

Reporting Web Solution for proper payment of ITC services, for National Including Digital Program in Elementary schools in Mexico.

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Abstract— This document presents the results achieved in the design, development and testing of the software application devoted to report (to a Central Site) the status of IT equipment, to be installed in thousands of classrooms in elementary schools in the country of Mexico. The Ministry of Education (SEP), decide to manage the classroom's IT equipments as a service, contracting installation, technical support and any other service to several Providers assigned by regions in the Country. This solution will allow SEP to get precise and on-time information, dramatically improving calculations for monthly payment to service providers, with the corresponding associated savings.

SEP: *Secretaría de Educación Pública*

CINVESTAV: *Centro de Investigación y Estudios Avanzados*

SP: *Service Provider*

ITC: *Information Technology and Communications*

MQ: *Message Queue*

PC: *Personal Computer*

I. INTRODUCTION

Over the last years the Ministry of Public Education of Mexico (SEP) had promoted the adoption of Information and Communication Technologies on Elementary education. By using a leasing model, contracting several providers, SEP installed essential ICT equipment to more than 120,000 classrooms in more than 60,000 schools, around the country. The equipment includes a personal computer (PC) for the teacher, an electronic blackboard, a projector and an uninterruptible power supply unit. Altogether, this equipment forms part of the learning tools available for teachers.

The contract signed with those service providers specified a set of service level agreements (SLA) related to correct performance of those components, being availability one of the main key performance indicators for payment purposes. The lack of an effective process to report failures or problems, have not allowed the precise calculation of some of the required indicators for the right payment to service providers (SP).

The answer to improve accuracy in SP payment calculations, was the development of a software application to concentrate

status information in a simple and reliable way, according to the usage pattern in the classroom (devices are not powered on 24 hours a day).

We developed a Non real time 'monitoring' system to report equipment status on each classroom where provider deliver the service.

Application is developed in a Microsoft Windows 7 Professional Environment (Win32), with following components:

- Application in Teacher's Personal Computer to keep (and transmit) data gathered in a format, about availability and functionality of any ITC device installed in the classroom and managed by the Service Provider.
- Application in central server to gather, keep and manage equipment status data to generate information reports.
- Communication application to transfer information from each Teacher's computer to the central Site assuring that information is correct and complete and comes from a valid classroom, preventing any security hazard.
- Design and creation of the Data Base to gather register data to be integrated with the additional information needed in the Help Desk System.

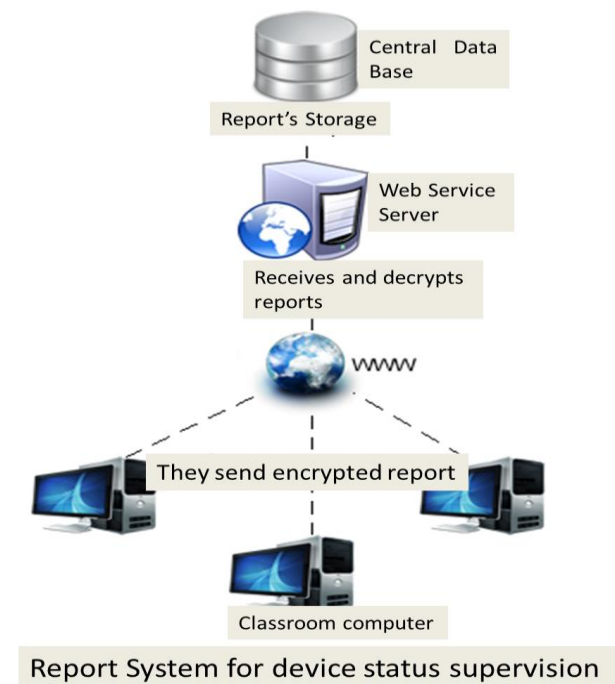
II. DESIGN

Following, the description of modules that forms part of the solution.

A. Architecture

As shown in the following diagram, the solution's architecture includes a Win32 system executed via a Windows Service, each time the classroom computer is turned on or at Teacher's choice with a manual selection in the screen. The System Message Queue is used for system log control and a Web

Service is used to transfer data to the central data base linked to the Help Desk System.



B. Application Users

Administrator: On charge of configuring system's parameters defined in Teacher's computer in the classroom. Access is done in the Web Services Application Server.

Installer: On charge of first time installation of the system in classroom computer. Once installed, the application can be set in 'test mode' to review functionality.

Teacher: The user that will generate the source data used to report equipment status; the teacher fills the format in, each time the computer is turned on, once he/she verifies specific conditions of each device in the classroom. Teacher can not proceed to use the computer if format's mandatory data is incomplete.

Solution includes:

- The software module in the PC to present the form and gather data, preventing the teacher to log in to the Operating System if he hasn't completed the information requested.
- The Operating System's messaging service to store data registered in the Form.
- The Internet web service to gather registers from any location in the country.

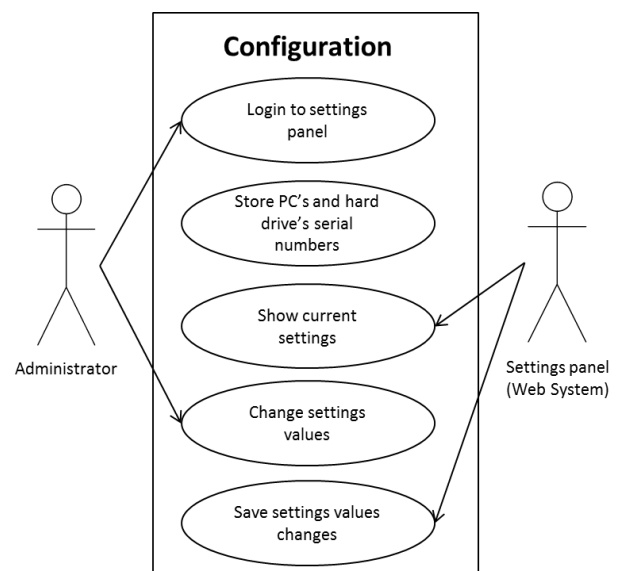
- The background software agent to monitor Internet connection availability.
- The centralized web application to process the data received, generation of the data base and report generation.

III.DEVELOPMENT AND TESTING

A. Software application Use Cases

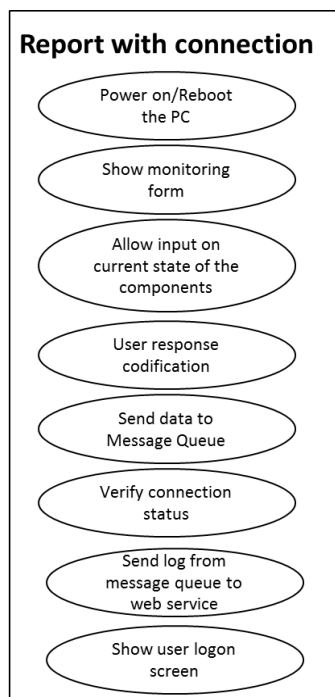
Following we describe the Use Cases developed in the system, that corresponds to the main processes in the system.

Configuration: This module automates changes, Administrator can modify the configuration of system parameters easily. The application takes into account the PC and Hard Drive serial numbers. This data is not shown to provider.

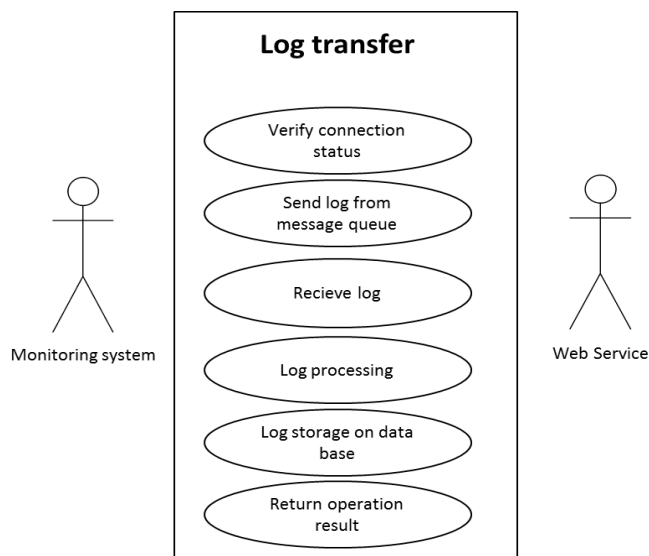


Status Register Transfer: This is one of the main processes and there two options, the first one if connectivity is available and the second one if it is not available. This process is executed each time the Teacher turns the computer on.

With available connectivity: Once the Teacher fills the Format in, reporting availability and any problem of each component, the data gathered in the format is encrypted and stored in the message Queue and sent to the central application by means of the corresponding Web Service.

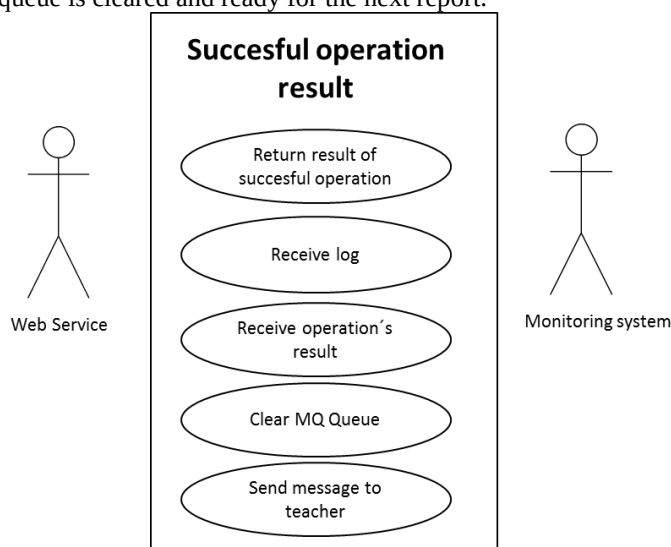
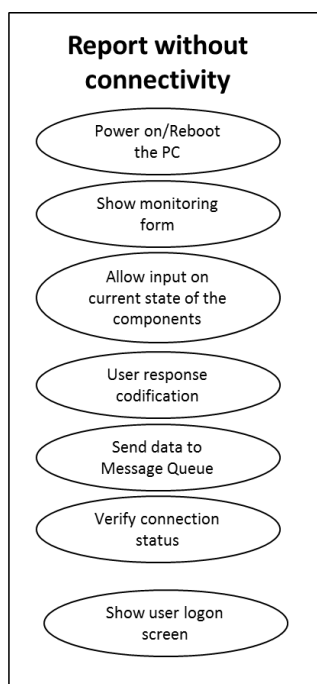


by the Help Desk application. Transfer mechanism confirms to the classroom computer software this operation and update is done in the MQ.



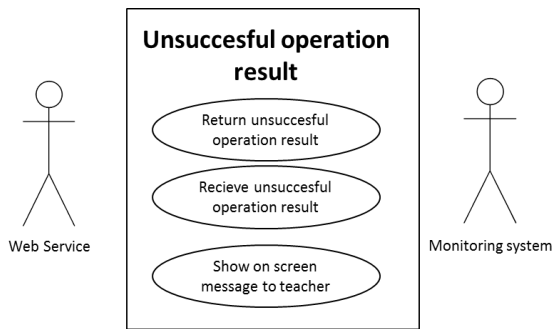
Without available connectivity: This process is similar to the previous one, except that due to the lack of connectivity, data is stored in the Message Queue Log to be sent when connectivity is active.

Successful Result: Once the previous process ends, the Application receives the result, that is successful and the MQ queue is cleared and ready for the next report.



Unsuccessful result: In case of a failure in the Log transfer process, the application receives that result from the Web Service and information is kept in the queue of the MQ to be sent in the next event with available connectivity.

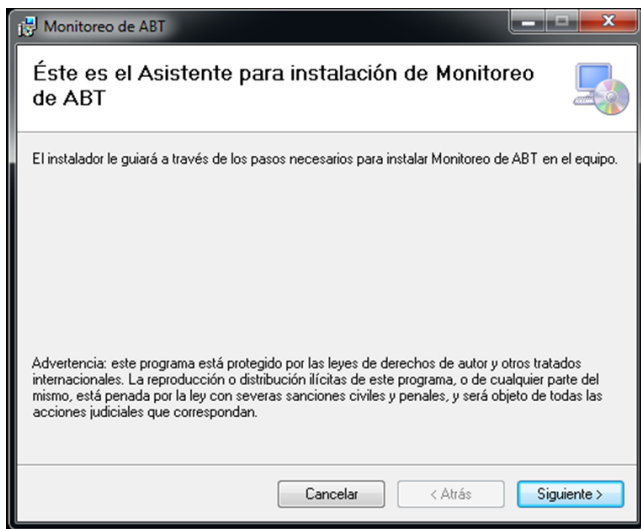
Log Transfer: If connectivity es available, the Log is sent via the Web and received and decripted to obtain the original information, which is stored in the Data Base, ready to be used



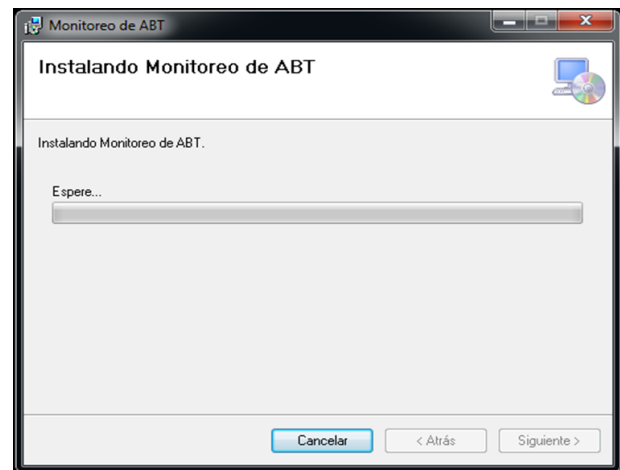
C. User Interfaces

Following we present the corresponding user interfaces or screens developed for the system.

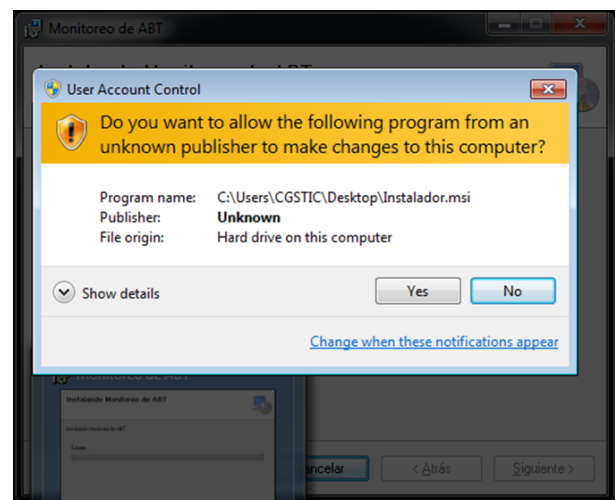
C.1 Next four slides resume the Installation process.of the PC application.



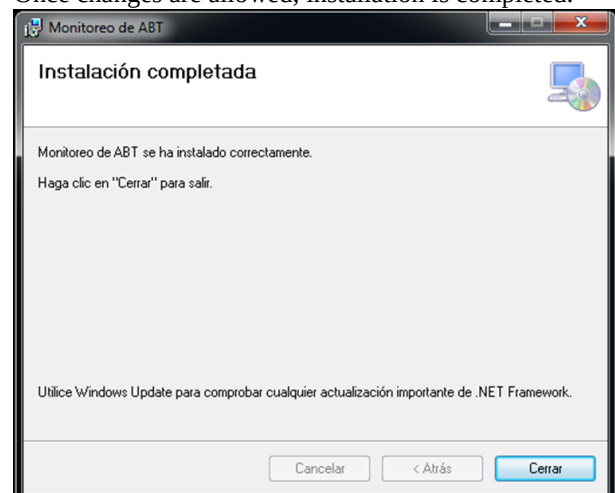
This screen corresponds to the application installation assistant.



Executing the installation.



Once changes are allowed, installation is completed.



C.2 Access to configuration panel. To start configuring the system and the Data Base, the Administrator needs to authenticate to the system, according to following screen.

Data Base Management of registered classroom personal computers. The central site application manages administrative data for each classroom computer, including among main data, the serial number of the equipment, classroom identity, state, county, school name and more data.

Administrar ABT

Administrar Usuarios

Identificador de ABT:

Filtrar

Ver todos

Registrar nuevo ABT

ABT	Entidad Federativa	Municipio	Localidad	Escuela	Instalada	Fecha Instalación	# de Serie
CGSTIC-PC	México	D.F.	Gustavo A. Madero	Cinvestav	☒	29/08/2012 06:40:53 p.m.	[P0EE85D8] [6429351.CN486431.C30254.]
WIN-RS1NJ3QD9QU	México	DF	Gustavo A. Madero	Cinvestav Virtual	☐	30/08/2012 06:38:20 p.m.	[P8CC7988][None]
NEZA7130MURBCR7	México	DF	Centro	SEP-Pruebas1	☐	17/09/2012 12:23:54 p.m.	[B6422820][INVALID]
USUARIO-PC	México	DF	Centro	Sep-PC1	☐	04/10/2012 11:48:01 a.m.	[B6422820][INVALID]
NEZA7130MURBCV3	México	DF	Centro	Sep-PC2	☐	04/10/2012 12:25:26 p.m.	[B6422820][INVALID]

C.3 Form presented each time the personal computer is powered On. It includes all equipment that is going to be reported their status (availability) and functionality issues. Teacher is not allowed to proceed to use the computer if the form is not completed.

D. Testing

All use cases were tested completely in any condition that could happen. For example, in the installation process, once software is installed, and the PC was reinitiated, we can send a report in test mode and verify the reliability of the process. The following screen shows the step where you can exit from test mode once installation is correctly finished.

In terms of performance in the receiving site, the bandwidth needed in the Internet access to received them without a large delay, will depend on the register length to be transmitted and the period of time they arrive (the worst case would be when all, let's say 143,000 computers, send the register in an estimated period of time between 30 and 60 minutes. Each register to be transmitted was prepared to not exceed 512 Kbits.

E. Results

Once installed and tested, the application proved to perform in a reliable way, with the right control points to alarm about

missing conditions in the different activities involved, like installation, classroom equipment administration, form fulfilment and transfer.

IV. CONCLUSIONS

When contracting a service that involves equipment's performance and availability, data about their status is key in order to calculate precise amounts to pay, according to service level met and contract conditions.

The designed process, IT platform and developed applications for the central site and personal computer in classrooms will improve accuracy of the billing process, contributing to significant saving, avoiding payments for services not delivered.

V. REFERENCES

- [1] Thai Duong and Juliano Rizzo, "Cryptography in the Web: The Case of Cryptographic Design Flaws in ASP.NET," in IEEE Symposium on Security and Privacy, 2011.
- [2] Windows, Dev Center, Desktop App Development , Microsoft, 2011.
- [3] Don Kiely, "Interacting with Message Queues", Application Developers Training Company, 2002.