Presentation of Tabular Information on WAP Enabled Devices.

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Abstract.

The limited size of display available on the majority of WAP devices means that its not possible to effectively display information stored in tabular structures. In this paper we present an approach that exploits the hierarchical nature of tabular information to enable table content to be decomposed over a number of WML cards, providing access to content in an effective and intuitive manner.

Keywords: Document standards, WAP, WML.

1. Introduction.

Mobile computing is a rapidly expanding area in which the recent release of WAP (Wireless Application Protocol) compatible mobile phones has gained significant attention. WAP phones (and other enabled devices) are intended to provide mobile access to information sources in a similar manner to the Internet. One problem that we envisage with such devices is that the limited size of display available may restrict the types of information that can be effectively displayed. A prime example of this is information stored in tables.

The nature of tabular layout means that it is not suitable for rendering on a small display. In order to overcome the problems imposed by a small display, we propose an approach that exploits the hierarchical nature of table content to enable effective and intuitive display of tabular information on WAP enabled devices.

2. WAP and WML.

In the same way that HTML (Hyper Text Markup Language) is used to serve content to Web browsers, content for WAP devices is defined in WML (Wireless Markup Language) [1]. Unlike HTML, WML is designed to work with compact wireless devices that by their nature have small displays, limited computational resources and low bandwidth high latency networks.

All WML information is organized into a collection of cards and decks (as illustrated in Figure 1). In WML the deck is the smallest unit that a server can send to a WAP device. Each deck contains one or more cards and it is possible to navigate between cards and decks via choice options, links etc, in much the same way as with HTML documents. Sending a deck of cards, as opposed to a single card, helps overcome some of the associated latency problems as a user can browse and navigate through cards within a deck without the need to make requests to the WML server.

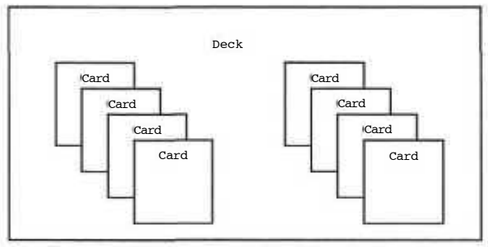

Figure 1: A WML Deck and Cards.

3. Displaying Tabular Information on WAP Devices.

The restricted size of displays on WAP devices means that it is often difficult to display information in an appropriate manner. Content created for WAP devices must therefore be as compact as possible, often limiting the type of information that can be supported. This is particularly true for tabular information. Whilst WML provides support for tables, only small tables (maximum 5x5 cells) with a simple grid structure are supported [2].

This is unfortunate as a great deal of information that may be useful for WAP users is stored in a tabular fashion (whether it is in plain text or HTML tables, or stored in a DBMS or spreadsheet). Fortunately, due to the hierarchical nature of the content of many tables, it is possible to display this information in a way that is not only clear and logical but also conforms to limitations of screen size and memory imposed by WAP devices.

3.1 The Hierarchical Nature of Tables.

Many tables contain data that is divided into groups or classifications. These groupings usually manifest themselves as repeated or spanning entries in the left most columns of a table. The nature of these groupings results in a table that can offer a simple and intuitive way for a reader to locate specific data, by selecting only the relevant subset of data at each phase of their search, finally focusing on the information of interest. To illustrate this, consider Figure 2, which shows a table containing information about Hifi components. If a reader wishes to locate information about a specific component, (in this case a specific Sony CD player) they would do so by locating the information relating to the appropriate make, then the type of component and finally the model of interest. The information in focus at each stage of this process is indicated.

Where information in tables contains groupings in this way, the content can be modelled as a tree as shown in Figure 3. A hierarchy is formed based on the groupings and each leaf node contains an item of data relating to a specific entry

Modelling the content of a table in this way is highly suited to WML. By creating the equivalent hierarchy in a series of WML cards, the content of each card can be kept small enough to be comfortably viewed, whilst providing access in a logical manner. The hierarchy is modelled as follows:

Make	Component	Model	Price	Test Date
Sony	Amp	TA FE2 3 0	100	Dec 99
Sony	Amp	TA FE330R	130	June 00
Sony	CD	CDP XE22 0	100	April 00
Sony	CD	CDP XB 93 0E	300	Sept 99
Sony	Tuner	ST SE300	120	April 99
Marantz	Amp	PM 4000	150	June 00
Marantz	CD	CD 4000	100	April 00
Marantz	CD	CD 6000 OSE	300	Sept 99
Marantz	Tuner	ST 77	600	May 98

Figure 2: How hierarchy within a table guides access.

- A separate card (a choice card) is generated for each set of choices. Each of the choices at each stage is composed of a link (just like a hyperlink in HTML) which connects to the next card in the hierarchy (whether it be another choice card or a data card containing information relating to an entity).
- A data card is generated for each entity, containing appropriate data from the leaf nodes.

Figure 4 shows the WML cards that would be displayed for each set of choices in our example. The arrows indicate the links that exist between the cards.

3.2 Effective Access to Table Content.

Because of the fragmented nature of the presentation of table content, it is essential that the user is able to guide the focus of the search. For example, when searching for Hifi components in the table in Figure 2, if the reader was specifically looking for details of CD players, it would be useful to have component types at the root card. With any other information al the root, the user would need to perform an exhaustive search, traversing a large number of links (often unnecessarily) in order to locate the appropriate details. To enable effective access, we allow information in any of the columns that display groupings to be chosen as the start point for the search (i.e. the root card).

3.3 Generating WML.

In this section, we shall discuss how the WML required to represent a table is produced. Two basic types of card are generated:

- Choice cards - generated at each stage where a choice should be made. There are two types of choice card, one for the root and another for all other choices, which enables navigation to the previous card.

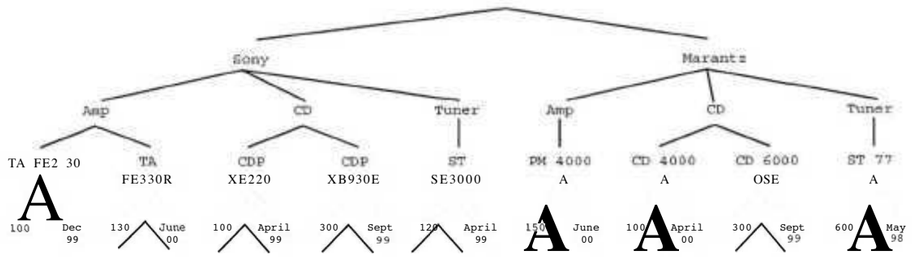

Figure 3: Tree representation of table content.

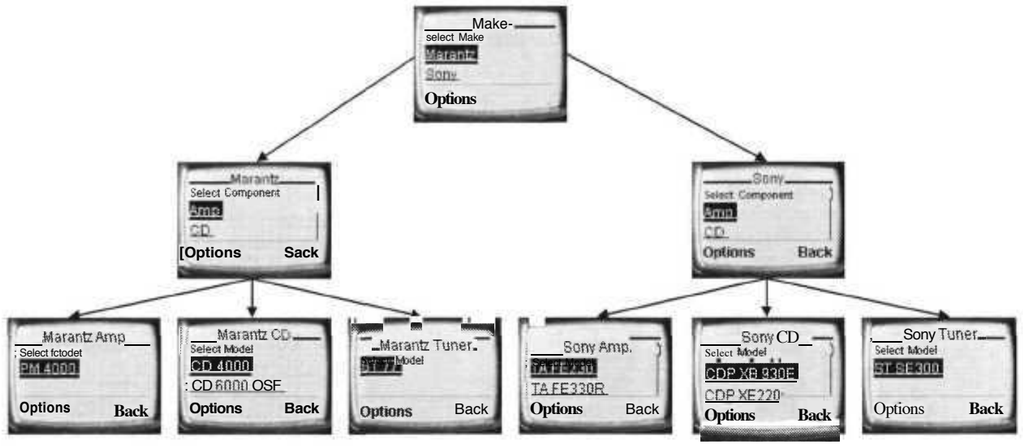

Figure 4: Hierarchy of WML 'Choice' Cards.

- Data cards - generated for each entity, containing information that appears in the appropriate row of the table.

We shall illustrate the generation of the required WML by examining code segments for each type of card. In each case, bold type indicates any information imported from the source table.

3.3.1 The Root Card.

Figure 5 shows the WML generated for the root card. The first line of a card definition contains a `card id`, which is a unique name for the card, and a title to be displayed. For the root card, these are simply set as the label for the first column of the source table (i.e. Make in this case).

On line 4 the user is prompted to make a choice and again the label of the first column is used. This prompt is followed by each of the choices available at this level.

```
1       <card id = "card_Make" title="Make">
2
?               <p>
4                       <small>Select Make</small>
S                       <br/>
6                       <anchor title="Marantz">Marantz
7                               <go href="#card_Marantz"/>
8                       </anchor>
9                       <br/>
10                      <anchor title="Sony">Sony
11                              <go href="#card_Sony"/>
12                      </anchor>
13              </p>
14      </card>
```

Figure 5: WML source and resulting display for the Root Card.

For each choice, a link (href) is generated where the title consists of the choice field (line 6) and the href consists of this choice field concatenated after '`#card_`" (line 7).

3.3.2 Choice Cards.

The remaining choice cards are generated in a similar manner to the root card. Figure 6 shows the WML generated for such a card. The main difference to note is the extra code that allows the user to navigate backwards through the cards visited (lines 3-5).

In addition, the `card id` and `title` are more complex. In choice cards beneath the root, these consist of a concatenation of all nodes visited to reach this stage. For `card id` these are simply joined (as spaces are not valid in `card id`) and concatenated after '`card_`', whilst for `title`, spaces are indented between each token (to aid readability).

As with the root card, the selection prompt (line 8)


```
1       <card id = "card_MarantzCD" title="Marantz CD">
2
3       <do type="prev" name="prev" label="Back">
4               <prev/>
5       </do>
e
7               <p>
8                       <small>Select Model</small>
9                       <br/>
10                      <anchor title="CD 4000">CD 4000
11                              <go href="#card_MarantzCDCD4000"/>
12                      </anchor>
13                      <br/>
14                      <anchor title="CD 6000 OSE">CD 6000 OSE
15                              <go href="#card_MarantzCDCD6000OSE"/>
16                      </anchor>
17              </p>
18      </card>
```

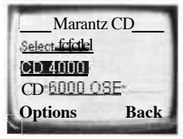

Figure 6: WML source and resulting display for remaining Choice cards.

utilises the appropriate label for the data used to generate the choices.

Again, links (hrefs) are generated for each choice. In a similar way to the `card id`, the reference is generated using a concatenation all nodes visited to reach this stage. This is joined to '`#card_`' and finally to each of the available choices (see line 11).

3.3.3 Data Cards.

A data card is created for each row of the source table. The `card id` and `title` are created in the same way as for choice cards. For this illustration, the data cards are defined to contain all information from the source table. Thus in Figure 7, the content (defined in lines 8-12) consists of each label and the associated attribute value

4. Conclusion.

By exploiting the hierarchical nature of information within tables, it is possible to present the information they contain in a compact and intuitive format suitable for viewing on the restricted displays of WAP devices. Based on this concept, we have developed a software tool that can transform tables from plain text and HTML documents, spreadsheets and DBMSs into appropriate WML decks.

5. References.

[I] Nokia WML Reference, Version 1.1, Available from http://www.forum.nokia.com

[2] The Independent WAP/WML FAQ, Available from http://wap.colorline.no/wap-faq/

[3] L.E.Hodge, W.A. Gray and N.J. Fiddian. Effective Reuse of Textual Documents Containing Tabular Information. *Proceedings of the Fourth Australasian Document Computing Symposium (ADCS 99)*, Coffs Harbour. NSW. Australia. December 1999.

[4] L.E.Hodge, W.A. Gray and N.J. Fiddian. A Toolkit to Facilitate the Integration of Tabular Information in Textual Documents with Database Applications. *Proceedings of The Fourth Multiconference on Systemics, Cybernetics and Informatics (SCI 2000)*, Orlando, Florida, USA, July 2000.

```
1       <card id = "card_MarantzCDCD6000OSE" title="Marantz CD CD 6000 OSE">
2
3       <do type="prev" name="prev" label="Back">
4               <prev/>
5       </do>
ft
7               <P>
8                       <b>Make:</b>Marantz<br/>
9                       <b>Component:</b>CD<br/>
10                      <b>Model:</b>CD 6000 OSE<br/>
11                      <b>Price:</b>300<br/>
12                      <b>Test Date:</b>Sept 99<br/>
13              </p>
14      </card>
```

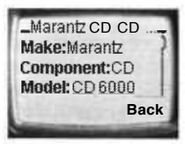

Figure 7: WML source and resulting display for a Data card.