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***Using PDAs for economic data collection***
*FINAL*
*March 2005*

**The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government.**

# Data Page

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# Executive Summary

The Department of Statistics is considering using mobile computing devices in data collection related to economic statistics from the field using the hand held PDA “Personal Digital Assistants” computer devices which purchase in early 2003 was supported by the USAID. In response, the ICTI component of AMIR called for this consultancy with the objective of analyzing the scenarios of using PDAs in economic data collection and implementing a pilot project demonstrating this usage, if deemed feasible.

Globally, implementation of PDA's use in field data collection is prevalent in many sectors and specifically in the health sector, yet PDA’s use in conducting economic surveys and census for national department/bureau of statistics is not as ubiquitous. In fact, most such institutions in Europe, Japan, or North America advocates for on-line web based information collection or through digitally filled forms that get exchanged through email. Of course, this trend is strongly tied to the penetration of Internet use among the communities of those countries and to the wide use of PC and digital information. From another perspective, PDAs have been reported to be used successfully in OMAN’s census for the Muscat areas and are being considered for the USA 2010 census.

In the case of Jordan's Department of Statistics (DoS), the use of PDA in data collection is possible. In fact, the most applicable application is the use of PDAs in conducting the monthly gathering of consumer, and industrial price and quantity indices as well as the wholesale price index. Those surveys need timely information gathering and their collection mechanism is well structured. Their forms are rather simple and may easily be computerized into a user-friendly interface on the PDA. Also the real time or daily batch information exchange of collected information makes monitoring of fieldwork progress instant. In addition, PDA use may replace the heavy copybook that are used for data collection, will reduce printing cost and paper usage tremendously, and will cut on mail, travel and per diem expenses as well as data entry human resource expenses. They may also serve as the test run surveys especially since they are short in nature and the results may be realized and perceived fast.

Yet, the major deterrent for PDA use at DoS is the fact that currently PDA technology is in flux and new hardware enhancements and operating environments are continuously offered in the market, at an extremely fast pace, changing the development platforms, offering new functions and communication mechanisms, and making any previous models totally obsolete. This is definitely validated by the fact that the CLIe Sony devices currently in DoS’s possession are now considered 'old' and are even inappropriate for use in field data collection activities.

Consequently a customized system for PDA use in collecting data from the field will be obsolete even before it gets implemented, as better and easier technology evolves rendering the system as 'old'. Any decision for pledging effort and money into such the development of such a system has to be made after weighing the immediate benefits for DoS against putting the investment in this fast changing technology. Based on this, the study concluded that since DoS is not running in 'crisis mode' regarding their field data collection and can bide their time before investing in PDA usage, it is recommended that DoS does not venture into this project currently. It follows that a pilot project at this time is not recommended.

The main report provides additional information and detailed uses of PDA in the field data collection operation at DoS. Moreover it points out additional constraints that should be considered and overcome when using PDAs, most importantly are the need for a well planned communication and data exchange mechanisms in terms of using “always on” real-time wireless connectivity versus batch transmission of data; the need for the data entry interface to be in the Arabic language therefore the operating system used on the PDA must be Arabic-enabled as well; and that the hardware requirements of PDA must be sufficient to allow on the move use of PDA.

# 1. Introduction

The Department of Statistics is considering using mobile computing devices in data collection from the field. The Department had previously acquired USAID support in acquiring hand held PDA "Personal Digital Assistants" computer devices to use them in field data collection related to economic statistics. Those PDA of type Sony CLIe' PEG – S 360 have been in possession of DoS since early 2003 but were not put to use due to lack of funds to develop the needed software for field data collection.

Currently, the ICTI component would like to investigate supporting DoS in using PDAs for field data collection utilizing the existing PDAs if possible, as well as implementing a pilot project to demonstrate this usage whenever recommended. Therefore, the objective of this consultancy spans two phases. First phase aims to analyze the scenarios of using PDAs in economic data collection, present usage options to stakeholders, provide recommendations for pilot project, and develop a business case and present to stakeholders.

The second phase will be the implementation of the selected pilot project and report on the findings from the pilot project including issues, risks, recommendations and future implementation plans.

## 1.1. Personal Digital Assistants

Personal Digital Assistants, Handhelds, Palmtops and Palm Pilots are all terms referring to pocket sized computer devices that make computing tasks more portable and flexible by being small enough to fit into one's pocket and mobile to be used anywhere. PDAs are used for a variety of personal and professional uses. Basic functions of a PDA include an electronic diary, address book, to-do-list, notepad, calculator, expense tracker and alarm clock. Most recently they are acting more like a PC with operating systems allowing for software that enables the PDA to be used for: word processing, spreadsheets, sending and receiving e-mail, downloading information from the Internet and giving presentations. Advances in telecommunications have also made their impact on PDAs such that now they are equipped with cellular phones capability, GPRS, Bluetooth and infra-red connectivity making use of the wireless telecommunication technology. In addition, PDAs are designed to work with a laptop or desktop computer that connects to the PDA via a synching cradle or Infrared beam/Bluetooth connection.

The two major Operating Systems for PDAs are Palm OS, and Windows CE. Examples of manufacturers of PDA models using the Palm Operating system include Palm, Handspring and Sony. Microsoft entered the PDA market with the Windows CE operating system, which is termed Pocket PC. Compaq, Casio, HP and Toshiba are examples of manufacturers of the most popular PocketPC devices.

There are several important trends that are ongoing in the mobile computer market.
Some of these include:

- The trend towards miniaturization where devices such as the palm pilot, mininotebook, and cell phone are assuming more of the functionality traditionally provided by the full size notebook for the mobile user. Functionality such as voice-mail, email, and web access are being provided on these miniature devices.
- Improved communications capabilities where wireless communications at higher speeds are becoming available at lower costs. Communications utilizing wireless LAN, and GPRS/GSM are enabling the PDA to act as a mobile phone, and a PC at the same time and allowing the mobile user to utilize the web as a tool for communications and conducting business.
- Incorporation of multimedia technologies. The availability of high quality color display, digital audio, and mass storage options allows mobile users to access video and audio content, thus enabling the delivery of content rich information to mobile users.
- Use of voice and pen input in conjunction with handwriting and speech recognition software
- Development of Bluetooth technology featuring radio transmission that can penetrate solid objects and communicate with several devices simultaneously. The key advantage of this technology is the ability to synchronize devices and peripherals without having a clear line of sight, or physical cable, between the devices.
- Development of user friendly operating system environments that are more similar to PC and as such more familiar to the user.

## 2. Analysis of PDA Usage in Data Collection

The use of PDA in data collection is widespread. The health sector has pioneered this use and now PDAs are highly used for collecting health-related information from the patient at his bedside for example, as much as for using PDA to access drug and clinical reference information at the point of care by healthcare professionals. This use of PDA in data capturing has spread rapidly to almost all industries that need to collect and access information in the field. Consequently, many mobile applications utilizing the new mobile operating systems on the PDA are now in the market facilitating aspects such as developing forms for data entry using the PDA, exchange of digital information, and mobile mapping and geographic information systems allowing the use of map and GPS among others. Examples of such software are UpToDate, Infotriever, FieldWorker, ArcPad-ESRI, and Mobile Memoire.

Yet, information about PDAs use in conducting economic surveys and census for national department/bureau of statistics is not as ubiquitous. In fact, most such institutions in Europe, Japan, or North America advocates for on-line web based collection of information or information filled digitally in forms and exchanged through email. This trend is strongly tied to the penetration of Internet use among the communities of those countries and to the wide use of PC and digital information. Still, PDAs have been reported to be used in OMAN's census operation and are being considered for the USA 2010 census.

In Oman, PDAs were specifically used in the census operation. They were tried in Muscat area and proved to be successful. In fact, using minimal resources, the census information for

that area, was cleaned, analyzed, and reported long before the actual data collection from the field of any other area in Oman was completed.

The USA Bureau of Census has gone to great lengths in studying the use of PDA in the upcoming 2010 census. PDAs in fact were major contributors to the re-engineering of their decennial census program, which is using the following points as the main guiding goals:

1. Increase the relevance and timeliness of census long-form data.
2. Reduce operational risk.
3. Improve the coverage accuracy of the census.
4. Contain costs.

To help achieving these goals, PDA will be used by the US Bureau of Census in two major data collection operations:

- The first utilizes PDA in updating the addresses of houses and buildings under the MAF/TIGER Enhancements Program – A multi-year effort to enhance and improve the existing Master Address File (MAF) and geographic information system (known as TIGER) by bringing them into alignment with true global positioning system (GPS) coordinates. Field staff conducting this address canvassing will use GPS-equipped PDA to obtain their assignments, navigate to assignment areas and locate and update address information for housing units through capturing the proper GPS coordinates, which in turn will be streamlined through the electronic transfer of address information directly into headquarters processing systems to update the maps, and record the data they collect.

- The second operation where PDA will be utilized is the actual collection of the census information using an electronic short form. This use of a short census data collection form is made possible because of an on-going household survey that was designed to collect and tabulate census long-form data every year throughout the decade. The existence of this survey eliminates the need to collect long-form data in 2010, therefore the 2010 Census is now able to use a short form on the PDA to collect timely information and focus on coverage.

The same PDA devices that were used to update the address frame will be used for the above-mentioned data collections and for non-response follow-up, improving the accuracy and efficiencies of this critical and expensive operation. Field staff will be using the GPS-equipped PDAs to assist with navigation and reduce the time needed to complete their assignments. PDA will also be used to conduct interviews, transmit the data directly to headquarters for processing, and receive regularly updated field assignments.

Through the use of automation and PDAs, the Bureau of Census expects to significantly reduce the amount of paper used in the field (including questionnaires, address registers, maps, assignment sheets, and payroll forms) and the large number of staff and amount of office space required to handle that paper. In addition, it expects to be able to reduce the clerical and administrative staff costs by as much as fifty percent.

Moreover, the Bureau will provide enumerators with their cases and assignment areas, along with geographic information from the MAF/TIGER system that will allow them to travel to and within their assignment areas efficiently, reducing time and mileage. Enumerators will also have GPS data and electronic maps on their PDAs. They will conduct interviews and record the information electronically and transmit data and administrative information on a daily basis, so that the information is quickly available both to the headquarters processing

systems and to the daily payroll and progress reporting systems. They also will receive updated assignments and instructions on the same daily basis.

Consequently, the PDA is used in a two-way approach where instructions are sent from head office to the field enumerator, and collected information, as well as information of completed assignments, per diems and other costs are uploaded back to the head office using the PDA as the medium. This two-way communication is done daily in a batch mode, and as such the PDA is an instrument that helps 1) in electronic data collection and 2) in controlling and managing the data collection operation.

In brief, PDA use in data collection in the field reduces costs, paper usage, and eliminates the time needed for keying data. It will increase the efficiency and control of the field work, improve the coverage of housing units, and provide collected information in a timely manner and in electronic form ready for compilation and further analysis. Moreover, control of the field operation is tremendously improved. Duplication of visits, missed housing units, and cost control are monitored and rectified immediately.

## 3. The Jordan's Department of Statistics

### 3.1. Surveying Activities

The Department of Statistics is responsible for providing data that reflect the socio-economic and demographic situation of Jordan. Nineteen major surveying activities are conducted as follows:

| Survey Activity | Periodicity |
|---|---|
| 1. Indices | |
| Consumer Price Index (CPI) | Monthly |
| Industrial Producer Price Index (IPPI) | Monthly |
| Industrial Production Index (IPI) | Monthly |
| Wholesale Price Index (WPI) | Monthly |
| Housing Price Index (HPI) | Monthly |
| 2. Agricultural Prices Survey | Monthly |
| 3. Wholesale and Retail trade | Quarterly and Annual |
| 4. Construction Statistics Survey | Quarterly and Annual |
| 5. Industrial Survey | Quarterly and Annual |
| 6. Employment and Unemployment Survey | Quarterly and Annual |
| 7. Agricultural Statistics | Annual |
| 8. Livestock Survey | Annual |
| 9. Environmental Statistics | Annual |
| 10. Transport, Storage and Communications Survey | Annual |
| 11. Employment Survey for Establishments Engaging 5 employees or More | Annual |
| 12. Services Survey | Annual |
| 13. External Trade Statistics | Annual |
| 14. Jordan Annual Fertility Survey | Quinquennial |
| 15. Household Income and Expenditure Survey | Quinquennial |
| 16. Population and Family Health Survey | Quinquennial |
| 17. Industrial Census | Quinquennial |
| 18. Agricultural Census | Quinquennial |
| 19. Arrivals and Departures Survey | Ad hoc |

- Agricultural Statistics: Provides data on cultivated area, number of trees by type, irrigation methods used, number of hired labor, farm gate prices, input prices, marketing costs, and preferable places for marketing etc..

- Livestock Survey: Provides data on number and characteristics of livestock by kind, breed, age, as well as data on livestock productions inputs, expenditures, quantity and value of production, number of employees etc..

- Environmental Statistics: Provides data on environmental indicators related to main environmental elements including water, air, soil, as well as data on pollutants.

- Construction statistics: Provides data on activities of the construction sector, workers, capital formation, building licenses, building materials, progress in construction of building, etc..

- Employment in Establishments Survey: Provides data on number of employees in public and private sector and their characteristics such as nationality, age, wages, education level, economic activity, etc..

- Price Indices: provides information on Consumer Price Index, Wholesale Price Index, Industrial Producer Price Index and Industrial Production Index.

- Services Survey: Provides data on number of establishments and employees and their characteristics such as occupation, compensations, and consumption. It also provides information about the size of investment, capital, etc.

- Industrial Survey: Provides data on number of industrial establishments and employees and their characteristics such as occupation, compensations, and consumption. It also provides information about the size of investment, capital, etc.

- Transport, Telecommunication and Storage Survey: Provides data on number of establishments and number of vehicles and employees and their characteristics such as occupation, compensations, and consumption. It also provides information about the size of investment, capital.

- Wholesale and Retail Trade Survey: Provides data related to internal trade for use in national accounts estimates and in price wholesale trade, employment, compensation of employees, and invested capital, purchases and sale, changes in stock, etc.

- Employment and unemployment survey: Provides data on Jordanian labor force and their demographics, socio-economic characteristics, etc..

- Annual Fertility Survey: provides data on reproduction, family planning, child mortality, characteristics of surveyed women, practices, etc.

### 3.2. Constraints on PDAs in Field Data Collection

*It must be clearly stated that PDA technology is in flux. Hardware enhancements and new operating environments are continuously offered and are quickly offered on the market thus*

*changing platform and making the previous models obsolete. This makes any long term investment in projects that depend on the technology of such instruments uncertain in nature.*

In addition, using PDAs in field data collection and surveys has its limitations as detailed below.

***1) Communication and data exchange***

The wireless GPRS-based Web combined with PDAs can facilitate exchange of data and information needed to conduct field operations and allow instant access to the collected data and transmit enumerators' assignments or update their payroll information. This data exchange using the Web can be done in real-time or batch mode. Real-time data exchange involves costs related to "always on" real-time wireless connectivity[1] and may suffer from unreliability since the available transmission rates may not facilitate timely and reliable transmission of information.

Therefore, the manner data is to be exchanged: wireless real-time versus wired batch processing must be considered properly. Real-time transmission of data collected from field operations needs to take into account the availability, cost per minute, and the reliability of a wireless connection, while batch processing can help work around problems with poor cellular coverage and high connection cost, and used when real-time transmission is not of real importance to the success of the operation. Also, both methods maybe considered together allowing enumerators to use the local network or their landline for information synchronization data exchange over the Web; and to connect via wireless GPRS-based connection when they are on the go and need timely information.

Moreover, data storage and data transmission rates limit the utility of PDAs in mobile applications. Memory capacity for data storage should be traded off against the "always on" wireless connection solution. If, for example, processing of collected data is done on a remote Web-server, then the memory and storage requirements are less on the PDA. If the processing is done locally on the PDA, then there are more demands on the device. However, the former scenario needs to trade against transmission cost to deliver the data back to a Web-server when an "always on" wireless connection throughout the workday is adopted.

Another issue regarding transmitting data in real time versus batch is the ability to interface and connect to the Web. If no coverage exists, then data must be synced in a service area and cannot be retrieved or transmitted in real-time. If a Web-based environment is used, then a backup plan must be implemented for when there is no connectivity. Such a plan might involve capturing a snapshot of the state of the Web environment for when wireless connectivity is unavailable. The information would then have to be re-synced when connectivity is resumed.

[1] The GPRS based connection in Jordan cost 1 fils per 1KB of data transfer.

Therefore, a decision at the onset of any project for data collection must properly consider and weigh the need for real time interchange of information versus batch processing.

***2) Type of data collected***

Most PDAs operate using a small screen and a stylus. This necessitates that the data to be collected to be in numeric form or multiple-choice based selection. Open-ended questions where the enumerator needs to "write-in" the answer must be avoided. Thereby, the form used for data collection must be user-friendly and rendered to fit for viewing on small screen. It should make use of radio buttons and check boxes, and allow for numeric data entry and drop down selection lists.

***3) Arabic enabled operating system***

Interface has to be in the Arabic language therefore the operating system used on the PDA must be Arabic-enabled as well.

***4) Hardware requirements of PDA***

Being on the move and using PDA for data collection requires that the device have a long-life battery, offer the possibility for recharging from a car-battery, or use of a back up battery. In specific, the device must have sufficient battery power to support 8 hours of fieldwork when fully loaded and operational.

Above also combines with the fact that the PDA should allow for the use of external storage (such as either built-in Secure Digital (SD) slot and/or a CFA compliant Compact Flash (CF) expansion slot, memory stick, etc..) which may be used to store information in-between recharging operations. The device must also have sufficient internal program memory and processing capabilities sufficient to support the software applications needed for security login, data transmission, assignment management, interviewing (questionnaire) instruments, and database. It should also run an easy-to-understand operating system, and should feature a 56K modem or a GPRS capability in order to support retrieval and transmission of completed work done.

## 3.3. Potential surveys using PDA

Most of the above surveys share the general characteristic of having questionnaires that require the entry of numeric data or involve multiple-choice answers, and have the name of the establishment/housing unit to be surveyed (such as the case in the construction survey and prices indices surveys) predefined and with a known address. The exception are the employment and unemployment survey and annual fertility surveys which have questionnaires requiring open-ended answers and names that have to be written in.

Therefore, PDA may be used in data gathering for most of the surveys carried out by DoS. PDAs are particularly useful in the quarterly construction surveys were location of establishment may be mapped out and its previously gathered information loaded to the PDA for the enumerator to review in his next visit. Also PDAs could be instrumental in conducting the monthly gathering of consumer, and industrial price and quantity indices as well as the wholesale price index.

It must be noted that DoS has investigated the use of PDA in the upcoming census of 2004. This extensive investigation resulted in the following issues which were considered as major obstacles to the possibility of their use:

1- Use of portable devices requires training of enumerators (15,000 enumerator employed for the census)
2- The device needs recharging during the day which may be difficult. Use of batteries is expensive.
3- The enumerator work will be halted if the device becomes inoperable for some reason.
4- Possibility of data loss and erasure of information from device's memory.
5- Certain fields in the questionnaire need to be coded (open ended questions) before their digital entry to the database so PDA's use is not appropriate in gathering such long-form answers.
6- The need to set up a hotline for technical support.

The given recommendation was that PDAs be used first in surveys requiring smaller samples in order to test their applicability before using them in census.

### 3.4. The Existing PDAs at DoS

With funding from USAID, DoS acquired 15 units of Sony PEG-S360 Clie Handheld. Following are its main specifications:

| | |
|---|---|
| - Operating System and Software: | Palm OS 4.0 |
| - Display Resolution: | 160 x 160 monochrome |
| - Installed Memory: | 16 MB |
| - Installed ROM: | 4 MB |
| - Processor Speed: | 33 MHz |
| - Input Method: | Touch-screen, Jog Dial, Stylus |
| - *Power* | |
| Average Battery Life: | 15 Days at 30 minutes a day |
| Battery Technology: | Lithium ion |
| - *Communications* | |
| Slot Types Provided: | Memory Stick |
| Wireless Connectivity: | IrDA |
| Interface Provided: | 1 x infrared - IrDA,<br>1 x USB - 4 pin USB Type A |

No modem or GPRS is provided. An external modem - SONY PEGA-MD700 Modem for CLIE PDA - 56K analog modem for Sony that is Powered by optional AC adapter or optional AAA batteries is available at US$ 129 at maximum.

In comparison with the required specifications for a PDA that may be used in data collection the above handheld Sony device falls short on battery life, and modem connection. At most

the battery provides 7.5 hours of continuous use. Once the battery dies, all the information on the PDA is gone. This in turn necessitate that the PDA synchronizes with a PC to safeguard its contents (e.g. the application executable, the database, etc..) Also the varied use of the PDA means that battery life will always be unpredictable. Also the S360's lithium ion battery is sealed inside and can't be removed, which means that no backup rechargeable battery can be used.

As for memory stick expansion Sony Clie PDA relies on a proprietary system of memory sticks that only works on Sony machines - and are therefore harder to find and more expensive.

This PDA also does not feature an internal modem or GPRS connection. To be able to connect to a main server or send and receive information through the Internet, an external modem device – mentioned above - should be purchased. It should also be mentioned that this item is discontinued, and its performance does not boast good reviews.

In conclusion, the existing PDA do not seem to be appropriate for use in the field and new PDAs should be considered. ***This is also an indication to the fast changes in the PDA technology as mentioned above.***

If the existing PDAs are to be used, thorough testing of the PDA battery use should be carried out before any attempt to develop any application around it. Also the modem accessory should be purchased and tested as well before any

### 3.5. The Existing Technology Infrastructure at DoS

Currently DoS has the following technological infrastructure:

1) A UNIX 450 Sun 1000 Sparc Oracle version 7.3.4 database server
2) A UNIX 450 Sun 1000 Sparc Oracle version 8i database server
3) A UNIX Ultra 450 Sun email server
4) A UNIX 450 Sun - Firewall
5) A Windows NT Server
6) A leased line through the Royal Geographic Center supplied by NITC.

## 4. Recommendation for PDAs Application

*Investment in the new technology of PDAs needs careful consideration due to the volatile nature of the product. Even though using PDA in collecting any of the above indices is feasible and development of the computerized system around the existing PDA technology is possible, yet it should be pointed out that both the PDA and the system will be 'old' within a year as better and easier technology that provides new functions for the PDA may be on the market. Investing in a pilot project at this time is not recommended; and any decision for doing so has to be made after weighing the immediate benefits as viewed by DoS against putting investment in a changing technology.*

Therefore if DoS is still interested and willing to invest in a new and changing technology of PDAs on the market even after considering all above-mentioned constraints in using PDAs in field data collection, then the most feasible first application for PDAs at Dos, and at this time,

would be in the collection of Indices (Consumer Price Index -CPI[2], Industrial Producers Price Index –IPPI [3], Industrial Production Index – IPI [4], and Wholesale Price Index –WPI [5]) for the following reasons:

1- The small number of enumerators employed to gather data from the field: This reflects on lower training cost and smaller investment in PDAs upgrade or new purchase.

   Around 15 enumerators are employed to gather monthly information for the CPI covering the 12 Governorates in Jordan. Three enumerators to cover Amman Governorate, 2 to cover Irbid, and 10 enumerators to cover the rest with 1 assigned for each Governorate.

   Only 2 enumerators are used to collect monthly information for the IPPI, and IPI from industrial establishments in Jordan.

   Only 1 enumerator is used to collect monthly information for the WPI from industrial wholesalers in Jordan.

2- The sampled establishments from which prices are collected are known by name and location, and their number is finite. The housing units which rents are gauged are also fixed and their location known. Such sample units change every five years depending on the completion of new censuses and they rarely require amendments. This translates in the possibility of pre-defining names and contacts on the database of the application to be chosen by the enumerator in a pull-down list vs. being entered.

   Of course, every Governorate has its own roster of establishments and houses that the enumerator surveys every month for CPI.

   The industrial indices are gathered from 200 establishments, and the wholesale index is gathered from 233 establishments.

3- The items which prices/ quantities are collected every month to produce the CPI, WPI, IPI and IIPI are fixed, and well defined. This translates in the possibility of pre-defining items' names in the application database to be chosen by the enumerator in a pull-down list vs. being entered.

[2] The Consumer Price Index is a measure of the rate of price change for goods and services bought by Jordanian consumers. It is the most widely used indicator of price changes. It is obtained by comparing, through time, the cost of a fixed basket of commodities purchased by Jordanian consumers in a particular year. Since the basket contains commodities of unchanging or equivalent quantity and quality, the index reflects only pure price movements.

[3] Industrial Product Price Indexes measure the changes in prices received by Jordanian manufacturers for goods as they leave the factory gate. Indirect taxes, transportation, wholesale and retail costs are not included in the price. The prices included in the PPI are from the first commercial transaction for many products and some services.

[4] Industrial Production Indexes measure the changes over time in quantities of production achieved by Jordanian manufacturers for goods they produce.

[5] Wholesale Price Index measures changes in the prices charged by http://www.britannica.com/needmorehttp://www.britannica.com/needmorewholesalers. Wholesale price indexes measure the changes in commodity prices at a selected stage or stages before goods reach the retail level; the prices charged by wholesalers to retailers.

The CPI is based on a fixed basket of consumer products that includes 800 items. Those products are combined under four major categories and 37 sub-categories. The major categories are Food, Clothing and Footwear, Housing, Other Services (Education, Transportation, personal care, etc.)

The IPI and IPPI are based on a fixed basket of 205 and the WPI on 233 items.

4- The type of collected data is numeric in nature. The form of data entry is very simple. This numeric simple form is very well suited for PDA use.

5- The information of indices must be published every month, except for the WPI, which requires quarterly publication. This in turn affects the collection cycle as follows:
   - For the CPI the collection has to be done on monthly bases. The price fluctuating food stuff such as vegetables and poultry are surveyed four times a month every Tuesday; the other food items must be collected during the first week of the month. The clothing and footwear items are collected during the second week of the month; the rest of the items are collected over the last two weeks of the month.
   - Housing rent information is collected for specific sample of house units every 6 months; Information of other non-changing category items such as education is collected once a year.
   - Prices of wholesale items are collected every month yet published quarterly

6- The need to produce the indices on monthly bases requires that the enumerators deliver their collected information promptly every month. Therefore, every enumerator travels to DoS offices in Amman or to the nearest DoS bureau around him, at the end of each month to deliver the data collection copybooks and receive new instructions if any. Copybooks from remote DoS bureaus will be send to Head office by the DoS mail pouch. The enumerator waits for the officers at DoS to finish data checking to receive back the copybooks and return to his governorate and location of work and restarts data collection for the next month cycle.

   Upon receipt of the collected information two employees at DoS are employed for 3 days to enter the information in Excel datasheets. The numbers are then crunched and analyzed through Excel and the Price Indices are published on the 5$^{th}$ of each month.

   Consequently, with PDA use in data collection from the field, data will be ready digitally and the enumerators will send the information back to DoS either on a daily bases – in batch mode, or if a GPRS connection is utilized, will update the numbers immediately within the database residing on the main server. This will cancel the need to make a trip to DoS offices every month, and the time for data checking and data entry.

   The readily available data will allow for timely and immediate computerized Index generation, right at the end of the month.

7- Monitoring of the enumerators in the field is currently done sporadically. A supervisor is sent to the field on ad hoc bases and when circumstances allow. There is no constant method to monitor progress and timing of data collection and to ensure proper collection from each and every establishment in the sample.

Upon PDA use in data collection, the real time or daily batch information exchange of collected information makes monitoring of fieldwork progress instant. Also any instructions or changes in sample may be immediately communicated back to the enumerator in the field instead of waiting for the end of month meeting.

8- In short, above surveys need timely information gathering and their collection mechanism is well structured. Their forms are rather simple and may easily be computerized into a user-friendly interface on the PDA. Using PDA in the price index field data collection will definitely serve as and entry point to the computerized data collection mechanism that may be adopted in the other survey activities in DoS. They may serve as the test run surveys especially since they are short in nature and the results may be realized and perceived fast.

9- From another perspective, the use of PDAs will centralize the collected information and make it available to other DoS users. Currently it is in Excel spreadsheets located on one of the computers within the section responsible for price indices, and not in a database on the central server, which can be queried by other DoS users.

10- In addition, PDA use will replace the heavy copybook that are used for data collection, will reduce printing cost and paper usage tremendously, and will cut on mail, travel and per diem expenses as well as data entry human resource expenses. The total estimated monthly cost of data collection for the Consumer Price Index only stands at the rough estimate of JD 230 [6] per month or JD 2,760 annually.

[6] Cost includes: Paper cost of around JD 90 + per diems for south region enumerators of around JD 80 + 6 days of data entry cost of around JD 60

## ANNEX A
## PDA Information

Most PDAs on the market are the familiar tablet-with-stylus types that feature a squarish display screen, a design pioneered by Palm, Inc. (now called PalmOne). Today the main choices are models that use the Palm operating system (OS)--mostly PalmOne and Sony models--and PocketPC devices from companies such as Dell, Hewlett-Packard, and Toshiba. The latter use a stripped-down version of Microsoft Windows. A few PDAs use a proprietary operating system. Kyocera, Nokia, Samsung, and Sony Ericsson offer units that combine a cell phone and a PDA.

Handspring, Kyocera, Nokia, and Samsung offer units that combine a cell phone and PDA.

**Palm OS systems.** Equipped with software to link with Windows and (for PalmOne-brand units) Macintosh computers, PalmOne units and their clones have a simple user interface. You use a stylus to enter data on the units by tapping an onscreen keyboard or writing in a shorthand known as Graffiti. Or you can download data from your computer. Most Palm OS-based PDAs can synchronize with a variety of desktop e-mail programs, such as Outlook Express and Eudora. (PalmOne models with VersaMail software are good at handling e-mails with attachments.) And all include a basic personal-information-management (PIM) application. Palm OS units are easy to use, although navigation between different programs is cumbersome because of the operating system's "single-tasking" nature.

Models with a backlit monochrome display (now scarce) are easy to read under normal lighting conditions and are very easy on batteries. Units that have a color display use a rechargeable lithium-ion battery, some of which must be recharged after just a few hours of continuous use. Most models make it difficult or impossible to replace the battery yourself. And beyond the warranty period, you can't be sure the manufacturer will do it for you.

The latest Palm OS models typically have expansion slots that let you add memory or attach separately purchased accessories. All Palm OS-based PDAs can be enhanced by adding third-party software applications--the more free memory that a model comes with, the more software it can accommodate. There is a large body of Palm OS-compatible freeware, shareware, and commercial software available for download at such sites as *www.palmgear.com.* Many Palm models come with "Documents to Go," word-processing and spreadsheet software similar to that used in Pocket PCs, but more versatile.

Price range: about $100 to $800.

**Pocket PC systems.** These resemble Palm OS-based models but are more like miniature computers. They have a processor with extra horsepower and come with familiar applications such as a word processor and a spreadsheet. Included is a scaled-down version of Internet

Explorer, plus voice-recording and perhaps some financial functions. The included e-mail program handles Word and Excel attachments easily. Also standard is an application that plays MP3 music files, as well as Microsoft Reader, an eBook application.

As you might expect, all the application software included in a Pocket PC integrates well with the Windows computer environment. You need to purchase third-party software to use a Mac. And you'll need Microsoft Office programs such as Word, Excel, and Outlook on your computer to exchange data with a PDA. Pocket PCs have a color display and rechargeable lithium-ion batteries. Unlike most Palm OS-based PDAs, replacing the battery of most Pocket PCs is usually straightforward.

Price range: $200 to $700.

**IMPORTANT FEATURES**

Whichever operating system your PDA uses, you may need to install programs in your computer to enable the PDA to synchronize with it. This software lets you swap data with leading PIM programs such as Lotus Organizer or Microsoft Outlook.

**Most PDAs have the tools for basic tasks:** a **calendar** to keep track of your appointments; **contact/address software** for addresses and phone numbers, **tasks/to-do lists** for reminders and keeping track of errands, and a calculator. A **notes/memo function** lets you make quick notes to yourself. Other capabilities include word-processing, spreadsheet, and e-mail functions. **A** voice recorder, **which uses a built-in microphone and speaker, works like a tape recorder.** MP3 playback **lets you listen to digital-music files stored in that format, and a** picture viewer **lets you look at** digital photos. **A few models also include a built-in** digital camera **and** keyboard.

A PDA's **processor** is the system's brain. In general, the higher the processing speed of this chip, the faster the PDA will execute tasks--and the more expensive the PDA will be. But higher-speed processors may require more battery power and thus deplete batteries more quickly. Processing speeds are 16 to 400 megahertz (MHz), and models typically have 8 to 64 megabytes (MB) of user memory. Even the smallest amount in that range should be more than enough for most people.

Nearly every PDA offers an **expansion slot** for some form of removable memory card: CompactFlash, MultiMediaCard (slots also accept SecureDigital cards), or Memory Stick. Models with two expansion slots can accommodate a **peripheral device,** such as a **Wi-Fi wireless networking card,** as well as removable memory. If you plan to transfer photos from a digital camera to your PDA, make sure the two devices use the same type of card.
Some PDAs offer **wireless connectivity.** Models with a capability known as **Bluetooth** can connect wirelessly over short distances to a properly equipped computer or peripheral such as a printer or modem. Models with Wi-Fi can connect over medium distances to a Wi-Fi-

enabled home network or to the Internet at "hot spots" in certain airports, coffee shops, and hotels. A PDA combined with a **cell phone** can make voice calls or directly connect to the Internet via a wireless Internet service provider. It's possible for a single PDA to have more than one of these three types of wireless connectivity.

A **backlight** for the display, which illuminates the characters, is standard. With monochrome screens, you need the backlight when using the PDA in the dark. The backlight is always

i-Mate Pocket PC (GPRS / GSM enabled)
***Also known as the XDA II***

[Click Large Image]

**Features**

- **Platform**
- Windows Mobile™ Pocket PC 2003 Phone Edition Software (GSM/GPRS).
- **Processor**
- · Intel® PXA263 400Mhz
- **Dimension**
- · Typical 60.9mm (W) x 130mm (H) x 18.2mm (T)
- · Max 69.9mm (W) x 130mm (H) x 19mm (T)
- · Weight; main unit with battery is approximately 190g
- **Memory**
- · ROM; Standard 64MB
- · SDRAM; Standard 128MB
- **LCD Module**
- · 3.5" Transflective TFT-LCD with Back Light LEDs
- · 240 x 320 Pixels
- · 64K colours
- · Sensitive Touch Screen
- **GSM/GPRS Function**
- · Full integrated GPRS/GSM (tri-band) module; 900/1800/1900Mhz.
- · Internal antenna.

- · General GSM Service:
- · Network Selection
- · SMS
- · Call holding, waiting, forwarding CLI (Calling Line Identity)
- Display own number, telephone number
- Multi-party conference call
- Spool Icon
- Network Lock
- GPRS Functionality
- GPRS Class B
- Multi-slot class 10
- PBCCH
- SIM
- 3V SIM Operation
- SIM Application toolkit
- **Stylus**
- Lock type mechanism
- **Keyboard / button**
- One button power on (wake up key)
- One 5-way navigation pad
- One camera shutter button (wake up key)
- One voice recorder (wake up key)
- One Volume control button (up and down)
- Two phone buttons (Send [Yes] and End [No]) (wake up keys) (with LED backlight)
- Two programmable AP button (wake up key)
- Reset Switch
- Key lock function support by software.
- **Notification**
- One Bi-colour LED for GSM standby, GSM message, GSM network status, PDA notification, PDA charging status
- One blue LED for Bluetooth status
- Vibration for notification
- Notification by sound, message on display.
- Top
- **Interface**
- One infrared SIR
- One individual port for signals (for USB, Serial, Car Kit, Power and Audio)
- One SIM card slot
- One SDIO/MMC card slot
- One external antenna connector
- One audio jack (2.5Ø diameter)
- **Bluetooth**
- Bluetooth 1.1 compliant
- Power class 2
- Support profiles: Serial Port profile, Dial-up Networking profile, Headset profile and Generic Objects Exchange profile.
- **CMOS Camera**
- Colour
- Resolution: VGA (480 x 640)
- **Audio**
- Loudspeaker

- Receiver
- Microphone
- Polyphonic MIDI ring tone (16+ chords)
- WAV/WMA/MP3 stereo
- **Power**
- Battery
- Removable and rechargeable lithium-ion Polymer battery,1,200mAh (typical) Data retention time: 72 hours
- Separate backup battery (25mAh, rechargeable) Data retention time: 20 to 30 mins (based on full capacity)
- Battery lock mechanism for removable battery
- Battery life (typical 64MB SDRAM)
- PDA mode: 12 hours
- Talk: 2.5 to 3.5 hours
- Standby: 160 hours
- AC Adapter
- AC input:100 to 240 VAC, 50/60Hz
- AC Input Current: 0.2A AC Max
- DC Output rating: 5VDC
- DC Output Current: 2A
- **Standard Cradle**
- USB Cable between cradle and PC
- 2nd Battery charging slot
- LED indicator for 2nd battery charging
- **Accessories**
- Bundle
- Stylus
- Stylus
- AC Adapter with Power Plug
- Carry Case
- USB Sync Cradle with 2nd battery slot
- User Manual, Quick Start Guide, Sync Software
- Options (examples of some items available)
- Serial Sync Cable
- USB Sync Cable
- Serial Sync Cradle with 2nd battery slot
- Serial Sync Cradle with 2nd battery slot + Audio jack and microphone
- USB Sync Cradle with 2nd battery slot + Audio jack and microphone
- Car Adapter
- Car Kit
- Mono wired hands-free headset with microphone
- Thumb Keyboard
- Foldable Keyboard
- Backpack: CF type II + VGA Out (within cable) + Battery
- **Standard Applications**
- Microsoft® Pocket Outlook; Inbox, Contacts, Calendar, Tasks
- Microsoft® Windows® Media Player
- Microsoft® MSN Messenger
- Microsoft® Pocket Internet Explorer
- Microsoft® ActiveSync
- Camera

- Album (video & audio)
- Photo contacts / photo caller ID
- Wireless modem
- XBackup
- **Value Added Applications**
- MMS Client
- **Regulatory**
- R&TTE
- FCC
- Pocket PC 2003 logo (NTSL)

# ANNEX B
# GPRS Information

GPRS (General Packet Radio Service) is a step between GSM and 3G cellular networks. GPRS offers faster data transmission via a GSM network within a range 9.6Kbits to 115Kbits. This new technology makes it possible for users to make telephone calls and transmit data at the same time. (For example, if you have a mobile phone using GPRS, you will be able to simultaneously make calls and receive e-mail massages.) The main benefits of GPRS are that it reserves radio resources only when there is data to send and it reduces reliance on traditional circuit-switched network elements.

With GPRS, an IP data transmission protocol, which is characteristic of computer networks, is being introduced to GSM. IP is a data transmission protocol which is used in Internet, the largest computer network in the world today.

## Main features of GPRS

Before introduction of GPRS, the radio capacity was used for calls and data transmission within the GSM network in a rather inefficient way. For data transmission the entire channel was occupied and was thus insufficiently used. With the GPRS technology, the channel is used more efficiently owing to the possibility of more than one user sharing the same channel. GPRS telephones user several channels for data transfer thus facilitating greater transfer speeds.

The GPRS infrastructure and mobile phones support a data transmission speed of up to 13.4Kbits per channel.

GPRS signaling and data traffic do not travel through the GSM network. The GSM network is only used for table look up, in the Location Register (HLR and VLR) data bases, to obtain GPRS user profile data.

## GPRS Telephones

Owing to the fact that more than one channel is used for downlink, the GPRS mobile phones make possible greater data transmission speeds. There are several types of phones with regard to the number of channels they use for data transmission...

- Type 2+1 ? two downlink channels and one uplink data transmission channel
- Type 3+1 ? three downlink channels and one uplink data transmission channel
- Type 4+1 ? four downlink channels and one uplink data transmission channel

The GPRS mobile phones can be classified into the following three classes in terms of the possibility of simultaneous calls (via GSM) and data transmission (via GPRS)...

- Class A ? Simultaneous calls (via GSM) and data transmission (via GPRS)
- Class B ? Automatic switching between the GSM and the GPRS mode is possible according to telephone settings.

- Class C ? Hand operated switching between the GSM and the GPRS mode

**Data Transmission Speeds**

The supported data transmission speed per channel is 13.4Kbits. Depending on the type of phone, the following data transmission speeds are theoretically possible...

- Type 2+1: Receive 26.8Kbits and send 13.4Kbits.
- Type 3+1: Receive 40.2Kbits and send 13.4Kbits.
- Type 4+1: Receive 53.6Kbits and send 13.4Kbits.

**The Network**

In the core network, the existing MSCs are based upon circuit-switched technology, and they cannot handle the GPRS style packet traffic. Thus two new components, called GPRS Support Nodes, are added:

- Serving GPRS Support Node (SGSN)
- Gateway GPRS Support Node (GGSN)

The SGSN can be viewed as a "packet-switched MSC;" it delivers packets to mobile stations (MSs) within its service area. SGSNs send queries to home location registers (HLRs) to obtain profile data of GPRS subscribers. SGSNs detect new GPRS MSs in a given service area, process registration of new mobile subscribers, and keep a record of their location inside a given area. Therefore, the SGSN performs mobility management functions such as mobile subscriber attach/detach and location management. The SGSN is connected to the base-station subsystem via a Frame Relay connection to the PCU in the BSC.

GGSNs are used as interfaces to external IP networks such as the public Internet, other mobile service providers' GPRS services, or enterprise intranets. GGSNs maintain routing information that is necessary to tunnel the protocol data units (PDUs) to the SGSNs that service particular MSs. Other functions include network and subscriber screening and address mapping. One (or more) GGSNs may be provided to support multiple SGSNs. More detailed technical descriptions of the SGSN and GGSN are provided in a later section.

**Security**

GPRS security functionality is equivalent to the existing GSM security. The SGSN performs authentication and cipher setting procedures based on the same algorithms, keys, and criteria as in existing GSM. GPRS uses a ciphering algorithm optimised for packet data transmission.

**Network Protocols Used**

There are several protocols used in the network equipment. These protocols operate in both the data and signalling planes. The following is a brief description of each protocol layer:

- *Sub-Network Dependent Convergence Protocol (SNDCP)*: the protocol that maps a network-level protocol, such as IP or X.25, to the underlying logical link control. SNDCP also provides other functions such as compression, segmentation and multiplexing of network-layer messages to a single virtual connection.

- *Logical Link Control (LLC)*: a data link layer protocol for GPRS which functions similar to Link Access Protocol - D (LAPD). This layer assures the reliable transfer of user data across a wireless network.
- *Base Station System GPRS Protocol (BSSGP)*: BSSGP processes routing and quality of service (QoS) information for the BSS. BSSGP uses the Frame Relay Q.922 core protocol as its transport mechanism.
- *GPRS Tunnel Protocol (GTP)*: protocol that tunnels the protocol data units through the IP backbone by adding routing information. GTP operates on top of TCP/UDP over IP.
- *GPRS Mobility Management (GMM)*: protocol that operates in the signalling plane of GPRS and handles mobility issues such as roaming, authentication, and selection of encryption algorithms.
- *Network Service*: protocol that manages the convergence sub-layer that operates between BSSGP and the Frame Relay Q.922 Core by mapping BSSGP's service requests to the appropriate Frame Relay services.
- *BSSAP+*: protocol that manages paging for voice and data connections and optimizes paging for mobile subscribers. BSSAP+ is also responsible for location and routing

## ANNEX C

### Plan for a Pilot Project

The pilot project will help determine and confirm the following issues before developing a full scale data collection software around the PDA :

1- Real-time or Batch data exchange:
Is real-time sending of information to the main server really needed? how much traffic – in KiloBytes will be generated? How much will that cost? Will real time information exchange help in data collection monitoring? Will daily batch information interchange suffice, or should the enumerator in the field be connected to the main database all the time and perform all information update on it directly?

2- Synchronization with main database:
Will the main database be Oracle, Ms SQL, or Ms Access based? How will the mechanism of integration between received data from PDA, if in batch mode, occur with the main database?

3- Training needed for field enumerators:
Will the training effort be great or minimum? Will a hot technical support line be needed?

4- How well will the adopted PDA perform in the field:
Will the battery be enough? How will recharging happen? Is the PDA easy to use? What will be the optimum procedure to follow for its use in data collection? Will the PDA memory be enough to handle the client-side application and data storage (if batch mode is used)?

5- What is the best design for the user interface? How best to optimize the process of data collection? How best to optimize the business process of handing back the information to the DoS and the processing of the CPI.

6- How reliable and fast is the GPRS/modem speed? (Please refer to Annex C for more information on GPRS).

7- What is the extent of savings in cost if PDAs are used in data collection?

Given above discussion, the Consumer Price Index may serve as a pilot test for PDA use in data collection. Amman and Irbid may serve as the main test areas. One enumerator from each governorate will perform the pilot test in parallel to the usual method of data collection

A subset of the consumer items and establishments may be used for testing. The most applicable main category of items to start with is the clothing and footwear which itself includes 8 sub categories of items. Those need to be collected during the second week of the

month and so allowing for leeway till the end of the month in case obstacles were encountered.

Moreover, communication will be tested from Amman and Irbid. The locations are not far from needed technical support or any required changes to the system.

The enumerators will have to document the processes that they adopted while using the PDA in the field and when interchanging information. This should include all the difficulties they faced, the time savings if any, and the obstacles encountered while using the PDA on the road.

The following steps will be followed in developing the Pilot Project:

1) Determine which state-of-the-art PDA to use and purchase at least two new PDAs. Test the device for battery usage, communication facility, and storage. (Please refer to Annex A for more PDA information and Annex B for iMate Pocket PC specification for an alternative to the existing Sony Clie PDAs.)

2) Based on the used PDA and its operating system, develop a system design to include the database structure, the user interface and the communication and synchronization module. The main database receiving the daily updates may be residing on the temporary server which may be uploaded to the permanent database at a later stage in the process.

3) Develop the user interface on the PDA – thin client, and the database structure residing on the main server. Upload known information (establishment name, item name and codes etc..) to the database system

4) Develop the synchronization module and data exchange.

5) Test the developed application

6) Train the enumerators on PDA use and system use.

7) Implement Pilot project and monitor for above-mentioned issues.

8) Report in details the results of the pilot project, draw conclusions, specify enhancements needed, and offer recommendations on how the full system can be implemented.

## Potential for Future Uses of PDA in data Collection at DoS

The following are potential future uses of PDA in the field data collection operation:

1- Use of Global Positions System devices (GPS) in locating the surveyed unit (e.g. building under construction, sampled housing unit, sampled business establishment) and maps supplied through special software e.g ArcPad and connection to the GIS system at DoS. Enumerator in the field can check his/her location against the uploaded map of the census blocks or street map as s/he move – the "you are here" concept.

2- Can use the GPS supplied with the PDA in updating the address coordinates of the sampled units or sampling frames.

3- Upon proving the concept of their use, the PDAs may be used in collecting field information for other surveys especially that of the construction statistics survey.