

Examining the Suitability of Channels for Services and User Roles

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This document reports upon a first effort to evaluate the suitability of different channels with respect to (1) content (2) services, and (3) user groups. In this evaluation, an initial methodology was devised and applied to a selected set of channels and services. The channels and services are specified according to technology and functionality, respectively. The impact of each channel upon each service is discussed.

User roles are also characterized, and a “common sense” examination of the suitability of these channel / service / role combinations is presented. Lastly, some general conclusions and future possibilities for new work are described.

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1. Purpose

In many parts of the world today, there has developed a widespread expectation amongst business professionals, common consumers and citizens that electronic information and services should be available wherever and whenever they are wanted or needed. In parallel, there is an ever-increasing proliferation of electronic equipment and devices in our everyday environment which have some greater or lesser capacity of making available such information and services.

When utilizing electronic services, end-users may employ their own personal devices (e.g., mobile phones and PDAs), company-owned equipment (e.g., PCs and laptops) and/or public equipment (e.g., electronic kiosks, bank terminals, TV-based solutions, etc.). When utilizing services, end-users are necessarily involved in different contexts and situations, such as working, shopping, learning, etc. One condition is universal, however: end-users tend to prefer and accept services which are *suited for* the device with which they are interacting with the service; services which are clumsy, slow, disorganized, etc. may be used "once-but-never-again". In addition, end-users tend to accept services which take into account their own knowledge, understanding and preferences.

Given this background, *the objective of this effort has been to evaluate the suitability of different channels with respect to (1) content (2) services, and (3) user groups.* To this end, an initial methodology has been devised and applied to a selected set of channels and services.

The remainder of this document shall describe the methodology which was employed, the selected services, channels and user groups, and the results of applying the methodology to those entities. Before doing so, however, a preliminary description of problem complexity shall be presented.

2. Complexity of the Problem

2.1 *The Nature of Services and Channels*

When in use, *electronic services* necessarily involve some form of *interaction*. Here, one part of the interaction involves some kind of service receiver, which could either be some person (e.g., an *end-user*), or instead with some other (possibly automated) actor. As part of the interaction, information (or *content*) is exchanged between the service receiver and the service; the exchange may be uni- or bi-directional.

A *channel* (or 'service channel') is here said to consist of all hardware and software elements utilized in the provision of and/or interaction with a service. Here, a service channel is said *not* to include the end-user nor the explicit content delivered or exchanged within a service.

In a nutshell, every electronic service is characterized by at least some degree of interaction, where interaction concerns the exchange of content through one or more channels. The manifestation of every service is dependent upon the channel(s) through which the content is delivered. In contrast, the configuration of a channel is *not* dependent upon any service.

2.2 Interdependency of Channel Aspects

Considering the definition of the channel concept given in the previous section, the examination of the suitability of channels immediately brings in the problem of combinatorial explosion. There are so many possible hardware and software solutions for service production, service data representation and transport, and for service presentation, that is nearly impossible to list and evaluate them all or even the most sensible ones. Figure 1 illustrates the problem.

Starting on the right side of the illustration, data are gathered from various sources and brought to the service site to be established as part of the service content. Data will be presented to the service in some form, e.g., a document format, that may be suited for the transfer facilities between the data source and the service, or to the data representation needed by the service. Thus, during transfer some kind of service- or transfer-directed conversion or adaptation may be needed. This adaptation may be located on any side of the transfer facility, i.e., near the data source or at the service site. It may even be seen as part of the transfer function.

On the left side of the illustration we find the user, the user-side equipment and some important aspects of the content produced by the service. On leaving the service side, the content may again go through some adaptation. This time the adaptation may be directed at aspects of the service channel, such as communication bandwidth or limitations on the user device interface. On the service user side, the important aspects of the channel will be given by the characteristics of among others:

- Network, bandwidth, connectivity type etc.
- Transfer protocol, (IP may be assumed, but there are still many carrier choices)
- Document format, i.e. how the content is represented (such as binary, HTML etc.)
- Content type, i.e. what the data represents (such as text, sound, picture etc.)
- User device, such as a fax, a mobile phone, a desktop or laptop computer etc.
- User interface, output may be presented on a display, a paper, a speaker etc. while input may be entered using a pointing device, a microphone, a keyboard etc.
- Presentation, i.e. how the content is presented (such as sound, light diodes, Braille, text, picture etc.).

All in all, the number of combinations are overwhelming, but in practice there are interdependencies between the channel aspects which reduce the number. As an example, no service will present video over a low bandwidth network and a four-line text-only display. Similarly, a service expecting strong textual interaction from the user is not very interesting if the user device does not have a keyboard or some other *efficient* text-entry facility. Also, the user himself will, in some sense, be drawn to particular services and thereby influence the channel choice. Examples are services providing sound output for the visually-impaired or accepting speech input for illiterates.

Some services of general interest may be adapted to different channels or to given user categories / roles. The issue as to whether such a service should be considered as one service which can be adapted (or transformed), or as many different services in which each can be directed to a particular user category or channel, can be discussed at length; this issue will not receive further attention here. In a later section, we will present a

service (“Green Pages”) that involves a text-based dataset which may be of interest to users both on stationary and limited-interface mobile devices. This service is currently available in printed form (e.g., in certain printed telephone directories) and over the Web using a regular display (i.e. PC). We indicate how this dataset may be made available on devices having only a five button keyboard and a four-line display. It remains a “Green Pages” service, but the functionality is so modified and reduced — and, in some sense, the characteristics of the channel and the user situation for which the service is now directed are so special — that it can hardly be called the same service. That choice is left up to the reader.

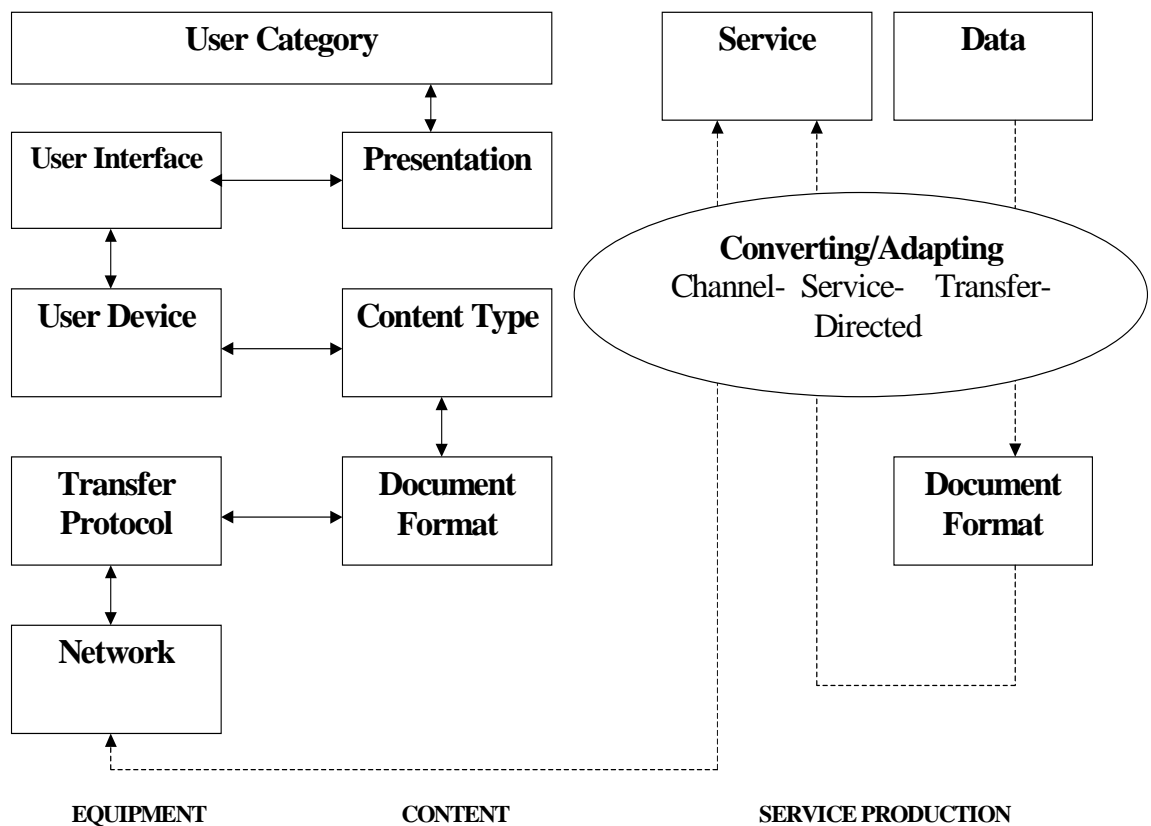


Figure 1: Relationships between equipment, content and service production

3. Methodology

In order to evaluate the suitability of different channels with respect to content, services, and user groups, an initial methodology was devised and applied to a selected set of channels and services. Since the resource frame for this effort was relatively small, only limited time was spent devising an evaluation methodology and reviewing it for its strengths and weaknesses.

The methodology employed consisted of the following, major steps:

1. To select the channels to be evaluated and to provide high-level specifications of their basic characteristics.
2. To select a few services and provide general descriptions of their primary functionality according to the manner in which that functionality can be delivered via a channel which is *not* restricted by bandwidth limitations, screen size, I/O devices, etc.
3. To define and characterize a limited number of user roles, and to provide indications about which channels these user roles most regularly employ and are comfortable with.
4. To provide descriptions as to how channels which are restricted by characteristics such as bandwidth limitations, screen size, I/O devices, etc. *impact* the manner in which the selected services can be realized via that channel.
5. To assess the suitability of services per channel, for each user role defined.

The remainder of this presentation is organized in accordance with the steps listed above.

4. Definitions of the Channels

For this study, three channels were selected and specified. Throughout this document, each of these channels is referred to by its *label* — a label which corresponds to the channel's respective end-point (i.e., terminal type). A high-level specification of these channels is provided in Table 1.

Table 1: Specification of channels (by label)

	Screen	Bandwidth	Pad/key I/O	Processing	Portability	Other
PC (desktop)	at least 15"	LAN, at least 1 Mbps	full keyboard mike, mouse, speaker	Intel, at least 300 MHz	stationary	colour, high resolution, highly expandable
PDA (handheld)	6", 15*5 cm 26*100 chars.	Modem card, 56 Kbps	small, but complete keyboard, stylus, mike, speaker	ARM (Risc), less than 200 MHz (Jornada)	easily portable, although not necessarily pocket size, 200-1100 g	medium resolution, memory < 16/32 Mb, flash card expandable
WAP (phone)	2" 5*20 chars.	GSM, 9.6 Kbps	tiny (alpha-) numeric keyboard, arrows, "rollbar", phone	ARM (Risc), less than 100 MHz (R380s)	small and highly portable, 80-200 g	B/W, low resolution, about 1.5 Kb WAP-memory

The channel end-points and the characteristic properties of the associated channels were chosen to be typical at the time of the study (Summer 2000). Even half a year later, other channel choices and "specifications" may be more appropriate. Solutions and products are constantly changing in this field and our technology environment is a moving target. One important basis of the choice was to have a clear distinction between the three channels. If we look at these channel end-points, the stationary desktop with a full LAN connection is obviously something other than any kind of portable computer device such as a palmtop or a WAP-enabled mobile phone. Similarly, a handheld PDA with a modem connection and graphical display is definitely something other than a phone with a limited 5-by-20 character display and a reduced set of keys. The other channel capabilities normally associated with the PC, PDA, and WAP end-points are also distinctive in the same way, in particular when one looks at the bandwidth.

Somewhere in between the three channels singled out for this study, lies the standard portable PC — now often called laptop — and the palmtop devices (i.e., the PDAs without "hard" keyboard). The main reason why the laptop was not included in the study was that it greatly likens the desktop with respect to user interface and other overall channel capacities. The palmtop was omitted simply in order to control the size of this study's scope, since resources were greatly limited. Otherwise, the palmtop is an interesting object of study, since its size approaches that of the mobile phone though its graphical interface and network connection possibilities equal its handheld counterpart. In fact, most PDAs (both handheld and palmtop) may now communicate

freely to the same extent that the current desktop or laptop, and may also communicate through wireless connection (e.g., WLAN technology) and become part of a local area network.

In addition, the WAP-enabled phone is slowly turning into a full-blown personal data assistant and communication device, and the casual ways in which it is carried and used can nearly characterize it as a wearable computer. As the capacity of the wireless networks increases from GSM to UMTS and beyond, we may quickly see the major substitutions of low-bandwidth WAP technology with full Internet capabilities on low-end devices. This trend will change the overall picture and make other choices of channels and end-points more interesting for a study. Still, these results of convergence are not quite there yet.

If we look at the three channels that were chosen for this study, we will see that the three most important distinguishing features between the PC and the PDA are bandwidth, screen size, and the fact that the PDA is portable. The distinguishing features between the PDA and the WAP devices are again bandwidth and screen size, but in addition the keyboard size and the fact that the WAP is itself a phone and can therefore offer almost global *personal* access.

5. Basic Definitions of the Services

For examination of the suitability we have chosen three services. In the subsections below, the central purpose and primary functionality of these services is described. The descriptions provided here concern the manner in which the service can be delivered through a channel which is *not* restricted by bandwidth limitations, screen size, I/O devices, etc. These services are:

- **NetBank Assistance**, a help service for users of Internet banking.
- **Green Pages**, a lookup service for explanatory and contact information concerning government institutions.
- **Form Access**, a repository of public forms and facilities for ordering or filling in forms.

Of these three services, Green Pages and Form Access are existing services available on the World Wide Web.

5.1 NetBank Assistance

The essence of this service is to help or assist Internet bank users, in particular those users who become stuck during a transaction. Help may be needed for several reasons, some of which are:

- Little user experience
- Erroneous use of functionality
- Erroneous service programming
- Communication errors
- Poor service design

Such users will need some facility to search for help information or to contact the bank's expert. The help functionality or expert may then guide the user out of the

troublesome situation and through the different steps needed to complete the transaction. The guide may even temporarily take over the transaction from the user.

Some problems with net-banking may be helped on the spot, either:

- by some kind of help functionality in the client side of the transaction, which might help the user overcome e.g., a communication error,
- by help information delivered via the network from the server, or
- by assistance from the bank through some other channel, such as a telephone.

In this service, the amount of data going from the user/client side to the server and back during the transaction will probably be small, unless impressive graphics are used. The amount of data transferred during the help session may be quite large, though, depending on the assistance functionality in use. Some alternative solutions for a NetBank assistance service are described later in section 7 of this report.

5.2 Green Pages

The essence of the Green Pages service is an information service concerning government institutions and services. One such piece of information might be a reference to the public service which helps clients find opportunities in a local job market. The service will basically deliver address information for the local service office as well as information about what the service office can offer and how the service office may be contacted. Such information is even available in a special “green pages”¹ section in the telephone directory of some Norwegian counties. An extended Green Pages service may be found on the World Wide Web. On the Web, the user may also read up-to-date news about job vacancies, where to apply and get tips on how applications for a job should be formulated.

For a PC the Green Pages service is a typical text-based Web service with facilities for formulating and submitting a search, and for displaying the result or for saving it for later use. The amount of information transferred in a Green Pages session is low in each direction.

5.3 Form Access

The essence of the Form Access service is a situation where a user needs to fill in a particular form and return it to the relevant institution. The service offers a means of locating the form and to ask for a copy to be delivered to the user. The user may choose to have the form — which may have been partly filled in by the service — delivered by fax or regular mail. But for a PC user on the Web, it is also possible to have the form delivered directly to the PC for printing or onto the PC’s display where the user may fill in or correct the information on the electronic form and return it over the Web.

Just like the Green Pages service, this service is not particularly demanding with respect to bandwidth. However, the WWW-based version of the form may be represented solely as a graphical image (rather than as e.g., an HTML-form) and as such involve more than a mere textual representation. The Form Access service — as it is currently implemented by some government institutions such as the revenue service — has several ways of locating a particular form. Some of these are direct search on the forms identifier, a search on words of a forms description or title, or a tree-climbing search

¹ In fact, the pages are colored green for easy identification.

through a hierarchical organization of the forms. Further information on the Form Access service may be found in [1].

6. User Categories and Roles

The purpose of this section is define and characterize the user categories / roles selected for this study, and to provide indications about which channels these kinds of users most regularly employ. This selection strongly reduces the scope of this effort, just as the selection and definition of a limited set of channels has done.

6.1 User Properties

Among the many properties characterizing a user we find:

- Knowledge of subject matter, i.e., what the user knows about the domain of the service.
- Knowledge of tool, that is, what the user knows about the particular tools used (i.e., the device, the platform, or the particular application).
- Frequency of service use (which is strongly related to frequency of tool use and knowledge of tool);, however, experience is something more than mere theoretical knowledge.
- Economy: a service may be expensive or come in alternatives that differ in cost
- Education: users with learning experience may understand a tool more quickly or may have less trouble with understanding (written or electronic) service information or help facilities. Educated people may also recognize and build upon similar service experiences in other situations.
- Other social characteristics, such as age, sex, disabilities, etc.
- Characteristics of the use context, such as physical restrictions (narrow passages, hanging on a ladder, darkness), job situation stress, urgency, environment (noise, pollution), availability of energy (battery life), etc.
- Enthusiasm: that is, when the user thinks it a service is “cool” or important, then she will be more tolerant.

It is important here that we do not see a user category as a fixed technical concept. A user category is related to the characteristics of the user and the use situation or use context, not to the service channel and device which ultimately offer the service interface to the user. Thus, there is in general no such thing as a "channel directed to a PDA-user". Still, a particular member of a user category may use a channel involving a PDA, i.e., the channel we have labeled PDA, in the context of a given service.

6.2 User categories

In this study we have chosen to select only three of the many user categories that are possible. We have given these three categories the labels *Professional*, *Occasional*, and *Recreational*. A rough description of these categories can be:

- **Professional**
 - Uses certain channels / channel end-points (e.g., PC, PDA, WAP phone) as a regular part of the job.
 - Is fluent in the relevant tools.
- **Occasional**
 - A home user.
 - Is able to run most relevant applications.
- **Recreational**
 - Young, part of the SMS-generation.
 - Hip, eager, and able to use anything that's considered cool or necessary in the social group of the recreational user.

These labels do not fully characterize the categories, and the categories we have picked are not distinct. Still, these rough definitions capture the most important features of these categories: who will use a device or an application either because they must do so at work, because it is practical and useful in the spare time, or because it is fun and of social importance. A particular user may of course fall into any one of these categories, depending upon the use situation. *Thus the categories should be interpreted as roles that a particular user may be in*, rather than a general description of the user at all times. Given this understanding, the term 'user roles' will be used in place of 'user categories' in the sections which follow.

6.3 User roles and channel use

In theory, any given user may occupy any of the three roles for any of the three services and any of the three channels that were chosen for the study (see sections 4 and 5). But in practice this may not be the case. Table 2 shows, in our view, which user roles will most likely be associated with the three channels defined above.

Table 2: User roles vs. channel use

	PC	PDA	WAP
Professional	yes	yes	yes
Occasional	yes		yes
Recreational	yes		yes

If the *professional* user's job demands it, and in particular if the employer covers the expenses for device and communication, this user can be expected to use any of the channels². The PDA is also device that many find to be an extra necessity, while waiting for satisfactory PDA-phone (or "smart-phone") convergence to come.

² Presently, most professionals use mobile phones, and most mobile phones offer WAP.

Under our assumptions, the *occasional* and *recreational* users will definitely use the PC. As for WAP, mobile phones are already a commonality. Thus, occasional and recreational users will probably have nothing against using the WAP channel as it becomes a common standard on mobile phones. But the cost may play a role in regard to the use of this channel. The cost will also play a role for the use of the PDA by these users. Currently the recreational and the occasional users will likely consider it to be too expensive.

6.4 User roles and system knowledge

One aspect of the user role that was mentioned in section 6.1, was knowledge of subject matter and tool, respectively. Table 3 relates the user roles to the expected user knowledge level. We need to distinguish between two kinds of knowledge, domain knowledge and system knowledge. Domain knowledge is high for the professional who uses the system and services regularly for many tasks on the job, but it is at a medium level for the occasional or recreational user who may use the channel for only one or a few of its possibilities. To exemplify, the professional banker may know everything about the domain of banking or finance, while other users only know enough about banking to do some transactions on their own banking account.

System knowledge is knowledge about the application, the service, the platform, the device, and the user interface. This knowledge is very much dependent upon frequency of use and experience both with the actual applications and with similar systems or services. Therefore, for the occasional user the system knowledge is medium for the PC, while it is high for the other two roles.

Table 3: User roles vs. system knowledge

	Domain Knowledge	System Knowledge		
		PC	PDA	WAP
Professional	High	High	Medium	Medium
Occasional	Medium	Medium		Low
Recreational	Medium	High		High

The professional will be a less frequent user of the PDA and WAP channels, and will therefore have medium system knowledge about these systems and the services offered over these channels, while the recreational user, as represented by the SMS generation, knows everything about the possibilities of WAP and PC. The occasional user applies the WAP very infrequently.

7. Alternative Implementations of NetBank Assistance

Channels can be restricted by characteristics such as bandwidth limitations, screen size, I/O devices, etc. Such restrictions necessarily impact the services delivered via such channels. Before proceeding in section 8 with descriptions as to how restricted channels impact the realization and use of the services selected for this study, we wish to further describe alternative solutions for NetBank Assistance.

This service is directed at a NetBank user that needs some guidance or help in order to finish a banking operation from her terminal. The service may of course take on many forms, depending on the channel in use, the operation involved, and the characteristics of the problem situation.

Assuming that the service is provided over an unrestricted channel (such as the channel we have labeled **PC**), a set of alternative implementations of NetBank assistance may be envisioned. Some of these are listed in Table 4.

Table 4: Alternative implementations of NetBank assistance

	How?	Expert required?	Online?	Solver?
1	help pages (text, bitmap, jpeg), FAQ, troubleshoot list	No	Yes	User
2	guided tour	No	Yes	User
3	a) formulate and pass problem to expert b) expert takes over, performs transaction and asks authorisation	Yes	No (abort)	Expert
4	print state and walk to bank	Yes	No (abort)	Both
5	application sharing , "show, point, talk"	Yes	Yes	Both
6	as 3a, then remote control	Yes	Yes	Expert
7	expert views transaction log , guides user	Yes	Yes (abort?)	Both

The alternatives span from 1), a simple **help pages** solution, where the user herself looks up in pre-prepared help information available in the application client itself or from a Web browser, to 5), an **application sharing** solution, where the user is in a direct CSCW (Computer Supported Cooperative Work) over-the-net contact with an expert in the bank who guides her until the banking operation is finished, or until the user can conclude the remaining operations on her own.

The other alternatives are, briefly explained:

- 2) **guided tour** allows the user to follow in the steps outlined by a set of linked direction pages with fields for entering values and choosing alternatives.
- 3) **pass problem to expert** means the user will abort the transaction, formulate a description of the problem and somehow pass that description (e.g., via e-mail) over to an expert at the bank. The expert will then take over and, after getting authorization from the user, perform the transaction.
- 4) **walk to bank**, is similar to 3) except that in this case the user will print out the state of the transaction, or write down a description of the problem, and take it manually to the bank's expert.
- 6) **remote control**, is also similar to 3), but in this alternative the user will stay online and be able to follow the transaction as the expert performs it.
- 7) **transaction log**, assumes that a copy of the transaction log up to the point of problem will be present in the bank for the expert to look at. Thus the user does not need to write a description, it is "already there". The expert will guide the user through the missing steps.

Most of the alternatives assumes the bank's expert is available to the user immediately when assistance is needed. This is of course a very expensive service and may seem unrealistic. We cannot assume that the user is willing to pay the real costs for such expertise help. Most alternatives, and in particular some of the alternatives involving expert guidance, also involve a learning experience: primarily for the user, but also to a certain degree for the expert and the bank's system developers. This learning will make the user more proficient and eager to use the NetBank services. It will also help the bank make better systems. Both results will benefit the bank in the long run. It may therefore be profitable for the bank to subsidize expert help or to allow the user some free help sessions per month in the beginning.

8. Channel Impact upon Services

This section of the report looks at the impact that moving from a high quality channel to more restricted channels (such as the ones we have labeled PDA or WAP) will have upon the services outlined in Section 5.

8.1 Impact upon NetBank Assistance

The impact upon the NetBank Assistance service, for both the PDA and the WAP channels, is summarized in Table 5. A "yes" in a column means it is considered possible to keep the functionality when moving from an unrestricted PC channel to one of the two more restricted alternatives. A "no" means we do not see this assistance alternative as a realistic possibility for that channel.

8.1.1 PDA Impact

Some further comments are due. For PDA we can assume that the help pages and guided tour alternatives, 1) and 2) — which do not involve an expert or high amount communication with the information source — may be available in a decent way. The two alternatives where the expert takes over, 3) and 7), also deserves a "yes". Alternative 4), walk to bank, would need a printer, fax or e-mail facility for bringing

information to the bank if we want to keep the service exactly as for the PC. But taking into account that the PDA is very light-weight, why not just put it in a pocket and bring it along to the bank? Of course, one may wish to use the PDA for something else before an eventual trip to the bank, so this course of action may not always be so viable.

Alternatives 5) and 6) involve some form of application sharing. For one thing, this will need a client side application on the PDA that is at present not known to exist (such applications are still of only limited use on a PC). It also will need an audio connection to the expert (e.g., over a phone or some other medium), in addition to the connection used for sharing.

Table 5: Impact of PDA and WAP upon NetBank Assistance functionality

	PDA	WAP
1 - help pages	yes	yes, but screen ...
2 - guided tour	yes	yes, but screen ...
3 - pass to expert	yes	yes, but keys ...
4 - walk to bank	needs printer/fax	needs printer/fax
5 - application sharing	needs phone and new application	no
6 - remote control	see 5)	no
7 - expert reads log	yes	yes

8.1.2 WAP Impact

A user doing banking on the WAP channel may find the help functionality of alternatives 1) and 2) useful, but the small screen and the reduced keyboard will make this awkward. The same can be said for alternatives 3) and 7), although these may involve less use of the keyboard and the screen after the expert takes over. A hands-free solution for the WAP simplifies contact with the screen and keyboard, but it is still clumsy. As was the case for the PDA, alternative 4), walk to bank, may involve the use of some printing facility. But walking to the bank with the WAP in the pocket seems again more sensible, unless the WAP device is required for another task in the interim.

One important point with the WAP is that it is first and foremost a phone, thus the user can easily come in contact with the bank expert over-the-phone. This is particularly handy for help alternatives 3) and 7), in which the expert takes over while being in phone contact with the user.

8.2 Impact upon Green Pages

While some of the NetBank Assistance alternatives, such as the one using application sharing, may need a broadband channel to be fully functional even on a PC, the Green Pages service is a low volume text-based service that should not be impacted significantly by a move to a less powerful channel.

8.2.1 PDA Impact

The PDA channel, as "specified" in Table 1, has a small but complete keyboard, a screen covering 26 lines of up to 100 characters, and a 56 Kbps modem communication facility. Thus it is well-suited for a limited text-based service such as the Green Pages. We can safely assume that the functionality will be almost the same as for the PC channel for formulating the search, reading the response, and for use of the information (such as storing it on the device for later use or for copying it into some text file³). The PDA does not have a printer easily available, so the user may have to write the information down on a piece of paper or save it on a local text file. But the pieces of information are small, such as an address or a phone number, so the PDA impact on the service can be said to be small. Small except in one respect. We should not forget that the PDA is portable and that this allows the PDA user to access the Green Pages from anywhere near a phone-plug (i.e., for establishing the modem connection) . This adds a certain kind of "portability" to the service in contrast to a stationary desktop.

8.2.2 WAP Impact

The Green Pages service has essentially three user functions, *search*, *show response*, and *use response*. The impact of using the WAP channel is not the same for all three functions.

8.2.2.1 Functionality

Briefly, the important points when evaluating WAP impact on the service functions, are

Search

- text input is cumbersome, but possible
- use of preset search criteria simplifies query
- search may be performed with arrows, i.e. thumb, only (see section 8.2.2.2)

Show response

- text output is OK, but display does not show the complete result within one screen-full (e.g., scrolling may be necessary).
- hierarchical step-wise search based on intermediate results and use of arrows may provide a practical solution, see section 8.2.2.2 below.

Use response

- once a phone number is there, it may be automatically applied or saved for later use
- the main impacts on use are
 - screen/key size, which make the use a little problematic
 - mobility, which is a definite bonus and more so for the WAP than the PDA
 - added phone facility, which makes it possible to use the response directly on the same device.

³ Many PDAs also have a form of "address book" for storing contact information.

8.2.2.2 Interface

Figure 2 gives an indication as to how a service may be adapted to better suit a given channel, in this case how Green Pages may be made more suitable on a WAP device.

The figure illustrates the steps the user will have to go through to find information about opportunities in his local job market. The illustration assumes that the WAP has a four line display and only five keys, four pointer keys and an info key.

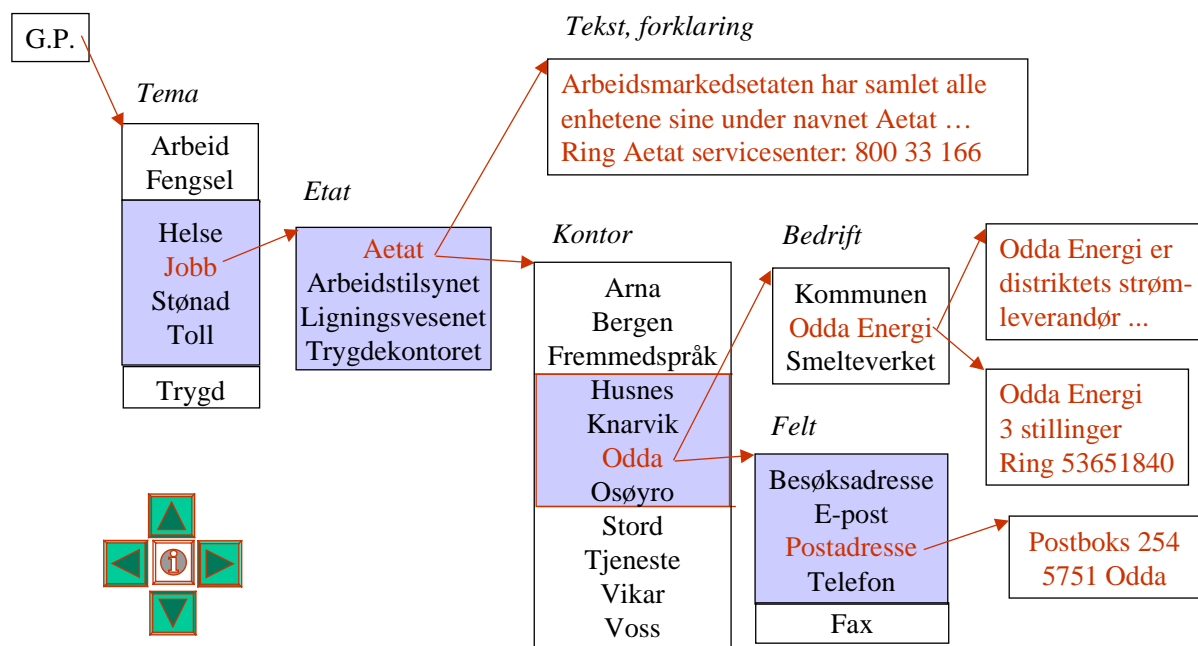


Figure 2: Simple Green Pages WAP Adapted Interface

Starting from the left, the user will begin by choosing the Green Pages service (G.P.) from a list of available services on his device. The service will return a list of themes (*Tema*) available from the public sector. By pressing the up and/or down pointer keys, the user can scroll through a "window" of four themes from this list. Further pointing focuses on the Job theme (*Jobb*) and the user then presses the right pointer key. This brings out the public services (*Etat*) that are in some sense connected with this theme⁴. The user focuses on the first of these, the public service *Aetat* (which functions as a mediator between the job market and people looking for jobs.) By pressing the info key, the user will get some information about *Aetat* (*Tekst, forklaring*). Pressing instead the right pointer, a list of *Aetat* local offices (*Kontor*) appears. There are several ways the service can determine what "local" means at this point. Locality could depend upon the user's identity and address, as found in a profile on the device, or it could be the result of GMS cell information or even GPS coordinates made available to the application. The user again focuses and can use the info key or the right arrow to move further down in the hierarchy until the job information (fields and field values) he is seeking is finally

⁴ This first step involves the only list (and search) of this service that is particular to the Green Pages application. The steps and lists further down and the hierarchy are all generic in the sense that they return lists of attributes or values that in principle could come from any service based upon a hierarchical database

found. At each step he may use the left arrow to back up in the tree, the right pointer to go further down into the tree, the up and down pointers to focus within a list, and the info key to get information about the current focus.

An important aspect of this illustration is that the user never has to enter any search value. All he needs is to make a choice, using the pointer keys, among the possible values available at each level of the search. This of course assumes that the number of different values in a list is limited. If the number of values is large, it will be necessary to refine the focusing functionality, for instance by using numerical keys, double-clicks or a "roll-bar", to move quickly into particular sections of the list.

The point of this illustration is not to designate a particular solution for the Green Pages service for a WAP user, but to show how a change in service functionality may make the service more suitable for a given channel.

8.3 Impact upon Form Access

The Form Access service is basically a text service, a simple service to find and order a form from a service center or repository. For this basic service, a narrow communication channel and a low-tech text display will be sufficient. Depending upon the channel, however, the Form Access service also may involve 1) a possibility of viewing the full form on the channel display, 2) a facility for viewing a form pre-filled with default user data, 3) facilities for correcting pre-filled values and completing the form, and 4) a way of submitting the form back to the service once it has been completed. For some of these additions to the basic services, a high quality channel such as the PC will be preferable. But both the WAP and in particular the PDA users may find the basic service usable almost as is, or accept a service that needs only a slightly adaptation to these channels. Larsen [1] has a thorough description of the Form Access service and a discussion on how it can be adapted to the WAP channel. Here we will only briefly mention the most important impacts that the WAP and PDA channels may have on the service.

8.3.1 PDA Impact

For the four basic services of Form Access the impact can be summarized as follows,

- *Find Form*

Very little impact. The functionality will be almost the same as for the PC, but the small screen size may not be able to show all results and explanations which follows from a search for forms within a particular subject. Furthermore, the small keyboard and/or stylus input facility will make filling out the search criteria less simple.

- *Order Form*

Very little impact. The functionality will be almost the same as for the PC, but the small screen will of course reduce the chances of the user being able to see the full form on the screen. Thus the user may be more inclined to ask for a paper copy to be sent by fax, by traditional mail, or by email over another channel such as the office or home PC. Ordering a copy via email should be as easy as on the PC, once the correct form has been identified.

- *Fill In Form*

For most forms, the user will be unable to see full form on the screen at once, or he may see it as an image with the size of the text and any pre-filled fields reduced and almost unintelligible. Therefore a paper or email copy will probably be preferred.

- *Return Form*

Very little impact. The functionality, i.e., an email facility with provision for including attachments, will be almost the same as for the PC when an electronic copy of the form is available on the PDA. Still, the Return Form function will probably be impractical in cases where the form is large or has many fields which need to be checked or filled out by the PDA user.

The conclusion for the PDA impact is that the user will probably prefer to use the PDA to locate and order a form, and to have it delivered on a separate channel, rather than to receive the form and update and return it directly from the PDA. Much, however, will also be dependent upon the complexity and size of the form itself.

8.3.2 WAP Impact

As was the case for the PDA channel, the WAP channel will most probably be used only to locate and order forms, rather than to receive and fill them out directly upon the device. A detailed description of an adaptation of the Form Access service for the WAP channel is given in [1]. The main impacts, which are mostly due to the smallness of the display and keyboard facilities, are as follows:

- *Find Form*

This will have a reduced functionality because of the awkwardness of entering search criteria. A hierarchical search structure such as that described for the WAP Green Pages service, could be used.

- *Order Form*

Once the form has been identified, the user will order a paper copy (mail or fax) or ask to have an electronic copy of the form delivered by e-mail (to be accessed later via a more powerful device such as a PC.) There is no provision for seeing the form on the screen.

- *Fill In Form*

The small screen and reduced keyboard make this impractical on the WAP. Some other device (such as PC or pen and paper) will be used.

- *Return Form*

The form will be returned using a separate channel, either electronically (e.g., from a PC via e-mail), or by paper copy (e.g., via fax or regular mail.)

9. Usability and Suitability

9.1 Usability

Some time ago, there was a tendency to view usability as a quality linked to an artifact and its user interface — a quality which was independent of the context of use. In ISO 9241 [2], however, the term usability was defined as:

The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

An important point in this more recent definition is that usability is defined to be a quality of the product (an artifact) in a specific context of use. Another important aspect

of this definition is that it tends to imply that usability is something which can be measured or graded. In recent years, the "usability community" has concentrated upon devising metrics and methodologies for measuring usability in testbeds and controlled experimental settings. Such activities are in accordance with the ISO definition of usability, since they seek to establish means by which usability can be measured.

Lockwood and Constantine [4] give five aspects of a system and its user interface which contribute to usability:

- *learnability*, is it easy to learn
- *rememberability*, is it easy to remember how it is used, from one use instance to another
- *efficiency* in use, is it easy for people use the system productively
- *reliability* in use, will users make fewer mistakes and recover easily from errors
- *user satisfaction*, whether people feel good about using the system.

With this list (which in a certain sense describes different dimensions of usability), one could easily imagine a methodology which asked users to evaluate or grade an artifact with respect to each of these dimensions.

9.2 Suitability

9.2.1 A simple definition

Our limited study has not had time to address usability in the ISO sense of the word. We have had neither room for building prototypes nor performing measurements in controlled or field settings. For this reason, we have settled upon a study of *suitability* rather than usability.

The definitions from Merriam-Webster [3] serve to define the term 'suitable' in the following way:

- to be proper for
- to be accommodating to or adaptable for
- to meet the needs or desires of
- to be in accordance with
- to be appropriate to or satisfactory for.

Quite clearly, suitability is closely linked to usability, and the ISO definition of usability given in section 9.1 does not immediately seem to offer much room for perceiving suitability as a quality distinctly separate from usability. In our study however, we choose to view suitability as a looser form of (ISO's) 'usability'. That is, we do not intend to design formal metrics for suitability, nor shall we attempt to measure it. Instead, we consider and rate suitability from the point-of-view offered by common sense, reflection and thought experiments.

As a simple example, consider the following: the large paper telephone directory of a city may be highly suitable for use in an office setting, but it is not very suitable for use on the top of a ladder or in the dark. This example demonstrates both the consideration of artifact and context of use, as recommended by ISO 9241. However, it does not plunge into metrics of any kind.

9.2.2 Examining channels, services and user roles

When considering suitability according to the simple definition above, there is an immediate interdependency between services and channels. That is, given a specific service and channel (such as a WWW-based Green Pages service available via a PC channel), a different channel (e.g., PDA) may accommodate that service "as is". Alternatively, either:

- the channel may need some special configuration to run the service "as is", or
- the service may need to be adapted somewhat in order to run within the channel "as is", or
- adjustments may be required of both.

These suitability considerations have been discussed in chapter 8. In this section, we examine each service/channel *pair* with respect to each of the user roles described earlier. During this examination, the issue as to whether the service/channel combination is suitable for a user role takes into account the following criteria and considerations:

Can the user use the service on the channel?

The user can use the service, in the sense that he is *able* to use the service, when

- he has the basic competence required to do so
- he has the functional and economical ability
- the service is available when he needs it.

Will the user use the service on the channel?

The user will use it when

- he is interested in the service provided
- he finds the cost, in terms of money, time or trouble, acceptable
- drawing on his experience, i.e., looking back at what happened the last time he used the service, he finds it's worth doing
- he finds that it is better in some sense than any other alternatives which may be available, (e.g., alternatives such as walking to the bank or waiting until he gets to his office).

Must the user use the service on the channel?

The user must use it when

- it is part of his job
- there is definite need to use the service
- he is pressed and needs the service immediately, i.e. the task is time-critical
- he needs information from the service in order to proceed, i.e. the use is information-critical.

Qualitative ratings of the suitability of channels, service and user roles covered in this study are summarized in Table 6. For the purpose of these suitability ratings, we have used a very coarse scale somewhat similar to the French Michelin Guide [5] star scale for top restaurants. While the Michelin stars — whether one or more stars — are only given to *top grade* restaurants, we have chosen to assign a star even to the least suitable combinations of user, service, and channel.

Table 6: Summary of suitability

	PC			PDA			WAP		
	Service								
	G.P.	Bank Ass.	Form	G.P.	Bank Ass.	Form	G.P.	Bank Ass.	Form
Professional	***	***	***	***	**	**	**	*	*
Occasional	**	**	**				**	*	*
Recreational	**	***	***				**	*	**

Legend: * : partly suitable, but does not really fit the channel; use if necessary
 ** : not unsuitable, useful and worth some effort
 ***: very suitable and useful, definitely worth the effort

The argument for this is that all the services we have looked at in this study can in one way or the other be adapted to the channel, at least for some of the sub-services that the service has to offer on the unrestricted channel.

The assignment of stars in the table are mostly obvious and self-explanatory, an example being the full score given for the professional on a PC channel. The WAP channel for the Green Pages service gets an extra star because of the added functionality of being able to use the result of a Green Pages lookup for a semi-automatic phone call. The extra star awarded to the WAP for the recreational use of the Form Access service, is linked to our definition of this user role, i.e. as a member of the SMS-generation with special deftness at thumbing on a restricted keyboard.

10. Conclusions

The objective of this study was to examine the suitability of different channels with respect to content, services and user groups. A methodology for the evaluation was devised, presented and used. It was judged that the methodology devised for this evaluation served its purpose relatively well, though it did not appear to address issues associated with *content* as well as it addressed those of *services* and *user groups*. This condition apparently stems from the fact that when services were described (see section 5), the focus was upon service functionality rather than the content type(s) associated with the service.

10.1 General Remarks

The conclusions regarding channel suitability are closely linked to the services discussed. Although the services employed for the study span a wide range of functionalities which demand very different capabilities from the channels, they are still not of a nature which allow us to draw general conclusions. Still, some remarks of a general nature are relevant:

The nature of the service determines the choice of channels

- a video service will not use a low bandwidth, text-directed, small and low resolution screen channel.

An enthusiastic or desperate user will accept anything

- if the information is critical or the device is hip enough, or
- when the user enough earlier experience to draw upon such that he expects that he can use the service successfully.

By adapting the interface and functionality, even the poorest channel may become suitable for a service and user role

- a set of well-chosen search criteria and a hierarchical channel-oriented information structure can make even a five-button device handy
- a fax facility may adequately replace an electronic forms delivery.

10.2 Future Directions

Future work in this field should try to identify *classes of services*, where such classes were differentiated by functionality and/or traffic pattern, etc. Such an approach would help serve to establish conclusions for suitability investigations which would be valid over a wider range of services.

In addition, further work could be directed at differentiating user roles through more careful definitions of the characteristics associated with each role. In this way, user roles could likely be organized according to equivalence classes and treated from different perspectives. That is, in one perspective a certain set of roles might be merged within the same equivalence class, while in another perspective that same set might be organized as a different constellation of equivalence classes.

Lastly, the methodology applied in this work has had its definite limitations. Thus, a search for alternative methodologies should be initiated prior to any new study of this kind. Among such candidates would be methodologies which employed factual prototypes (thereby realizing factual channel characteristics) and trials in the field.

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