3GPP TSG-T2 #12
Los Angeles, US
12th - 16th February 2001

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3GPP TSG SA2#15 **S2-001834**
Makuhari, Japan, November 13th – 17th, 2000

3GPP TSG SA WG3 Security — S3#17 **S3-010058**

27 February - 02 March, 2001

Gothenburg, Sweden

3GPP TSG-T2 #12
Los Angeles, CA USA
February 12-16, 2001

T2-010295

Liaison Statement

From: TSG-T2

To: TSG SA1, SA2, CN5

Cc: SA3

Subject: The Wireless Communication Transfer Protocol (WCTP)

Contact: **www.wctp.org**, brennan.hayden@rtswireless.com, graham.heaton@rtswireless.com

Attachments: **T2 – 010122 White Paper on WCTP**

Aether Systems, Inc. (formerly RTS Wireless) gave a presentation on behalf of the WCTP Forum on the Wireless Communication Transfer Protocol (WCTP) in the opening plenary of TSG-T2. The presentation was given to the TSG-T2 group in order to bring awareness that this protocol is being used today in US wireless networks and was seriously being considered by many ISPs and ASPs in Europe for the delivery of SMS via the Internet.

The following is excerpted from the WCTP white paper document T2-010122, submitted by Aether Systems with this liaising proposal:

> "WCTP is an XML-based protocol that combines the best of the Internet with the best of wireless text messaging to create a medium known as "wireless Internet messaging". For WCTP to be used for SMS delivery there has to be a Document Type Definition (DTD) defined of the 23.040 parameters. WCTP has already been adopted by the Personal Communications Industry Association (PCIA, http:/www.pcia.com) and is today the only sanctioned and implemented XML-based protocol explicitly designed for two-way wireless messaging between the Internet and wireless network gateways.
>
> A white paper on WCTP is attached to provide a much deeper understanding on how WCTP is applied for messaging across many differing types of wireless networks. Among many features WCTP enables wireless Internet messaging developers to
>
> 1) use XML as their application authoring tool;
> 2) use HTTP, or similar mainstream Internet technology as their transport protocol;
> 3) use the Internet as their inter-networking transport;
>
> By using WCTP in conjunction with a suitably equipped gateway, a developer will:

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- Have access to messaging features that would normally only be available with a direct connection to a carrier's switch or SMSC.
- Control how messages are formatted and displayed on a device.
- Allow a message to be tagged with a reference number that could later be used to correlate a response back to a previously submitted message or be used to query the status of a previously submitted message
- Encrypt the payload of the message that would only be decrypted by the destination device, thus creating a secure end-to-end connection.
- Submit a message over the Internet to the carrier via HTTPS (secure-HTTP), thus providing secure message submission.
- Direct messages to multiple applications even if the recipient is the same
- In conjunction with a suitably equipped gateway avoid the connectivity scaling problems of common and wireless network operators.
- Deploy wireless applications in an environment more likely to have the Quality of Service controls available in the traditional Internet.
- Take full advantage of the capabilities that gateways and wireless devices provide."

This liaison statement is sent to TSG SA1, SA2, and CN5 (bodies studying OSA), as there may be synergy between the work currently being undertaken in OSA and the already developed fully open, non-proprietary WCTP. The WCTP Forum has suggested to T2 that this synergy can be seen by viewing WCTP as both an abstraction layer that potentially presents an API for inter-working with a 3G network, and as a continual "migration enabler" for non-3G applications already developed, and yet to be developed. TSG-T2 recognises that this protocol needs to be reviewed by the appropriate parties and understands that it will be presented by Aether Systems at the appropriate forthcoming 3GPP meetings.

WHITEPAPER :
THE WIRELESS COMMUNICATION
TRANSFER PROTOCOL (WCTP)

AETHER™

Enabling Wireless Messaging Everywhere

In order to deliver information wirelessly, there are a number of challenges. As applications go, wireless *messaging* seems to be the furthest evolved in overcoming these challenges. This paper describes how a new technology – the Wireless Communication Transfer Protocol (WCTP) – enables wireless Internet messaging to be the truly ubiquitous wireless application medium the world has been waiting for.

INTRODUCTION

A recent report suggests that teens in the UK are smoking less. The reported reason? They spend so much money on SMS messages, they have less money for cigarettes. Fantastic or not, this anecdote accurately reflects the cultural impact attributed to ***wireless text messaging*** in the areas in which it has become popular. Consider that wireless text messaging, which includes both SMS and paging, is available on over 700 million wireless devices around the world, accepting and delivering over 15 billion messages per month.

Also very interesting is the ***wireless Internet***, and particularly the ***wireless Web***. The wireless Web is synonymous with application environments such as WAP, HDML, PQA and i-Mode, and network technologies such as GPRS, CDPD, PDC, or circuit-switched data. Though special devices and advanced networks are required, use of wireless Web technology is growing quickly by all accounts, with some 25 million users worldwide.

Considering the near universal conceptual appeal of the wireless Internet, and the ubiquity of wireless text messaging described above, one might find the combination of these technologies compelling.

The Wireless Communication Transfer Protocol (WCTP) is an XML-based protocol that combines the best of the Internet with the best of wireless text messaging to create a medium known as ***wireless Internet messaging***. When properly applied, this combination of technologies—XML, the Internet, and wireless text messaging—is viewed by many to be the wireless "killer app" that application developers and end users crave. Wireless Internet messaging promises a truly ubiquitous, universally accessible application medium for mass-market wireless applications.

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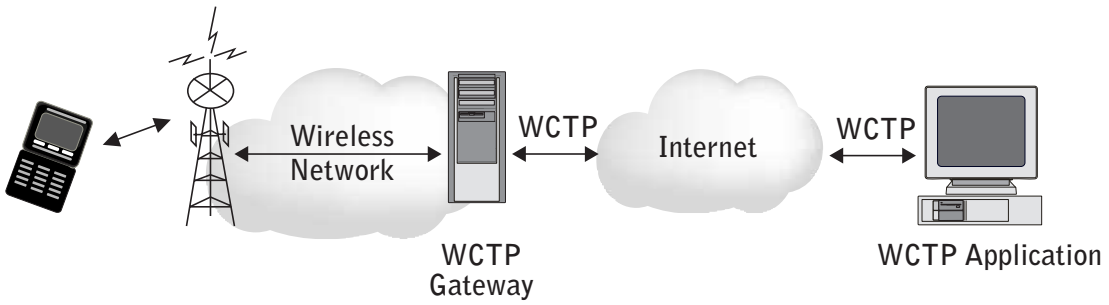
WHAT IS WCTP?

The Wireless Communications Transfer Protocol (WCTP) is a fully open, non-proprietary, XML-based wireless protocol, adopted by the Personal Communications Industry Association (PCIA, http://www.pcia.com). It is the only wireless industry sanctioned XML-based protocol explicitly designed for two-way wireless messaging between the Internet and wireless network gateways. WCTP provides standardized data representation and transfer protocols for messages that are sent to or from a wireless device.

WCTP enables wireless Internet messaging developers to 1) use XML as their application-authoring tool, 2) use HTTP, or similar mainstream Internet technology, as their transport protocol, and 3) use the Internet as their inter-networking transport.

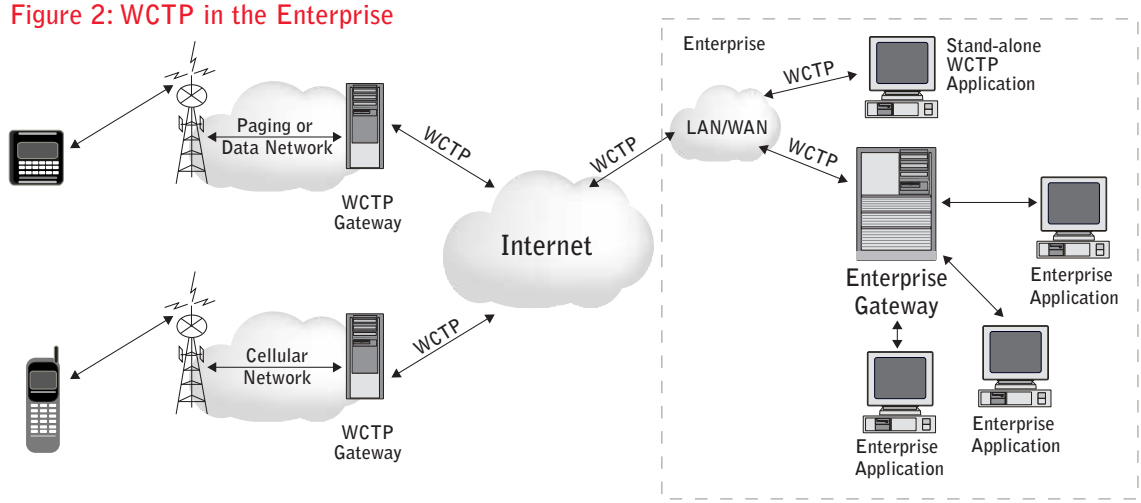
WCTP applications, in conjunction with WCTP Gateways, allow the creation of services that interact with wireless devices. A WCTP Document Type Definition (DTD) — a type of file associated with XML documents that defines how the markup tags should be interpreted by the application presenting the document — defines the data that can be exchanged between the device and the application through the gateway.

Figure 1. Basic WCTP Application



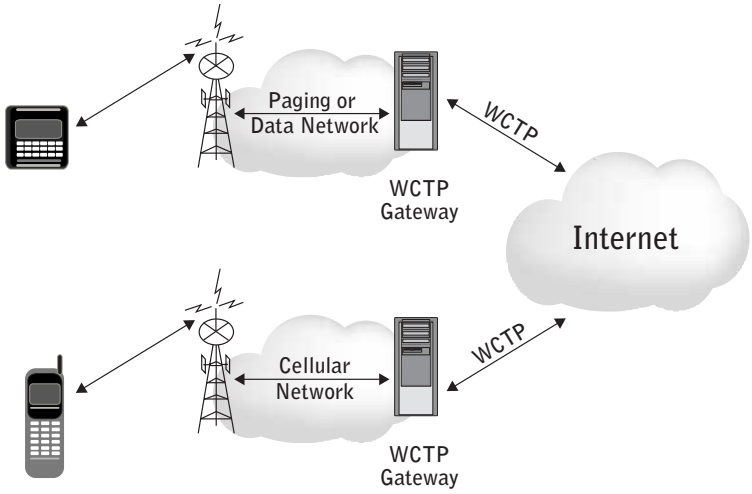
WCTP is particularly useful for Enterprise wireless applications, often in conjunction with an Enterprise Gateway. WCTP consolidates wireless application traffic within the Enterprise, and between the Enterprise and wireless networks, while increasing functionality and quality of service. WCTP used in this manner can also reduce the amount of specialized protocol support required by Enterprise IT departments.

Figure 2: WCTP in the Enterprise



WCTP is also useful for application data sent between devices on two wireless networks that do not have built-in inter-network routing.

Figure 3: WCTP for Carrier Internetworking



Introduced initially through the paging industry for use in dedicated text messaging networks, WCTP is being successfully applied to messaging applications in all wireless text messaging technologies.

Some of the interesting ***Internet*** features of WCTP are:

- WCTP uses HTTP as the message transport between WCTP Gateway and peer applications. This means that WCTP works well over the Internet and with Internet related infrastructure. Proxy servers and firewalls can be readily configured to pass WCTP traffic.

- WCTP messages are composed as XML (eXtensible Markup Language) text. Two key benefits of XML are that messages are human readable and parsing tools are readily available. Further, the use of XML fits well with HTTP as the message transport mechanism.

Some of the interesting ***wireless*** features of WCTP are:

- There are provisions to address the realities of Enterprise connectivity to wireless networks. For example, there are three connection models: polling host, transient client, and bi-directional push. WCTP also has constructs to support the lack of a persistent session layer in a protocol stack. These options are important in making WCTP an effective "edge" protocol between an Enterprise Gateway or application server and a carrier gateway.
- Explicit payload identification is provided, such as alphanumeric, embedded multiple-choice-responses, binary, etc. There is also a "pre-formatted" attribute, useful for where content is formatted in a compact form to optimize over-the-air bandwidth usage.
- There are provisions to account for latencies in message delivery to wireless devices. For example, besides the common "message validity period", there are "notify when queued" and "notify when delivered" attributes.
- Status notifications, while present in the wired world as well, are more important when dealing with wireless devices, and therefore more richly featured in WCTP.
- WCTP contains operations that allow retrieval of subscriber data from a server. These query operations are very specific for representation of wireless device characteristics.
- There are extensions under development that explicitly support known messaging over-the-air payloads for commonly used wireless networks and devices, such as GSM, ANSI-41, iDEN, ReFLEX, and Tetra.

COMPONENTS

Technologies Used to Implement WCTP Services

WCTP works because it uses well-established Internet based protocols and services, including HTTP and XML, and recognizes explicitly the essential role of gateways in messaging applications. The essential technology components are briefly described below.

WCTP Gateway

A WCTP Gateway within a network accepts and generates messages that adhere to WCTP, and provides responses according to the protocol specification. This gateway communicates within the wireless network to other infrastructure elements, creating WCTP response messages on behalf of the wireless device, the application, or on behalf of other network elements. The gateway communicates outside the network a) directly with applications, b) with other

wireless networks that support WCTP, and c) with other WCTP Gateways in a wired network such as the Enterprise. Using a WCTP Gateway results in uniform appearances of data outside the served network, regardless of the appearance within the network.

WCTP Application

A WCTP application is an application that supports receipt and delivery of WCTP messages. It is distinguished from a WCTP Gateway in two respects. First, a WCTP application serves as a destination endpoint for a message, whereas a gateway receives traffic indirectly through network routing. Second, a WCTP application does not perform the routing and other communication layer processing required of a gateway. It does its work using the payload information contained in the messages, without operating on the underlying communication layers. Note there is nothing to preclude one WCTP application from communicating with another WCTP application if they share a common gateway or a set of interconnected gateways. This might be useful for applications that take similar form in their wireless and wired forms, and are in fact used in alternating modes by the same user base. One application fitting this description is Instant Messaging.

WCTP SDK

A WCTP SDK is a library of software routines that can be used to construct WCTP applications. Because WCTP is a symmetric protocol, a WCTP SDK could potentially be used as a tool to build a WCTP Gateway as well. Due to the full two-way nature of the protocol, the same WCTP operations are required of a WCTP Gateway as of the WCTP-enabled application. A good WCTP SDK will include XML-parsing tools, a simulation environment, and sample source code for a WCTP application.

Wireless Device

A WCTP application is generally built to run in the wired world and interact with a wireless device. For this to work, the wireless device needs to be served either by 1) a WCTP Gateway within the wireless carrier network, or 2) an Enterprise application accessed through and Enterprise WCTP Gateway connected to their wireless network via some protocol conversion. These two options are not mutually exclusive. Wireless devices can also communicate between themselves on different networks through interconnected WCTP Gateways in the respective networks. This is useful when the two networks have no built-in routing available between them.

Wireless Network

A routable connection must exist between the application and the wireless device through the serving wireless network. WCTP is designed to make it safer than other methods to allow this communication to occur without necessarily requiring a bilateral agreement between the

Enterprise and the carrier. More significantly, carrier intermediaries can be readily used that support WCTP, and which can provide a single Enterprise connection in a similar arrangement to an ISP or ASP agreement, that in turn routes the traffic to the wireless carrier of choice.

IMPLEMENTING WCTP

One's position in the value chain directs which elements are necessary for any given organization to implement WCTP. Some possible approaches are described below.

WCTP in the Wireless Network

A wireless network operator generally deploys a WCTP Gateway in order to take advantage of WCTP. Because the purpose of the WCTP Gateway is to be the connection point to network-external applications, carriers should deploy a WCTP Gateway that can throttle, concentrate, and route the traffic from these connections to the more sensitive and specialized message switches within their networks. This requires a WCTP Gateway that supports protocol conversion to the specialized protocols used by their SMSCs or Paging Terminals. A network with a) multiple SMSCs and Paging Terminals, b) limited simultaneous connection capacity in these network elements, or restrictive network connectivity policies, can then solve its application-scaling and accommodation problem at the same time as it deploys WCTP capability.

A wireless network operator who deploys WCTP also can leverage this technology to benefit its Enterprise business, by publicizing and promoting WCTP SDKs and WCTP-enabled applications. This approach has the potential to increase usage-based revenue, and decrease subscriber churn.

A wireless network operator who deploys WCTP also can leverage this technology to benefit its Enterprise business, by publicizing and promoting WCTP SDKs and WCTP-enabled applications. This effort will increase usage, and therefore revenue and retention.

WCTP in the Enterprise

An Enterprise can take three approaches to WCTP.

In the first approach, an Enterprise could use a WCTP Gateway for consolidating traffic from multiple points within the Enterprise. Messages may be originated from one or more users or applications at individual computers connected on a LAN or WAN to the Enterprise host. It is expected that an Enterprise WCTP Gateway will accumulate these messages and submit them to the wireless network as if originating from a common host. Responses on behalf of these messages will be returned to the Enterprise WCTP Gateway, which will then direct the responses to the proper recipient or application. The individual applications can deliver the traffic to the Enterprise WCTP Gateway by any means supported by the gateway and the applications, including via WCTP. This approach is most appropriate for large Enterprise installations. (See Figure 5.)

In a second approach, each application integrates its own WCTP handling with the network-resident WCTP Gateways that serve the users' devices. In this model, each application would

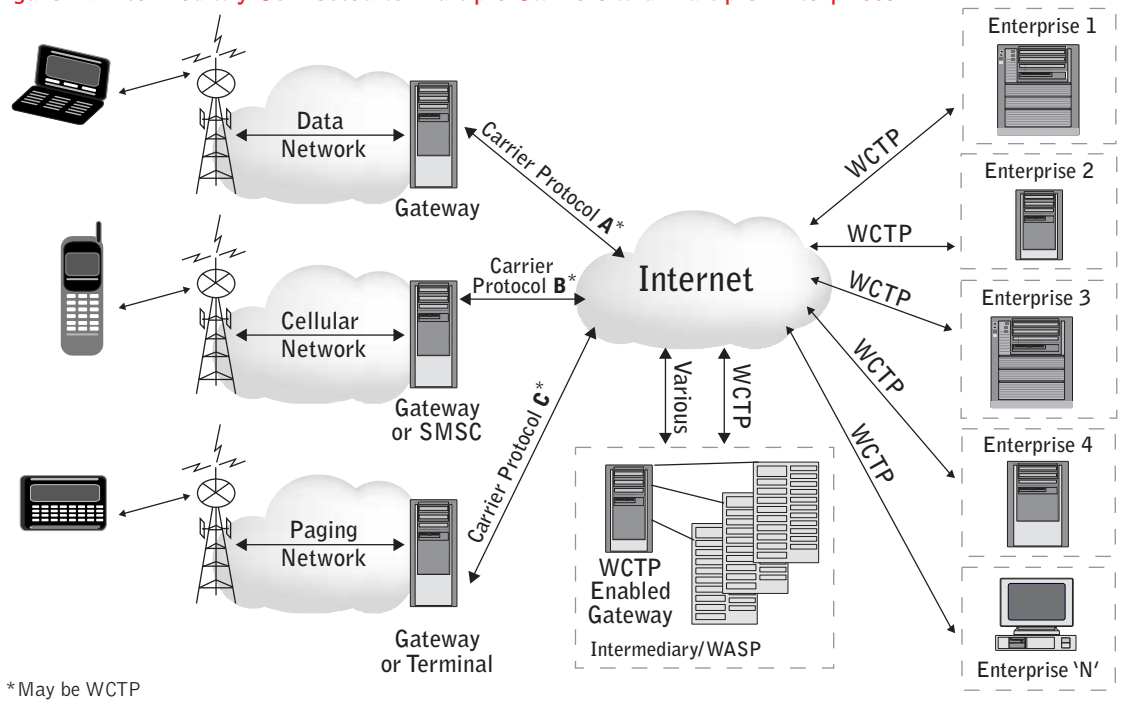
implement both the client and server WCTP processing capability, and support full session capability. This approach is most appropriate for smaller Enterprises, with less distributed application resources.

In a third approach, a messaging application may submit messages to one or more wireless devices on one or more networks, using a Transient Session defined in WCTP. In this approach, responses are either not expected at all, or only one is expected. Delivery notifications and multiple responses are not automatically returned. Instead, the sender would poll for data regarding previously submitted messages if that information is required. In support of such checking, the WCTP Gateway returns a message tracking number whenever a message is submitted. This approach is most appropriate for very simple applications, or devices. WCTP is usually built into the application in this approach, rather than in an Enterprise Gateway. In this case, a WCTP SDK would likely suffice.

WCTP in the Non-carrier Service Provider

A non-carrier service provider, such as an ASP, WASP, or Internet Destination, would likely deploy WCTP in a manner similar to the first approach described above in the section on Enterprises. Though the applications may not be as diverse as in the Enterprise in some instances, the connectivity and routing options are almost always challenging. This situation is best served with a WCTP Gateway that can consolidate internal traffic, and customer connections in the case of the ASP, and route externally to a large number of wireless networks.

Figure 4: Intermediary Connected to Multiple Carriers and Multiple Enterprises



*May be WCTP

If applications are simple enough, and an intermediary is used for wireless network connectivity, a non-network service provider might consider the third application-only approach listed above in the Enterprise section. However, application and connectivity complexity tend to increase regardless of the starting point, and a gateway will likely eventually be desirable.

WCTP for the Software Developer

All manner of messaging systems might do well to add support for WCTP to their list of supported protocols. For the reasons stated earlier in this article, WCTP offers unique opportunities for differentiation in application functionality, increased time-to-market, and decreased software maintenance costs. Developers may find that WCTP is the easiest of the available options to develop for, and that over time the older protocols provide migration paths to WCTP — a task well suited to XML-based technology. As a special case, XML-based IDEs might do well to look at incorporating WCTP into their functionality, so that next-generation wireless Internet messaging applications – not just wireless Web applications – will be supported.

By using WCTP, in conjunction with a suitably equipped gateway, a developer can:

- Have access to SMS and Paging features that would normally only be available with a direct connection to a carrier's SMSC or paging terminal, regardless of the underlying protocol (SMPP, CDMP, UCP, CIMD2, WMapi, TNPP, TAP, etc).
- Control how messages are formatted and displayed on a device.
- Allow for a message to be tagged with a reference number that could later be used to correlate a response back to a previously submitted message or be used to query the status of a previously submitted message.
- Encrypt the payload of the message, which would only be decrypted by the destination device, thus creating a secure end-to-end connection.
- Submit a message over the Internet to the carrier via HTTPS (secure-HTTP), thus providing secure message submission.
- Direct messages to multiple applications, even if the recipient is the same.
- In conjunction with a suitably equipped gateway, avoid the connectivity scaling problems of common and wireless network operators.
- Deploy wireless applications in an environment more likely to have the Quality of Service controls available in the traditional Internet.
- Take full advantage of the capabilities that gateways and wireless devices provide.

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Developers with an interest in WCTP should visit http://www.wctp.org.

THE WCTP VALUE PROPOSITION

The creators of WCTP, veterans of the wireless messaging industry, were motivated by the following objectives:

1. Capitalize on the Internet standards that are already in place or rapidly emerging.
2. Dramatically simplify the process of implementing innovative wireless messaging applications.
3. Define a next-generation architecture explicitly for the wireless messaging medium, rather than adapting some other application paradigm.
4. Create an extensible architecture to quickly enable the support by applications of the full feature sets of new wireless devices and networks.
5. Send and receive messages containing any type of data (i.e. binary, text, multi-byte characters, reduced-bit characters, etc.).
6. Support the ability for wireless devices to send messages to wireless devices on other wireless networks.

In short, WCTP aims to provide key benefits for all members of the value chain involved in wireless applications. Some of these benefits are described below (Please see the Appendix for further details on how WCTP achieves the objectives stated).

Service Providers

WCTP is already supported by leading network operators supporting two-way wireless messaging. Network operators are deploying WCTP for a variety of reasons. Four are mentioned below:

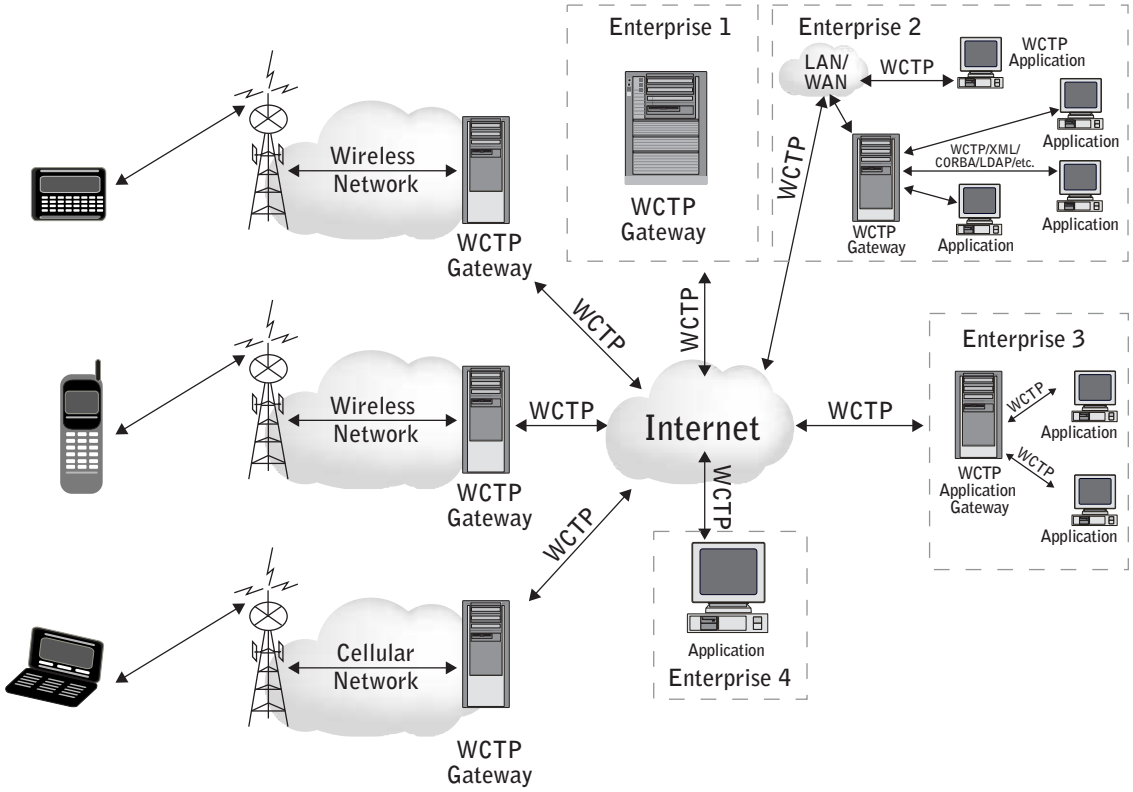
First, they expect that a mainstream way for applications to exchange messages with subscribers will result in differentiation of their basic services. Second, they expect the value of their services will increase, by making more applications available, and by making new applications available in less time than by other methods. Third, they believe Enterprises, an important growth segment, demand familiar ways of application interaction with their networks. Fourth, they believe that use of state-of-the-art protocols will increase data security, decrease scaling and administrative costs, and safely support the increase they are experiencing in requests for more straightforward network access for applications.

Application Developers and Enterprises

WCTP is gaining support from leading Software Developers and by a variety of Enterprises. Organizations that are adopting WCTP see compelling benefits.

First, it allows them to use a next-generation technology such as XML for new application development. Second, it presents a viable migration strategy for pre-XML wireless messaging application interface protocols using older technology. Third, it maximizes the role of the gateway, allowing the application developer to focus on payload and back-end interfaces rather than network idiosyncrasies. Fourth, it offers direct synergy with wireless carriers for the first time, because WCTP is the first access technology aggressively promoted by wireless carriers — precisely because it was designed to be used in that manner. Finally, because WCTP uses HTTP — another fully accepted Internet protocol – firewall administration can be done in ways familiar to those already used to manage World Wide Web access.

Figure 5: Multiple Wireless Carriers and Multiple Enterprises Inter-connected thru WCTP



Subscribers

Wireless subscribers, though shielded from direct WCTP interaction by wireless gateways, benefit from the adoption of WCTP in several ways.

First, through the time-to-market benefits that accrue to carriers and developers, it provides more utility and value for their device, due to more diverse and numerous applications

brought to market sooner. Second, it makes the unique features of any given device more useable, by allowing application developers easier and quicker access to unique features for a given device. Third, WCTP improves quality, reliability and security for wireless messaging applications, due to scalability and administrative benefits that carriers and Enterprises get from deploying WCTP. Fourth, it reduces the cost of advanced applications due to the economies-of-scale afforded by the Internet, portability, and competition brought to the wireless Internet messaging application market.

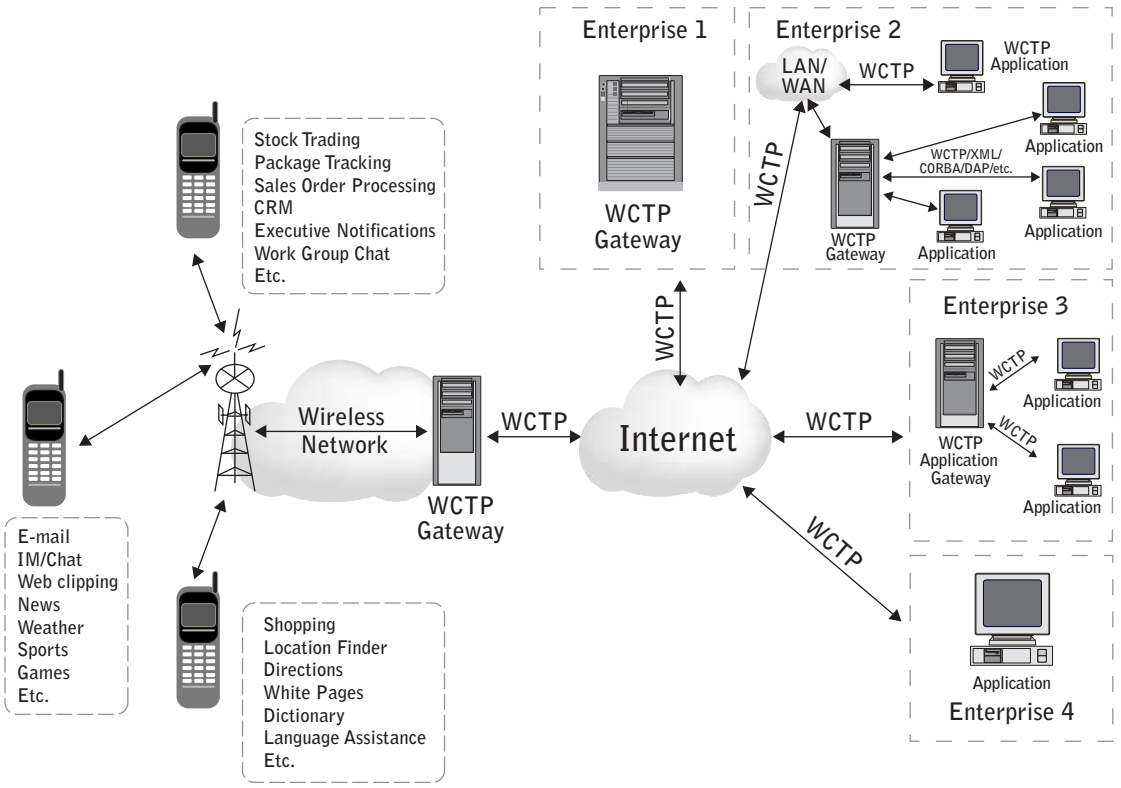
APPLICATION EXAMPLE

To illustrate the use of WCTP, the following example shows how to use WCTP to provide a unique service.

Example: The Package Tracking Application

The Package Tracking Application service allows a user—with a single wireless request—to track the delivery of a package through an express courier through each intermediary stop. The user first enters a tracking number, from his shipping bill for example, into his wireless device. This message is addressed to a specific service address where the Package Tracking

Figure 6: Diverse Subscriber Base with Equally Diverse Application Options

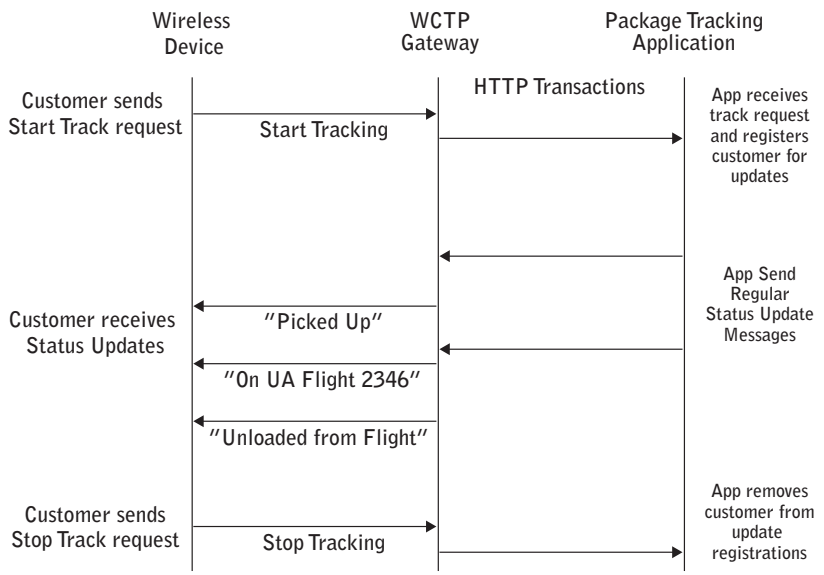


service has been installed. The wireless message is routed to a WCTP Gateway, established by the carrier in this instance. The WCTP Gateway translates the wireless message into a WCTP HTTP request.

An HTTP request, containing the user's request, is sent to the application. The application extracts the customer's request (i.e. the tracking number) from the HTTP message and queries a database for the latest status. The application then builds an HTTP message containing the package delivery status information. The WCTP Gateway extracts the reply information from the HTTP message and builds the wireless reply message that is routed to the customer's wireless device.

After the initial status delivery, assuming the package delivery is not complete, the application continues to deliver incremental status updates as the package works its way through the delivery service. This functionality takes us beyond the simple client/server interaction, typical of most application models. The example shows how WCTP supports the asynchronous application "sessions" necessary to associate each status update with the original request and all previous status updates. The user benefits by having only the new package status information sent, rather all previously reviewed information. If the user tires of status updates, a stop request can be sent to the application.

Figure 7: Package Tracking Application Example



Contrast this efficiency with a Web model, in which the full package history would likely be generated and delivered each time, wasting valuable bandwidth. Further, in a traditional wireless text messaging model, there would be no clear application method of association between one status update and another, or of associating the stop request with the corresponding start request.

Implied in this example is an application function that maintains a list of one or more user IDs and the package numbers for which status updates are requested. This list is processed periodically by the application, with new status messages being generated and sent to users.

Application Development

Some important pointers for WCTP application developers to keep in mind:

- Applications may need to be prepared to act as an HTTP server and client. As a client, the applications need to send (POST) HTTP messages to the WCTP Gateway. These are either new messages sent to the wireless device, or responses to previous WCTP requests. As an HTTP server, the application needs to be ready to accept asynchronous messages from the WCTP Gateway.

- The messages sent and received are XML documents. The application needs to be able to create and parse these messages. The XML documents must meet the specification of the WCTP DTD defined in the WCTP standard.

- WCTP application developers may need to be able to build the mechanisms that allow their application to respond to asynchronous HTTP requests from the WCTP Gateway. For example, an HTTP message listening program that can easily be integrated into the application software would be helpful.

- Generating and handling the XML messages exchanged between the WCTP Gateway and the WCTP Application should be assisted by tools designed for this purpose. Use of these tools hides the complexity of building and parsing XML text documents. The same tools should also be tightly integrated with the HTTP interfaces used to transport the XML text messages.

Generating and handling the XML messages exchanged between the WCTP Gateway and the WCTP Application should be assisted by tools designed for this purpose.

As stated earlier, XML tools to perform the services listed above are readily available, one of the advantages of using XML and HTTP.

WCTP AND WAP

WAP defines a full protocol stack that is intended to provide a very precise and complete framework to integrate the Internet with wireless networks, and a Forum (http://www.wapforum.org) in which the two network "families" – the Internet and wireless telephony — might be brought closer over time. One element required to accomplish this objective is the WAP architecture, which calls for all wireless devices to support several WAP protocol layers.

WCTP is more limited and more focused in scope. It defines only a methodology to move messages between the wired and wireless networks, usually using one gateway or two. It prescribes no constraints on the wireless device. It does not require that all of the wireless networks appear uniform, and can be used both by WAP-enabled networks as well as non-WAP-enabled networks.

Put another way, WCTP provides a way for wireless Internet messaging applications to continue to thrive and grow along with WAP. Over time, WAP may in fact become the universal model. Even so, WCTP can serve as the perfect complement to WAP, providing WAP applications a ready resource to reach beyond the boundaries of WAP whenever necessary. WCTP is designed precisely for those situations when networks join in a manner that was not envisioned by the network standards designers, and for a very specific application set – two-way, asynchronous exchange of information with and between wireless devices, wireless network gateways, and wired applications.

CONCLUSION

A WCTP-enabled application environment, when fully realized, serves a purpose for wireless Internet messaging similar to that of the traditional Internet. When a PC connects to the Internet via a particular ISP, that PC can be certain it can communicate with any other computer connected to the Internet, regardless of the ISP used. Similarly, applications written to the WCTP standard, when connected to a network of WCTP Gateways, deployed within the wireless networks and interconnected over IP networks, have the essential application elements of the Internet – namely, any-to-any communication, through use of a commonly deployed and peer-to-peer architecture and shared addressing.

APPENDIX A — WHY IT WORKS

Someone once said that the nice thing about standards is that there are so many to choose from. In that context, WCTP is distinctive. WCTP is in fact the first protocol designed explicitly for two-way wireless text messaging between the Internet and wireless networks. Other protocols used for this purpose today were designed for other purposes, and later adapted for use in wireless Internet messaging.

To understand why WCTP is so useful, it is helpful to discuss some of the limits of two technologies mentioned earlier that are closely related to wireless Internet messaging – the wireless Web, and wireless text messaging.

Some Limits of the Wireless Web

The wireless Web, though already serving millions of users, has proven a more challenging proposition than many thought when the idea was first introduced. One of these challenges is lack of wireless network infrastructure sufficient to carry data streams of sufficient speed and quality. By most accounts, a true wireless packet data network is required, as well as affordable, power-efficient handsets. A second challenge is producing wireless devices of sufficient uniformity and utility to bring predictable user experience, economies of scale and attractive cost/benefit ratios to application developers. Application developers are reporting great frustration at composing style guidelines appropriate to all of the potential target wireless Web devices. Finally, a third challenge is connecting the wired Internet to the wireless Internet in a way that minimizes time-to-market and maximizes quality of service for applications. In many application categories, such as mobile commerce, the security demands have exceeded the state-of-the-art of the available technology. In other instances, the reliance on circuit-switched data has reduced the cost-effectiveness and reliability of service.

These challenges in one form or another have been written about extensively in the wireless trade press, and experienced first hand by end-users and application developers using the wireless Web. Nonetheless, market development has proceeded in a fairly steady manner, and this technology certainly has a valuable role to play.

Some Limits of Wireless Text Messaging

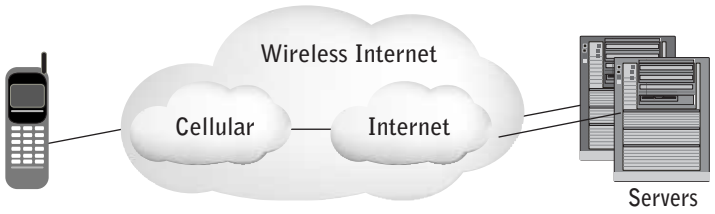
In the case of both SMS and paging, unlike the wireless Web, the network technology was designed and deployed from the beginning to support text messaging. The purpose-built nature of these services may account for their wide popularity. Users seem willing to use extremely basic interfaces when accessing a few basic application services, such as user-to-user messaging and command-based information retrieval. Interestingly, the limitations of the user interfaces presented in SMS and Paging environments tend to foster both modest expectations by users, and realistic ambitions by applications developers. However, connectivity to the Internet is where the limits of wireless text messaging begin to show.

Getting Connected

Many who have attempted both wireless Web and wireless text messaging would conclude that it is more difficult for an application developer to use the Internet with a wireless text messaging device than with a wireless Web device.

This disparity occurs because Internet connectivity is intrinsic to the wireless Web. Though in some instances connectivity might be actively or passively blocked by a firewall, the basic technology for connecting is built-in to the wireless Web. XML-like application constructs are accessed via the HTTP session protocol and IP transport protocols, well-supported and understood tools in the Internet world. Wireless Web technology is also largely a browser-based "pull" application model, which has the key benefit of relieving the application from knowing the device address in advance of an application session.

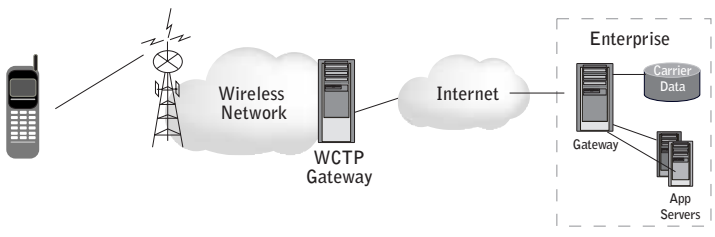
Figure A-1: Wireless Web Internet connectivity



In the case of wireless text messaging, connectivity is less straightforward. Neither SMS nor Paging standards define application access protocols in their respective standards that would be familiar to an Internet developer. The access protocols that do exist are less broadly supported than the corresponding network standards and their adoption and implementation by the relevant infrastructure providers is non-uniform. These are protocols such as SMPP, UCP and TNPP, for example. Further, for a variety of business and technical reasons, wireless carriers have not been aggressive in making Internet connections available to those who would use them.

A certain segment of the wireless carrier market has deployed Internet gateways connecting to their SMS and Paging infrastructure, for access by protocols such as SMTP and HTTP. However, application developers have problems when using these gateways for a very diverse set of users. For example, these gateways are not uniformly deployed or managed, often requiring that a database of Carrier or gateway idiosyncrasies, constructed by brute-force, be available to the application execution environment. Further, these Internet protocols provide no standards-based access to the two-way or extended feature capability of the devices, further "dumbing-down" an already basic technology.

Figure A-2. Wireless Text Messaging Internet connectivity



Wireless Internet Messaging

WCTP goes to the heart of this Internet connection problem. Since WCTP is XML-based, like the Web, it provides a familiar application environment for Internet developers. WCTP is a wireless messaging protocol, making it a well-focused tool for wireless messaging applications. WCTP is extensible, ensuring that application developers can capitalize on innovations in networks and in new devices. WCTP is inherently two-way, providing native support for real-time interactive applications, and enabling gateways to play fully the facilitative role for which they are deployed. And, WCTP can be transported using HTTP, simplifying secure firewall administration in the Enterprise.

One powerful way to consider the value of WCTP is to consider the limits of one widely used Internet-based method of wireless messaging – SMTP, or "regular e-mail". In this paradigm, a specialized SMTP gateway receives standard e-mail messages for each wireless device, sent to a standard Internet e-mail address of the form <phone_number_or_pager_id>@carrier.com. The gateway then delivers the e-mail to the device in a form the wireless network and device can process. Although a very useful tool to both users and application developers, it has some limitations, which include:

- Message formats are non-uniform across carriers, and controlled (sometimes arbitrarily) by the carrier, not the application.
- SMTP does not provide a mechanism for querying the current state of a previously submitted message.
- SMTP provides no clear standards to support secure e-mail delivery, either at the SMTP protocol level or at the payload level.
- SMTP is not inherently a two-way protocol and therefore provides no standard mechanism for correlating a message to any potential response(s).
- SMTP has limited addressing in that it can only be used to direct messages to a single application: E-mail.

WCTP overcomes all of these limitations.

Also, early adopters will be glad to know that WCTP is already deployed. It is real – and not just somebody's good idea. There are already a variety of tools, applications, gateways and carriers from which to choose. WCTP is well-supported and broadly represented, owing to its adoption by PCIA — a long-established communications standards body, endorsement by a growing number of wireless carriers, and implementation by a rapidly growing list of software developers at all points in the value chain.

APPENDIX B — HOW IT WORKS

Overview

In a variety of both subtle and explicit ways, WCTP is the reflection of the model of the delivery of wireless messages through wireless carriers to wireless devices. Based on XML, WCTP describes the exchange of messages between WCTP Gateways, Internet-resident application, and wireless devices. WCTP-enabled wireless networks provide an "internet" through which messages pass between wireless devices and hosted applications, regardless of the technology connecting the two end-points.

Gateway

A gateway is a network element that translates between two networks that have no — or perhaps very little — built-in accommodation for each other. Most wireless messaging applications use gateways to process incoming and outgoing message traffic.

XML

XML (eXtensible Markup Language) is a "markup language", not unlike HTML. WCTP uses XML in its specifying its message definitions. WCTP messages are formatted XML documents.

XML is a specification developed by the World Wide Web Consortium. It allows application developers to create their own customized tags, or formatting commands, enabling the definition, transmission, validation, and interpretation of data between programs. XML allows the application developer to write applications that intrinsically transmit "data about the data", or metadata. A program receiving data in XML format can then read and interpret the metadata to know how to proceed. As long as both programs can agree on the rules to exchange and describe the information – known as a "protocol" – the data can be exchanged in ways as unlimited as the application developer's imagination.

The advantages of using XML are:

- It is a standard followed by many Enterprises and web tools developers. The use of XML, particularly over HTTP, is becoming the de-facto mechanism for implementing Internet-based services.
- It provides a mechanism for specifying the WCTP message formats. The use of XML allows for a formal definition of the message formats.
- WCTP XML messages are human readable. Messages are textual and can be helpful to debug and observe the behavior of the system. XML is self-describing.
- XML parsing tools are readily available from a number of vendors.

It is suggested that the developer investigate XML further through materials found in a reference book or found on the web. One useful site is http://www.xml.org. A brief overview, using WCP as an example, is provided below.

Elements and Attributes:
XML documents are made up of elements. An element is a text block made up of a starting tag, ending tag, and zero or more nested elements. A XML document contains a tree of elements rooted by a single element. In the following example, the root element is the wctp-Operation element, and it contains a single wctp-SubmitRequest element.

The SubmitRequest element contains a wctp-SubmitHeader and a wctp-Payload element. The Payload contains a single wctp-Alphanumeric element that contains the actual message being delivered in the message.

Figure B-1: Example WCTP XML document

```
<?xml version="1.0"?>
<!DOCTYPE wctp-Operation SYSTEM "wctpv1-0.dtd">
<wctp-Operation wctpVersion="1.0">
  <wctp-SubmitRequest>
    <wctp-SubmitHeader
       submitTimestamp="2000-11-21 16:43:01" >
       <wctp-Originator
          senderID="5165551212@wirelessnetwork.com"
          securityCode="ThePassword"
       />
       <wctp-MessageControl
          messageID="A4345Y6N"
       />
       <wctp-Recipient
          recipientID="stockroom@shippers.com"
          authorizationCode="GetSomeInfo"
       />
    </wctp-SubmitHeader>
    <wctp-Payload>
       <wctp-Alphanumeric>
        This is the text message
       </wctp-Alphanumeric>
    </wctp-Payload>
  </wctp-SubmitRequest>
</wctp-Operation>
```

An element can contain zero or more Attributes. Each attribute is defined as a "name=value" pair, and defines some aspect of the element it is contained within. Notice in the above example that the wctp-Operation contains a wctpVersion attribute. The element wctp-Originator contains two attributes, etc.

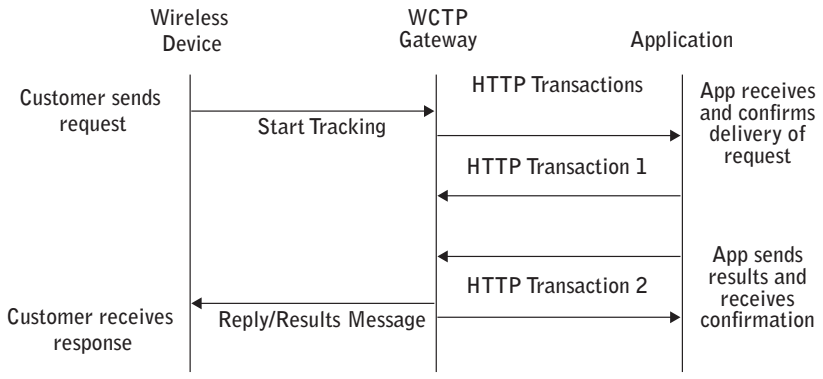
DTD

An XML document is defined by its DTD (Document Type Definition). The DTD defines the correct structure of a XML document. The DTD provides the parsing rules that can be applied to a XML document to check its correctness. The DTD that defines the WCTP messages structures can be found at http://www.wctp.org.

HTTP

HTTP is the method used to move messages between a client and a server. Web users likely recognize the letters "HTTP" from the Web-site addresses they enter into their browsers. However, unlike in the Web browser model where the browser always acts as the client, in WCTP's use of HTTP, both parties to a communication may act as the client or the server at any time. Also unlike the Web, WCTP returns the requested information to the client as a separate transaction, not as a reply to the request (see figure B-2).

Figure B-2: A Typical WCTP exchange using HTTP.



WCTP Sessions

HTTP is a stateless protocol, meaning no session information is maintained from one transaction to the next, even when the same connection is used. Therefore, WCTP provides mechanisms for short term and long term session management. The WCTP XML elements have been defined with attributes in which this state information is maintained.

Short term sessions are implemented using a "messageID" attribute in the request message, and long term sessions are implemented using the "transactionID" attribute. These values are placed in the the request message and returned in any response messages.

WCTP Operations

Following are the 13 defined WCTP operations:

wctp-SubmitRequest	wctp-MessageReply	wctp-StatusInfo
wctp-Confirmation	wctp-SubmitClientMessage	wctp-SubmitClientResponse
wctp-ClientQuery	wctp-ClientQueryResponse	wctp-PollForMessages
wctp-PollResponse	wctp-LookupSubscriber	wctp-LookupResponse
wctp-BindDomainAlias		

GLOSSARY

ANSI-41:	American National Standards Institute standard for digital cellular networks
ASP:	Application Service Provider, providing Internet access to applications and services that normally would reside on the client's computer
CDMP:	Cellular Digital Message Protocol developed by Motorola. Open interface between Motorola message center and any intelligent peripheral
CDPD:	Cellular Digital Packet Data, a specification for supporting wireless Internet access
CIMD2:	Nokia SMS application protocol for Messaging Distribution, version 2
DNS	Domain Name System, an Internet service that translates domain names into IP addresses
DTD:	Document Type Definition, a type of XML document file that defines the data that can be exchanged between a wireless device and the application through a gateway
Gateway	A network element that translates messages between two incompatible networks
GPRS	General Packet Radio Services, provides a continuous wireless connection to the Internet for mobile phone and computer users
GSM:	Global System for Mobile Communication, the wireless standard of Europe and Asia
HDML	Handheld Device Markup Language, enables wireless access of text portions of Web pages by cellular phones and PDAs
HTTP	Hypertext Transfer Protocol, a set of rules for exchanging files on the Web
HTTPS	Secure Hypertext Transfer Protocol, for exchanging Web files in a secure transaction mode
IDE	Integrated device (or drive) electronics
iDEN	Integrated Digital Enhanced Network, a Motorola technology that integrates two-way radio, telephone, text messaging and data transmission into a single network
i-Mode:	A packet-based service for mobile phones offered in Japan by NTT DoCoMo
IP:	Internet Protocol, the method by which data is sent from one computer to another on the Internet
ISP	Internet Service Provider
LAN:	Local Area Network, a computer network spanning a relatively small area (i.e., an office building or plant)
Packet	A discrete unit of data, which comprises part of a message sent through the Internet. Messages are broken down into packets to expedite delivery

PCIA	Personal Communications Industry Association, a trade group to advance seamless global communication (see www.pcia.com)
PDC:	Personal Digital Cellular network. Second generation technology used in digital cellular telephone communications in Japan
PQA:	Palm Query Application
ReFLEX	A wireless communication standard for two-way messaging
RF	Radio Frequency, which creates an electromagnetic field when input to an antenna; cellular phones and two-way radio services operate in the RF spectrum
SDK	Software Development Kit, a library of software routines used to construct applications
SMPP	Short Message Peer to Peer Protocol, an open standard designed to provide a flexible data communications interface for transfer of short message data
SMS	Short Message Service, similar to paging, for sending messages of up to 160 characters to mobile phones using GSM (Global System for Mobile Communication)
SMSC	Short Message Service Carrier
SMTP	Simple Mail Transfer Protocol, for sending and receiving e-mail via the Internet
TAP	Telocator Alphanumeric Protocol, a direct paging protocol
Tetra	Network in Europe and Australia based on telecommunications standards Institute Standard for terrestrial trunked radio
TNPP	Telocator Network Paging Protocol, a direct paging protocol
UCP	Universal Computer Protocol, a European paging protocol used for SMSC applications
WAN	Wide Area Network, a system of interconnected LANs
WAP	Wireless Application Protocol, a secure specification that allows users to instantly access information via handheld devices (see www.wapforum.org)
WASP	Wireless Application Service Provider (see ASP)
WCTP	Wireless Communication Transfer Protocol, a fully open, non-proprietary, XML-based wireless protocol adopted by the PCIA, for two-way wireless messaging between the Internet and wireless network gateways (see www.wctp.org)
WMapi	Wireless Messaging Application Programming Interface
XML	eXtensible Markup Language, a specification developed by the World Wide Web Consortium, to create common information formats for sharing both format and data on the Web and intranets (see www.xml.org)

About Aether

AETHER SYSTEMS, INC

Aether Systems is recognized as a leader in wireless data applications services, enabling real-time data communications over a full range of wireless devices and networks. Using our engineering expertise, software products, vertical applications, and customer service and network operations center, Aether Systems offers the market a total solution. Aether targets these solutions to a variety of industries, including financial services, health care, transportation logistics, and mobile workforce automation, to deliver on the promise of a world without boundaries where there are infinite possibilities.

RTS Wireless became a wholly owned subsidiary of Aether Systems, Inc. in December 2000.

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