System Overview”, A80TD0008 Rev B, Virginia, 26 April 1998.

[6] ORBCOMM Global,L.P. “ORBCOMM Serial Interface Specification”, E80050015 Rev C, Virginia, 30 June 1998.