Time Series Modeling using Mobile Devices and Broadband Internet

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Abstract. In this paper we present one application included in the Project @DAN, an AdvANced and high secure mobile platform to support the digital economy, that started on November 2001, and is financed by the *EU IST-2001-32634*.

   This application will provide all types of services necessary to model and obtain forecasts of time series data by the professionals of any kind of organisations.

   The user of this application will be able to obtain two different types of services: demand forecasts and consultancy using mobile terminals, broadband internet and internet payments.

   The background system installed in a server, is FOREtess[+], which is an evolution of TESS (see Prat et al. (2000)).

1 Introduction to the @DAN project

The development of the new economy and the information society is being curbed due to both the insecurity that potential customers are feeling with regards to the communications and the lack of standards that could stimulate developments of this security.

   @DAN, an aDvANced and high secure mobile platform to support the digital economy, seeks to remove these barriers in the mobile communications environment.

   The main goals of the @DAN project can be summarised, but not limited to the following list:

[+] FOREtess is in process of being registered as a trademark by UPC.

Develop a secure mobile platform to support developments of m-commerce applications, specially these one pertaining to the field of the digital economy. Specifically, this platform will provide two basic functionalities: digital signature and secure payments based on a smart card. Each one of the components will be produced by a relevant expert in the field.

✓ The platform and related tools produced will be used for the development of two prototypes. These prototypes will shown a spectrum of functionalities that will prove the necessary capacities of the platform. The prototypes will be produced by two different universities which have showed in the past their skills in the subject.

✓ These two prototypes, will be tested and assessed by different industrial and services end users organizations. This assessment will be conducted by an SME that has interest in the commercialization of the results obtained.

2 Architecture of the platform to be developed

The @DAN platform will provide two basic functionalities: digital signature and electronic secure payment based on a cryptographic smart card. A relevant expert in the field will produce each one of the components.

This platform will be based in three components:

✓ UMTS component (wideband), with possibilities to read a smart card
✓ Smart card (cryptographic features)
✓ Digital certificates (X509.v3 based)

The next figure shows the architecture of the platform applied to the times series prototype.:
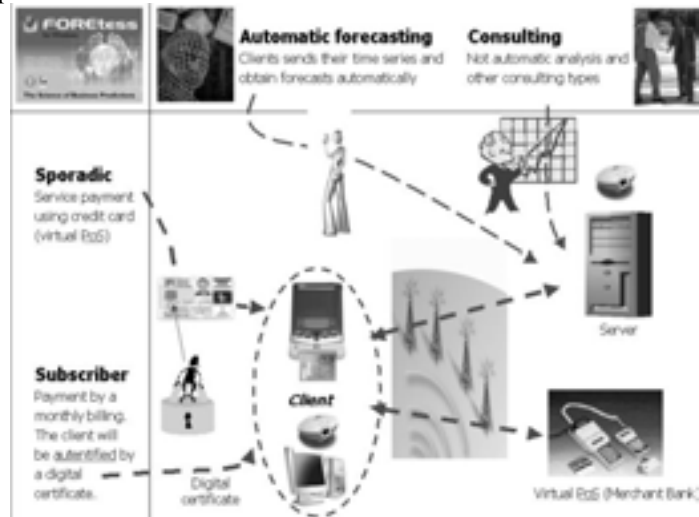
In what follows, we will comment on the requirements for the communication infrastructure and then we will see what is proposed as a solution for both the wireless and the fixed parts.

3 Solution adopted for the first phase of the @DAN project

The technology initially considered in the project, UMTS, is a cellular technology that provides a maximum throughput between 384 Kbit/s and 2 Mbit/s, depending on the speed of the terminal. This maximum throughput has to be shared among all users within the cell. Provided that there are few users in the UMTS cell, this technology can indeed be expected to be sufficient for the support of the requirements.

However, due to the unavailability of systems with this technology to date, and the uncertain perspectives, it has been decided to employ alternative wireless access technologies to fulfill the main objectives of the project.

Therefore, we resort to Wireless Local Area Networks technology (WLANs). In particular, we consider the systems based on the standards IEEE 802.11b. This technology has some attractive characteristics: it is widespread in the market and therefore relatively economical, it does not require spectrum licenses and, as we will see, it complies with the requirements of the project.

IEEE 802.11b provides radio communication between terminals at a nominal throughput of 11 Mbit/s. The maximum range is about 150 meters.

4 Fixed infrastructure

I2CAT is an experimental Internet platform that combines telecom companies, content service providers, technology providers, universities, governmental institutions and final users. The goal of this platform is to develop and to test new generations of applications, network services, network protocols and technologies, testing the acceptance and the social impact of the new generation of Internet (IPv6) by the final user.

I2CAT is based on an optical broadband network that interconnects all members and end users at high-speed rates. All the network providers are connected to the Gigapop, that resides in the UPC, using several technologies like Gigabit Ethernet, PoS (Packet over Sonet) or ATM (1.2 Gbps/622 Mbps/155Mbps).

The @DAN project will use the I2CAT platform that provides interconnection between the project partners UPF, UPC, SECARTIS and Caixa de Catalunya with high speed links above 2Mbps using wired and wireless LAN technologies. At the same time, @DAN takes advantage of the multiple services deployed on the I2CAT platform as VoD, streaming video and videoconference based on MPEG 1 /2/4 and H.323 standards.

These @DAN partners are transparently interconnected with the TCP/IP suite over Ethernet wire and wireless access technologies offering an adequate network platform to deploy secure @DAN applications.

ADSL is a technology that makes it possible to employ the existing telephone wires to transport data at relatively high data rates. In this way, we can build an access network that reaches a large part of the population without the need of

installing new physical links. At this time, ADSL is being deployed commercially in Western European countries. With the commonly offered data rate of 256 Kbit/s downlink and 128 Kbit/s in the uplink we can expect ADSL to be suitable for our purposes. The client only needs to have a POTS (Plain Old Telephone Service) line, an ADSL modem and to contract the ADSL service from an operator.

5 Wireless terminals

The initial wireless terminals to be used in the project are Compaq iPAQ PDA´s. These handheld computers have the Pocket PC operating system and can host up to two PCMCIA cards. There are IEEE802.11b PCMCIA cards commercially available and we expect that GPRS PCMCIA cards will be available soon. Other features of these devices are a Web browser, a Java virtual machine and Jdk2.0 for Java applets and applications development

In a second phase, SIEMENS handsets will be used.

6 Time series prototype

One of the two prototypes developed to prove and validate @DAN platform is the UPC Time Series application.

Based on the @DAN platform, UPC will develop an application that will allow individual persons or members of any kind of organisation to obtain forecasts and other useful information from their time series database in an easy, fast, accurate and secure manner.

The system is being designed to allow for two different types of users:
- ✓ Sporadic users that from time to time will use the application to obtain forecasts of some time series of interest.
- ✓ Subscription paying users that either from a desktop computer or from a mobile device will use the application for time series modeling and forecasting or for receiving consultancy services.

It will perform a fairly complete statistical treatment of time series, be that in routine large-scale applications or, for example, in careful analysis for short-term economic policy, control and monitoring. Although other frequencies are possible, our attention centres mainly on monthly and quarterly series.

UPC application prototype will be accessible by using workstations, laptops and mobile devices, which have a web browser.

The web based application performs all its operations on server side, and the only difference between diverse client devices is the user interface, specially designed for each one of them.

7 Functionalities of the application

The next table shows the different functionalities depending on the specific type of terminal used to access the prototype (the use of a mobile device imposes some restrictions on the functionalities to be implemented in such a handheld PC):

FUNCTIONALITIES	Desktop computer	MOBILE DEVICE
SECURE CONECTION	YES	YES
USER AUTENTIFICATION	YES	YES
VIRTUAL TPV	YES	YES
NEW USER'S REGISTRATION	YES	NO
TIME SERIES AND USERS DATABASE	YES	YES
DOMAINS ORGANISATION	YES	YES
IMPORT EXCEL, ACCES, ASCII files,	YES	POCKET EXCEL FILES
CREATE NEW TIME SERIES AND DOMAINS	YES	YES
UPDATING TIME SERIES MANUALLY	YES	YES
AUTOMATICALLY TIME SERIES UPDATING	YES	NO
EXPORT RESULTS	YES	POCKET EXCEL FILES
POSSIBILITY OF IMPORT TIME SERIES FROM PRIVATE DATABASE (EXTERNAL)	YES	YES
MODELLING		
AUTOMATIC AND MANUAL UNIVARIATE MODELLING	YES	YES
INTERVENTION ANALYSIS	YES	YES
INTERVENTION DATABASE	YES	YES
TRANFER FUNCTION	YES	YES
FORECASTING	YES	YES
AUTOMATIC SYSTEM	YES	NO
SEASONAL ADJUSTMENT	YES	YES
TREND AND CYCLE ESTIMATION	YES	YES
CONFIGURATION OF BACKEND SOFTWARE	YES	YES
THE PROBLEM OF AGREGATION	YES	YES
CONTROL OF FORECAST ERRORS		
EWMA GRAPHIC	YES	YES
CUSUM GRAPHIC	YES	YES
GRAPHICS AND PLOTS	YES	LIMITED
CONSULTANCY (video, multimedia)	YES	LIMITED

Finally, other relevant characteristics of this prototype are:

- ✓ The system will be provided with secure connection and user's authentication by electronic signature system, and secure Internet payments.
- ✓ The system will offer an online help system and also access to a Time Series Course.
- ✓ Possibility to ask questions to an expert (videoconference, forum, e-mail list,…)

8 Technical requirements estimated at the server side

The technical requirements estimated at this moment for the hardware and software

to support the development at the server side are:
- ✓ Windows NT/2000 server
- ✓ Internet Information Server
- ✓ Scripting language installed (ASP, PHP, …)
- ✓ Database server (MySQL)
- ✓ Videoconference Server (Microsoft Exchange 2000 Videoconference Server)

9 Conclusions

Technology is moving quicker than ever before, especially mobile technology. Global usage of the mobile device will continue to grow at a high rate. In fact, it could be said that the developments in technology are racing ahead of our imagination's capability to deal with it.

The past three years have seen an outbreak in the number of wireless communication devices. The emergence of these mobile delivery channels - digital phones, personal digital assistants (PDAs), etc. - presents an opportunity for many communities, e.g., academic and scientific communities looking to increase their efficiency and easiness to access the data and tools they needs to use.

It is probably. unlikely that individuals are confident in the use of wireless access to Internet until the right security solutions exist to support them. These include the delivery of identification and authentication, content privacy and non-repudiation support to wireless networks that are currently available for wired networks via public-key infrastructure (PKI) technology.

@DAN will try to provide a platform for the development of these new solutions. @DAN time series modelling and forecasting prototype will demonstrate the advantages of this new technology.

References

Prat, A., Gomez, V., Sole, I., and Catot, J.(2000). *TESS: system for automatic seasonal adjustment and forecasting of time series*, Proceedings of Compstat 2000, Physica-Verlag, pp. 391-396.