Mobile application access channels – technologies, attributes and awareness

F Schwenke
e-Innovation Academy, Cape Peninsula University of Technology
Cape Town
South Africa
freddies@tiscali.co.za

M Weideman
e-Innovation Academy, Cape Peninsula University of Technology
Cape Town
South Africa
melius@gmail.com

Abstract

A current topic among role players in the mobile commerce industry is access channels. Even though some role players try to show with confidence that their preferred channels are superior to others, little of this can be proven academically. A literature study has been done to identify the available access channels for mobile applications. The study also identified different characteristics that should be considered when decisions are made about support for the channels. During the literature survey it was found that the question: "Which access channels should my mobile applications support?" is one of the most pressing in the industry. A questionnaire has been sent out to determine the completeness of the list identified through the literature study. Secondly, the awareness of these role players was determined in terms of the identified characteristics. The results of the questionnaire were compiled into a number of bar charts. The results show that, in general, the role players are not in agreement about the different channels or their characteristics. This confirms information received from a leader in mobile applications development that role players do not base their arguments on facts, but rather on hunches.

Keywords m-commerce, access technologies, mobile applications

1. Introduction

The purpose of this paper was to investigate the available access technologies (channels) for mobile applications. For the purposes of this paper, mobile applications are regarded as applications that execute on mobile devices using cellular networks for communications, e.g. a cellular telephone. Furthermore, the paper regards access channels as the technology used by such applications to communicate within a client-server environment where the mobile application is acting as the client application. The server application will be running on a server that is accessible through an Internet connection – probably on a wired network.

This is a topic of active discussion among role players in the mobile-commerce (m-commerce) industry. Role players attempt to prove that their preferred channels are superior to others for their respective applications, but very little of this can be proven academically. The authors used this research to not only identify the available access

channels, but also the characteristics that may need to be measured in order to prove superiority of one channel above others.

2. Literature survey

A number of access channels are available to mobile applications. Some of these have been in existence for longer than others.

2.1 Mobile applications

A user's experience of a product can be divided into three parts: physical perception, actual use and value. These need to be taken into consideration in the design of software interfaces. With mobile applications, two major complications arise because of these needs. Included are physical constraints (small screen, limited keyboard etc.) and device variation (different devices have different capabilities). These complications can cause users to have a variety of conceptions about the application depending on the device that they are using. Such design constraints make it difficult to create useful mobile applications. Successful mobile applications will strike a balance between the design constraints and maximizing the usefulness of the applications (Rondeau, 2005:63-65).

Zhang & Adipat indicate that mobile applications are emerging to give companies a competitive advantage. An easy-to-use interface, however, is critical for adoption of such applications. This leads to the fact that usability testing is a very important issue (Zhang & Adipat, 2005:293).

Hanekom & Weideman (2006) defined three major restrictions in the use of mobile devices to view web content. These are:

- mobile communications have limited bandwidth, but this is being addressed with the arrival of 3G,
- mobile devices have limited processing power and scripting abilities and
- mobile devices have small screens.

The same authors also defined two designs to transcode information exist currently:

- a Java application that downloads a complete HTML page and converts it to a mobile page before displaying it and
- a WAP gateway that transforms HTML content to WML content.

2.2 Available channels

The following existing access channels have been identified:

2.2.1 BREW (Binary Runtime Environment for Wireless)

The “Binary Runtime Environment for Wireless” is a technology created by Qualcomm. It is similar to MExe (see section 2.2.5), in the sense that it is a layer between the application and the device OS (Operating System). It allows lower level access than the Java VM (Virtual Machine), but it is also more exclusive, in the sense that there are a limited number of devices which support it. BREW devices support a Java VM that runs on top of BREW (BREW, 2007).

2.2.2. Cell broadcast

This is a one-to-many SMS type service where the same message is sent to multiple receivers. It is typically used for news delivery and similar services (McKitterick, 2003).

Jeng et al (1998:1), Paulraj & Moorthi (1995:6) and Bakhuizen & Horn (2005) all define Cell Broadcast as an area-based service by which short messages are delivered to all subscribers within a given area. Paulraj & Moorthi quotes traffic updates as a typical example of this service.

Messages broadcast in this way, are sent in blocks of up to 93 characters each, with a total of up to 15 blocks per message (Bakhuizen & Horn, 2005).

Kolmel & Alexakis (2002), suggest another use of this service. They claim that it can be used for location-based marketing services. They also indicate that at the time of their research, this was only used in pilot projects, but that it could become a very prominent marketing tool (Kolmel & Alexakis, 2002).

2.2.3. I-Mode

This is a technology that was created by the Japanese. It allows access to Internet services from mobile devices (McKitterick, 2003). It is a packet-switched Internet service that allows access to I-Mode compatible Internet content. Security is added through a dedicated leased-line circuit. Users are charged based on data volume (Hu, Ye & Lee, 2005).

Sonera MediaLab (2002) indicates that support for this technology grew rapidly between 2000 and 2002 to more than 34 million users and 57000 websites offering support for it.

Hjelm et al (2001) states that I-Mode was primarily developed for the entertainment arena as opposed to WAP, which was developed for business applications. I-Mode was developed by one company and was based on HTML. The most recent version (2001) contains elements that are not supported by HTML. This makes it a superset of an existing subset as opposed to an application of a standard.

I-Mode, like WAP, is based on the browsing paradigm. A gateway translates the protocol layer and application information. This translation is restricted to the wireless adaptation of TCP and HTTP. By comparison, I-Mode uses an optimised version of HTTP running over TCP, while WAP uses a custom defined protocol stack (Hjelm et al, 2001).

2.2.4 Java

J2ME was introduced into the market in 1999 as a programming language that is portable across wireless devices. The API was developed from scratch. Four factors are given as reasons for J2ME applications to be successful for mobile applications. They are:

- it enables dynamic delivery of the application to the user,
- it provides cross-platform capabilities, eliminating the need for different versions for different devices,
- it provides good underlying technology for complex applications and
- it provides the ability for the application to keep running, even if disconnected from the network.

For this technology, a J2ME application known as a MIDlet is used as the client application (Setiawan, 2001:11,20,22).

MacDonald et al (2005:3) indicates that new Java Card technologies can be used in mobile devices. Replacing the traditional SIM card with a Java Card, which in turn can execute Java applications, can achieve this.

2.2.5 MExe (Mobile Execution Environment)

This is a Java environment on mobile devices. It allows full application programming on the device, includes location services, sophisticated menus and other interfaces. It incorporates WAP, but also has additional functionality (McKitterick, 2003).

Jormakka & Jormakka (2002), describe this technology as a specification that provides a standardized execution environment in user equipment. MExe caters for a variety of configurations and divides them into so-called Classmarks. Jormakka & Jormakka (2002) describes three of these Classmarks. They are:

- Classmark 1 – WAP based devices,
- Classmark 2 – PersonalJava devices and
- Classmark 3 – J2ME devices.

MExe provides a security and access rights model that benefits these technologies (Jormakka & Jormakka, 2002). Boman (2001:65) also describes MExe as an environment for multiple technologies.

Penttila (2002:7) further indicates that the MExe specification has certain requirements. One of these is the ability of the user to customise the user interface according to personal requirements. The author indicates that services selected in this way could also be transferred to “wired” computer devices such as laptops (Penttila, 2002:7).

2.2.6 SAT (SIM Application Toolkit)

This is an ETSI/SMG standard for services using GSM phones. The toolkit is built into the GSM SIM card. It creates interactive exchange between the handset and the network application and therefore provides the SIM card with a proactive role in the handset (McKitterick, 2003).

This technology allows applications to be stored on the SIM card. It was suggested in 2005 that the SAT technology is limited in capabilities. This is due to the fact that it was developed in 1994. More recent devices are capable of a much richer instruction set than that available to SAT. The same authors suggest that a Java solution overcomes these limitations. The SAT API allows an application running on a SIM card to be notified of events and to issue commands (MacDonald et al, 2005:1-2).

2.2.7 SMS (Short Message Service)

SMS is a service provided by mobile network operators that allows the sending of short (140 or 160 characters) messages from a mobile device. The message can be sent to one designated number at a time (McKitterick, 2003). SMS is a transaction-based, store-and-forward technology (MobileIn, 2004).

Tang et al (2001) devised a prototype by which mobile users can access networks, execute remote commands and receive results to their mobile devices. This is a good example of a potential application that makes use of SMS technology.

Another possible application of this technology was developed in the health care sector. An SMS diary was designed by which chronic patients could send data to the health care professionals, which in turn could use the data to monitor the patients. The same technology was also use to remind patients to take medication (Anoj & Moldrup, 2004).

2.2.8 WAP (Wireless Application Protocol) / XHTML

WAP (Wireless Application Protocol) was one of the first technologies that allowed Internet content to be displayed on mobile devices. Information is translated to fit within the constraints of a mobile device (McKitterick, 2003). A WAP gateway would translate information from the WAP protocol stack to the WWW protocol stack (Hu, Ye & Lee, 2005).

Englert (2005:112) suggests that not all devices are compatible with all WAP gateways, which could cause timeouts.

The new version of WAP, WAP 2.0, changed the constraints of WAP 1.0. With WAP 2.0 came XHTML MP (Mobile Profile), which allows mobile devices to connect directly to Internet sites. The need for the WAP gateway was eliminated (David, 2004).

2.2.9 WEB Clipping

The WEB Clipping technology involves a WEB Clipping proxy that “clips” web pages and delivers low bandwidth results to the mobile device. It is specifically intended for low band-with data transfer and therefore it is unattractive for downloading applications (Foley & Dumigan, 2001:106-107).

This is a Palm proprietary format, which McKitterick predicted would be superseded by WAP services (McKitterick, 2003).

WEB Clipping was introduced with the Palm VII series of Personal Digital Assistants. It involves a web clipping client application that is placed on the Palm. The application then interacts with a content provider's web site (Chen & Cimino, 2002:S54).

2.2.10 WIG (Wireless Internet Gateway)

The WIG system is similar to the SAT system, in the sense that it is an application that is loaded onto the SIM card. Two main entities are needed for this system: the server and the SmartTrust™ WIB (Wireless Internet Browser). The system allows for both request- and push-services (SmartTrust™, 2003:13-15).

The WIG server is responsible to translate WIB requests to HTTP and deliver them to the application server, which is not part of this system. The response is then translated back to WIB script and delivered back to the WIB. The SAT messaging protocol is used for this service. A number of ways exist to minimize data load on the network (SmartTrust™, 2003:13-15).

Push services (server initiated dialogue) are based on the WAP push specifications (SmartTrust™, 2003:13-15).

2.2.11 USSD (Unstructured Supplementary Service Data)

USSD is a technology unique to GSM networks. It provides session-based communication as opposed to transaction-based communication like SMS. This feature allows shorter response times. No special menu is needed on the phone in order to access the service. The command is entered on the initial screen, similar to telephone calls. Since USSD communications are routed back to the home location of the network, it also works when the user is roaming. This technology is available on all GSM phones (MobileIn.com, 2004).

There are two types of USSD dialogues: network initiated and mobile initiated. Once a dialogue is established between the mobile device and the network, it continues until either party explicitly releases the dialogue. This results in smaller data packets during the dialogue, since the service code does not need to be transmitted each time. Timers in the USSD network prevents hanging dialogues. Only one dialogue between the network and the mobile device is possible at any one stage. The USSD node often acts as a relay between the mobile device and the external application (Open Mobile Alliance, 2001:11-14).

2.3 Characteristics

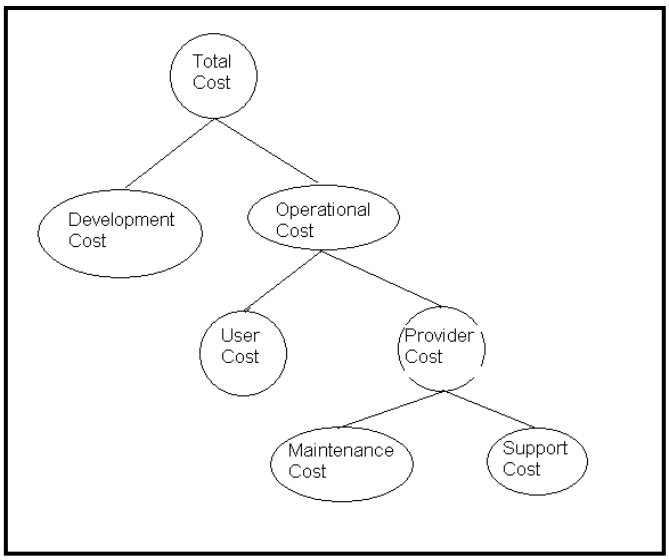
The following characteristics have been identified as applicable to mobile applications:

2.3.1 Cost

Figure 1 shows the different aspects of the cost structure that can be calculated. These aspects may all be different for the different access channels and are therefore important to measure (Janse van Rensburg, 2007). The user cost in the diagram may often be “reversed charged” by the provider, where the provider carries the direct cost, and charges it back to the user in the form of bank charges.

SmartTrust™ (2003:15) indicates that the operational cost for WIG services can be “hot” billed to the user with different tariff classes.

Figure 1: Composition of the cost structure



2.3.2 Security

Security in m-commerce applications is also important. M-commerce applications need to be able to verify the identity of the user. Designers of m-commerce applications need to take this into account (Tarasewich, 2002).

Securing a J2ME application requires security keys, certificates and user identities to be stored within the user device. Mobile operators and Financial Service sectors are likely to find this risk unacceptable. Storing information on a tamper resistant SIM card is much safer (MacDonald et al, 2005:3). The same authors propose a technique by which a combination of J2ME and Java Card technologies can overcome the security limitations.

Since WEB Clipping is unattractive for downloading applications, the chances of it being used to transfer viruses are limited (Foley & Dumigan, 2001:107).

2.3.3 Ubiquity

Wordnet (2006) defines ubiquity as “the state of being everywhere at once”. For the purposes of this research, ubiquity will be defined as the availability of a specific access channel regardless of cellular network or mobile handset.

In order for the convenience characteristic to be realistically measured, the authors had to consider the ubiquity aspect.

2.3.4 Usability

Tarasewich (2002) defines *usability* as the quality of a system with respect to ease of learning, ease of use and user satisfaction. By measuring the time, error rate and user perception while a user perform a certain set of tasks, the usability factor can be determined. A number of methods exist to evaluate the usability of a system.

Tarasewich (2002) states that developers of mobile applications need to decide which protocols they will accept. If they do not, they run the risk of having to support multiple protocols. This in turn comes with the added maintenance problems (Tarasewich, 2002).

Even search engines have to be customised for mobile devices. In 2002 a limited number of search engines had any support for mobile content (Sonera MediaLab, 2002).

3. Pilot study

3.1 Purpose

The purpose of the study was to determine the completeness of the list of access channels and characteristics found during the literature survey. Furthermore, prominent role players in the South African mobile applications marketplace were asked about their knowledge of the different access channels.

3.2 Research questions

The study attempted to answer the following questions:

- Is the list of access channels identified during the literature survey complete?

- How knowledgeable are the role players in the South African marketplace about available access channels?
- Is the list of characteristics identified as important during the literature survey complete?
- How knowledgeable are the role players in the South African marketplace about the different characteristics of the available access channels?
- To what extent do the role players in the South African marketplace agree about the characteristics of each of the access channels?

3.3 Method

A questionnaire was compiled and sent to a number of prominent role players in the South African Mobile Applications marketplace. Based on the experience of Bytheway et al (2003:11), a substantial number of responses were expected.

The target group for the questionnaire was determined by asking a prominent role player in the marketplace about other possible role players that may have valuable feedback. A group of 57 potential respondents was targeted with the questionnaire that was sent by email. Respondents were asked to compare the different technologies based on the different characteristics. They were also requested to order the technologies for each characteristic from most suitable to least suitable.

The questionnaire was designed to obtain the following information from the respondents:

- Whether or not they have knowledge about the technologies.
- Whether there are any other technologies that should be studied that were not yet known by the authors.
- Whether there were any characteristics other than those already identified by the authors that should be studied.
- How each of the technologies rates with regards to each of the characteristics. This measurement is based purely on the opinion of the respondents. A scale was purposefully not given for the ratings. The authors wanted the respondents to order the access channels from best to worst and not to give any indication of how good or bad a channel was.

3.4 Results and interpretation

Figure 1: The distribution of responses received

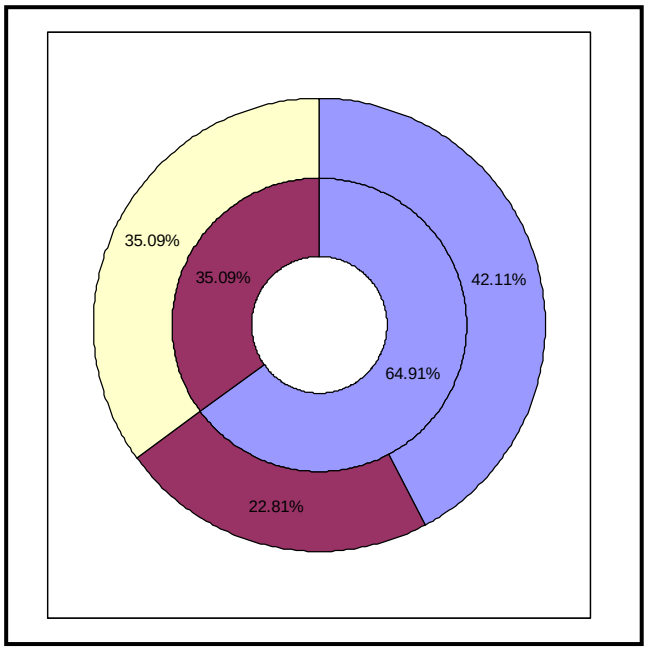


Figure 1 shows the distribution of the responses on the questionnaire. The inner circle indicates the total number of received responses. The outer circle breaks this down further to also indicate the number of completed responses and the number of "incorrectly targeted" responses received. Daily reminders were sent to respondents that have not yet replied. This strategy was successful and a total response rate of 63.16% was achieved. A total of 22.81% of respondents indicated that they were incorrectly targeted or were for some reason not able to complete the survey. That left 40.35% of respondents that completed the survey and supplied data. If the 13 respondents that indicated that they were incorrectly targeted are deducted from the total sample, the response rate is calculated at 52.2% of correctly targeted respondents that supplied data.

The results of the survey were gathered and compiled. A tally was calculated to find the total number of each of the order ratings for each of the characteristics for each of the technologies. These were then compiled onto a number of bar charts for visual representation. For each rated characteristic one chart was created that contains all the ratings given by the respondents.

Figure 2: Respondents' knowledge of access channels

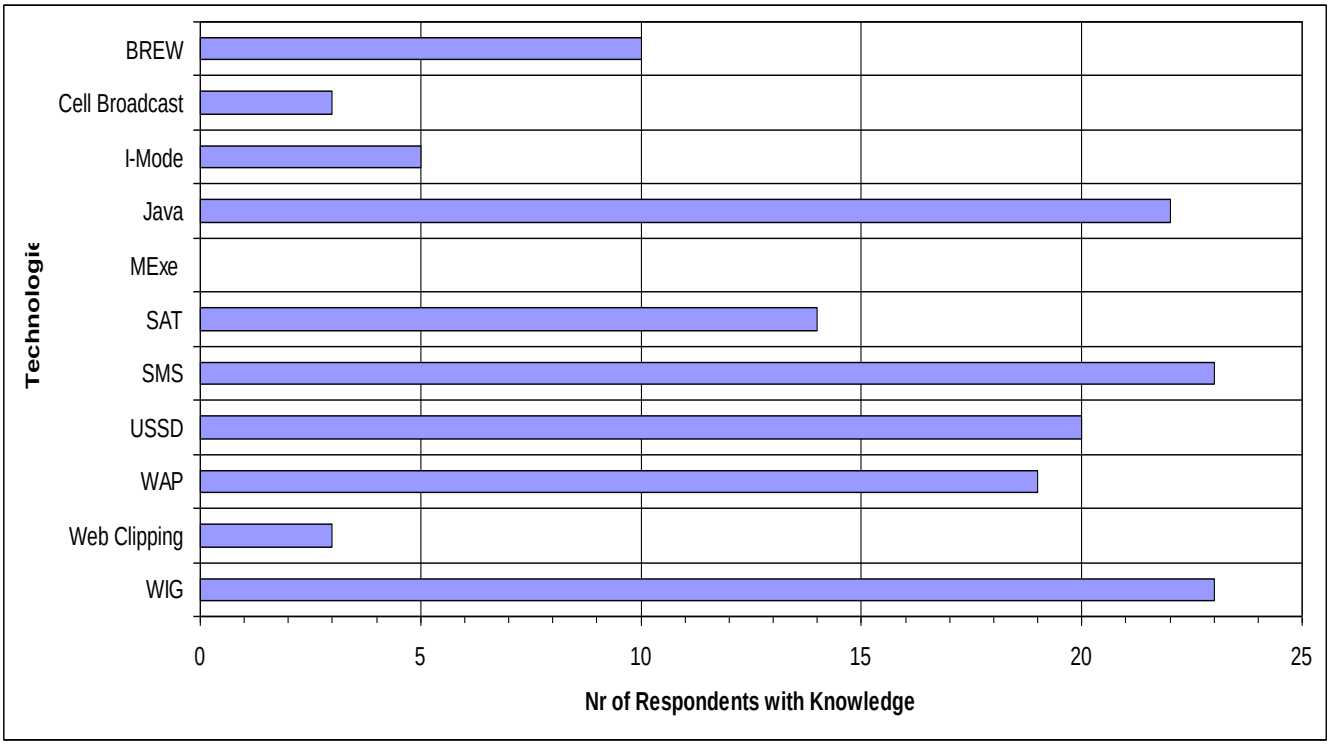


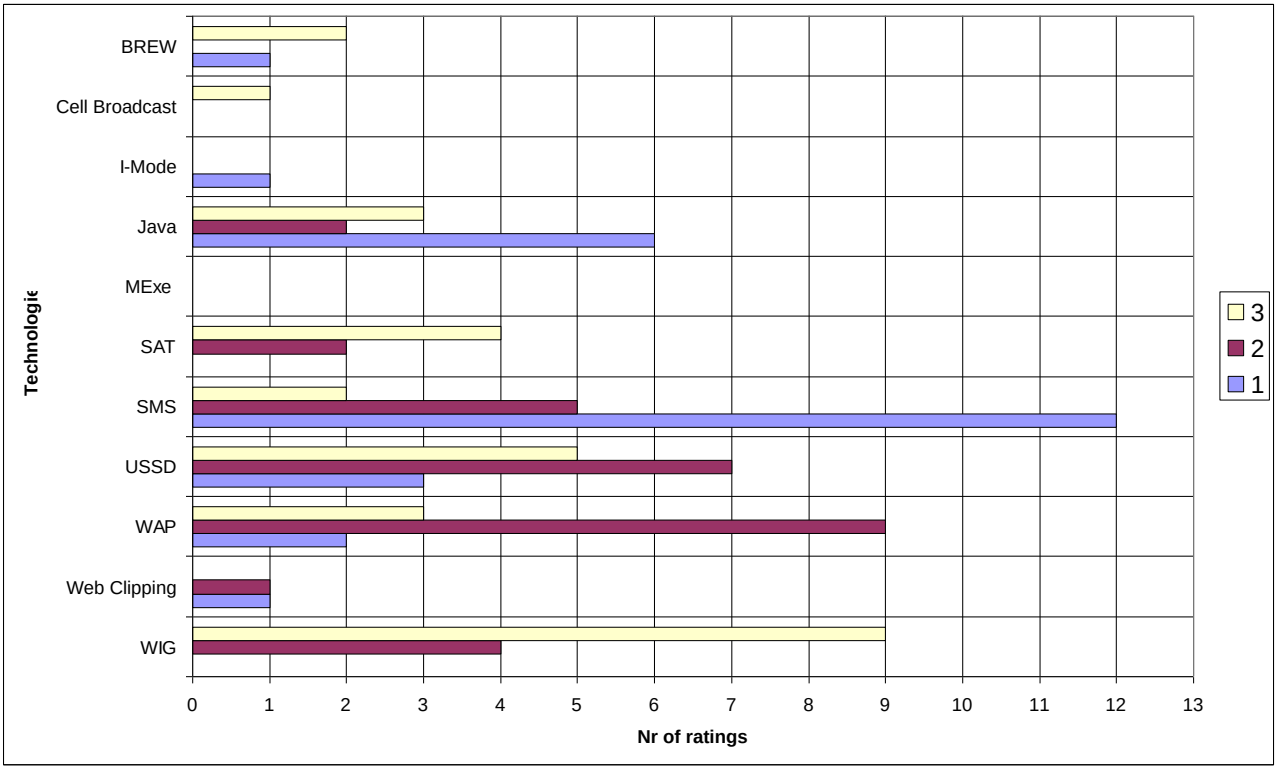
Figure 2 indicates that Java, SMS and WIG are the best-known channels; while MExe, Web Clipping, Cell Broadcast and I-Mode are the least known channels. The distribution of knowledge among the channels are good, for the lowest four, indicating that respondents are fairly well informed about the existence of most access channels that have been identified.

3.4.1. Interpretation of the ratings for the different characteristics

The following graphs (Figures 3 - 8) each represent one characteristic that was rated by the respondents. Each graph contains the first three ratings recorded for each characteristic. Each bar represents a specific rating (1st, 2nd, 3rd, etc) and indicates the number of those ratings recorded for each of the channels. The legend indicates which rating is represented by which colour bar.

In general, a good distribution of one colour bar among the channels, will indicate that respondents are not in agreement about the rating for that specific characteristic among the technologies. Furthermore, the more different colour bars shown for one specific technology, the less the agreement among respondents about the rating for that specific technology. A low distribution of the same colour will indicate agreement among respondents about the rating for a characteristic among the technologies. And finally, a low distribution of colours in one technology will indicate agreement among them about the rating for that technology.

Figure 3: Order ratings for Development Cost for each access channel



From Figure 3, the authors gathered that most respondents considered the SMS channel to be the most cost effective in terms of development. Java had the second most 1st ratings for development cost with USSD significantly fewer and WAP even farther behind. WAP did however gather the most 2nd ratings. This is a strong indication that the respondents are rather uninformed to the development cost of the technologies even though they do all have opinions.

Figure 4: Order ratings or Transactional Cost for each access channel

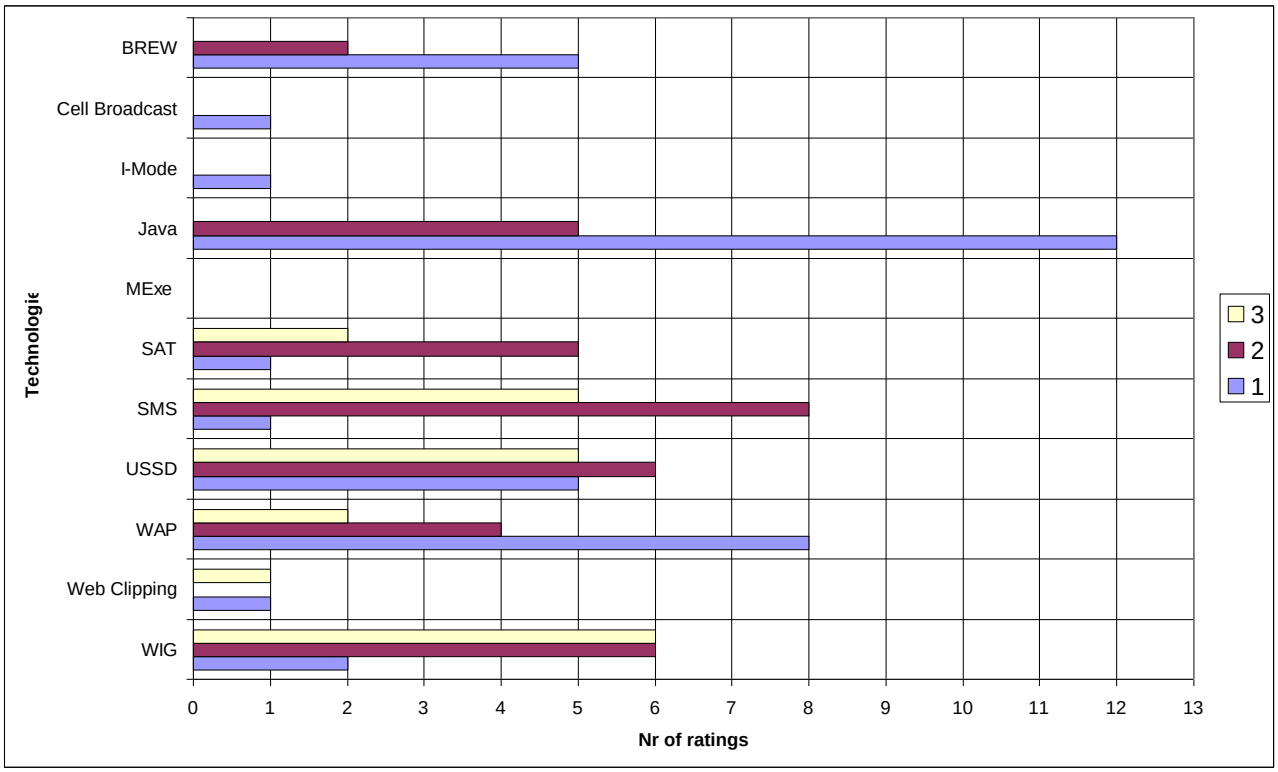
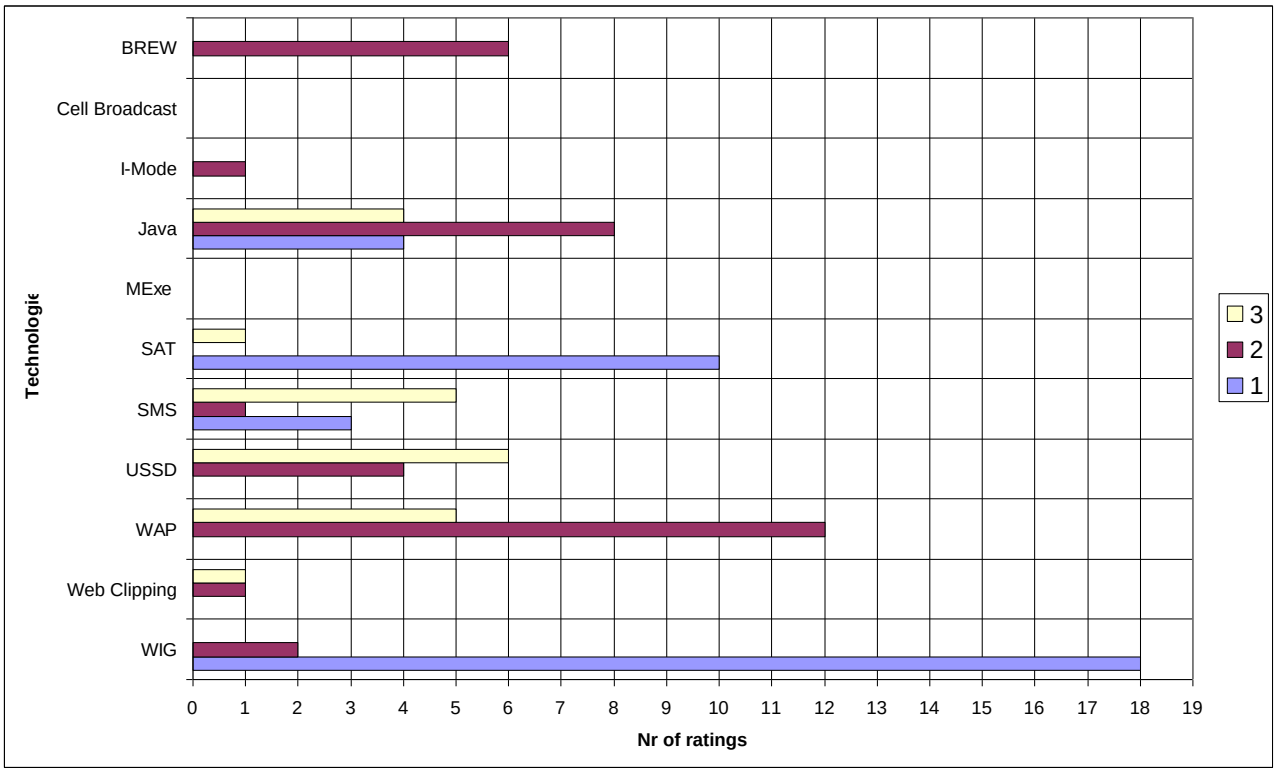


Figure 4 indicates that most respondents seem to be rather well informed and have similar opinions about the transactional cost of the different channels. The distribution still indicates that the responses were based on opinion rather than fact, though.

Figure 5: Order ratings for the Security of each access channel



The authors deduced from Figure 5 that SIM card technologies are generally considered the most secure options. The respondents were consistent in rating WIG the best with a rather high number of 1st ratings given to SAT. WAP and Java were similarly rated the 2nd best options. While USSD received the most 3rd ratings, there is enough distribution to believe that the respondents are not in agreement about the rest of the technologies as far as security is concerned.

Figure 6: Order ratings for Ubiquity on Local (South African) Networks for each access channel

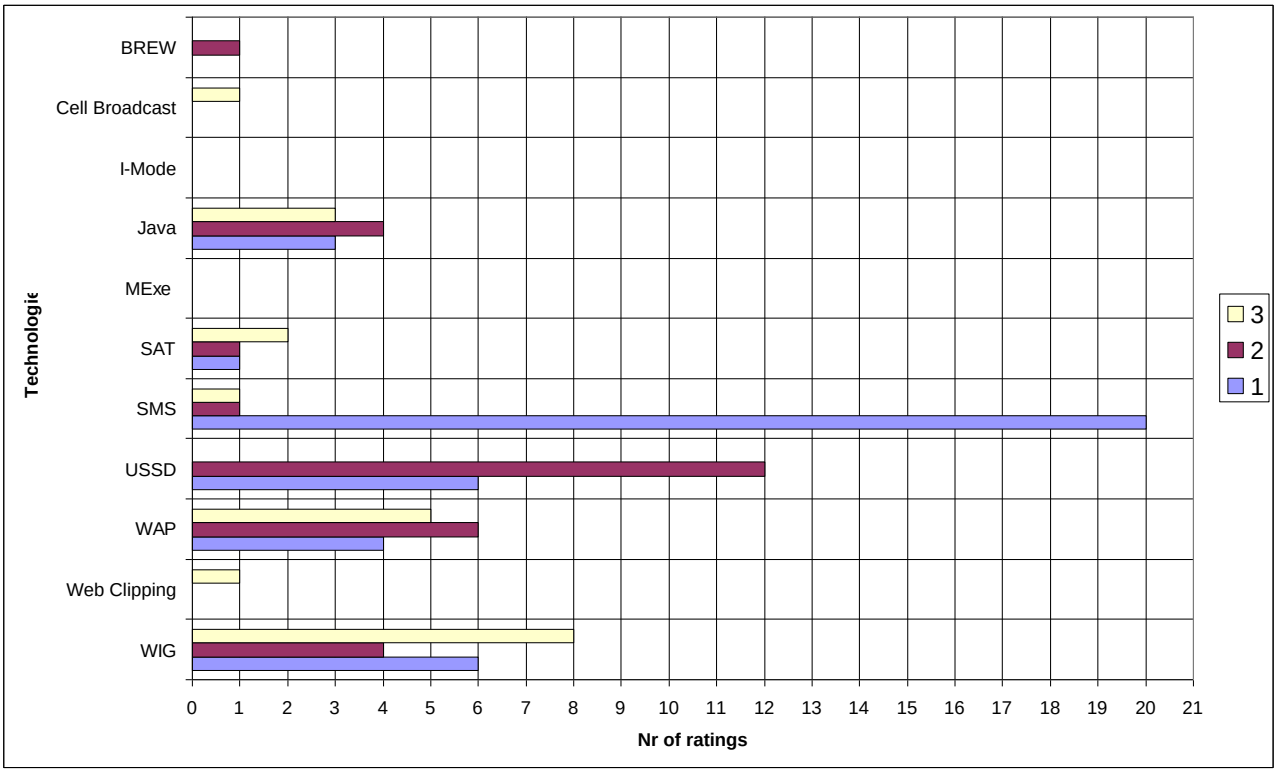
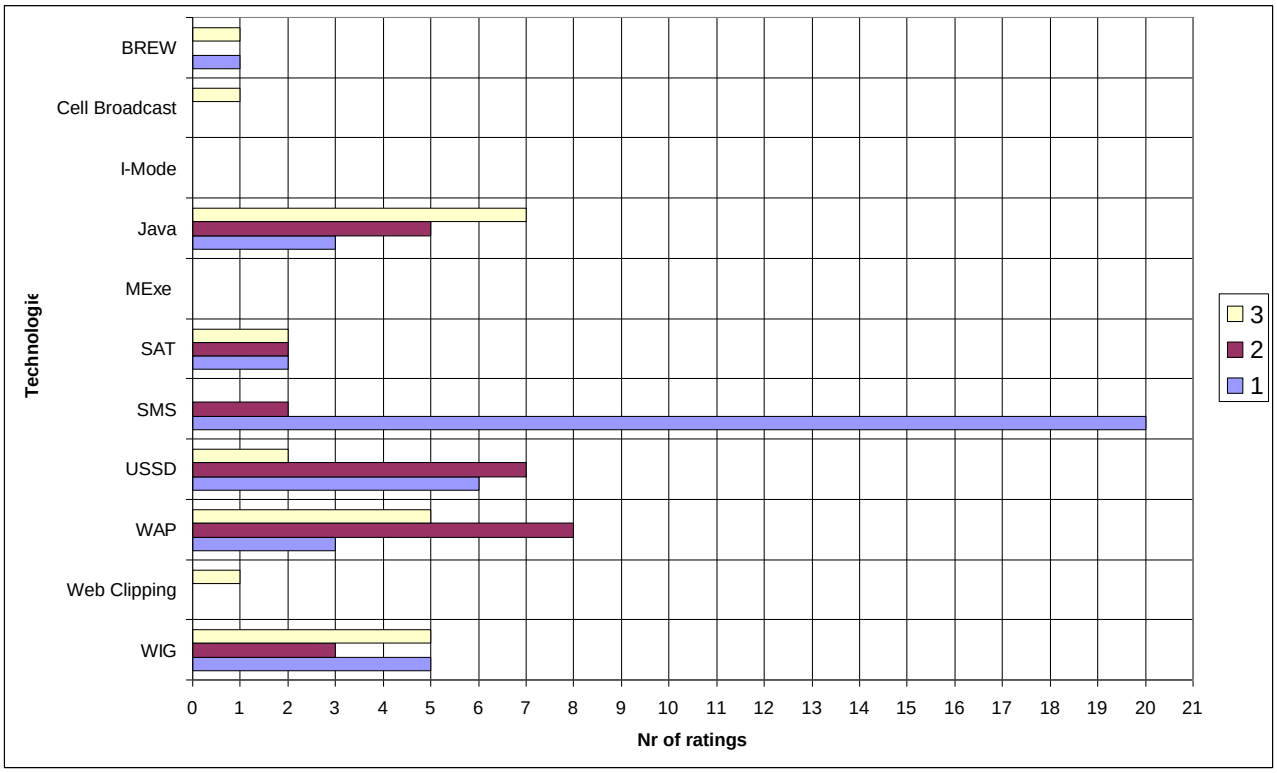


Figure 6 indicates that respondents agree generally that SMS is the most available technology within South African networks, but the distribution indicates that they are not in agreement about any of the other technologies.

Figure 7: Order ratings for World Wide Ubiquity for each access channel



Similar to Figure 6, Figure 7 indicates that respondents are in agreement with the fact that SMS is the most available internationally, but they do not agree significantly about any other technology's availability.

Figure 8: Order ratings for the Usability of each access channel

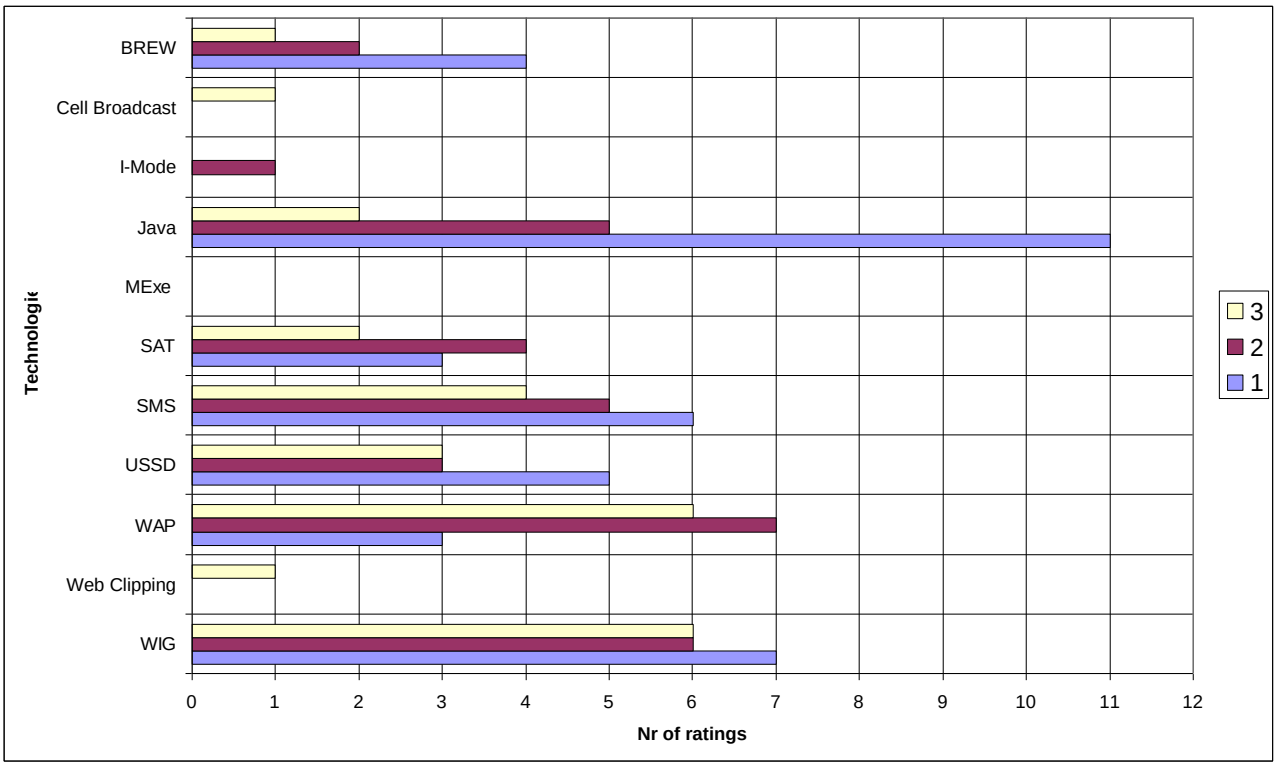


Figure 8 indicates that respondents generally agree that Java is the most usable technology for access channels, but a significant number of 1st ratings were also awarded to the WIG channel. WAP is mostly rated 2nd best, but not with a significant margin. This indicates that respondents are not in agreement about the usability of the channels.

4. Conclusion

During this research, the authors identified the available access channels for mobile applications. A literature survey was done, which revealed the available channels as well as characteristics that would need to be studied in order to choose between the technologies. A survey was conducted among role players in the South African Mobile Applications marketplace to determine how much the respondents knew about the access channels that are available, and their respective characteristics.

The results from the questionnaire indicated that respondents are well informed about a number of access channels, but there are certain characteristics about which they are not in agreement. The ubiquity aspects are best known with security second and transactional cost third. Development cost and usability characteristics are the least known characteristics among respondents.

It is clear that the respondents are not in full agreement about the importance of any specific attribute, which seemed to indicate that their responses were not based on facts but rather on hunches. Further research will be required to measure the characteristics in order to enable role players to make fact-based decisions about access channels.

5. Further research

Further research will have to be conducted in order to scientifically measure each of the characteristics. Such research can then be used to help decision makers to decide which access channels should be supported for their respective applications.

The questionnaire identified one additional access channel that may need to be considered in further research: IM (Instant Messaging).

Two additional characteristics that may need to be considered in further research were also identified by the results of the questionnaire:

- market penetration and
- likelihood of market penetration.

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