# MOBILE SIMS – IMPROVING OPERATIONAL PERFORMANCE

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***SUMMARY***

*In order to meet the deregulated and privatized markets' and customers' partly contradictory demands of improved efficiency and quality of service, electric utilities have to inspect their working practices and find the procedures and methods that can be improved and rationalized. Clearly, current practices of spatial information management and handling are far from optimal. Tasks are unnecessarily repeated and existing information is not available where most needed.*

*This paper addresses the problematics described above and as a solution, presents a concept called Mobile SIMS which is based on intelligent interaction of the central GIS and NIS systems and mobile computers. The technology of the concept and its obvious benefits in different areas of utility operation are also discussed.*

## INTRODUCTION

During the last few years, the everyday operational performance of electric utilities has clearly improved. One reason to this is that the utilities have moved from traditional paper archiving to digital information management. Unfortunately, the old policies of strictly centralizing the information and its management have been kept, especially in the area of spatial information management. Documentation of planning, construction, operation and maintenance are still being composed and updated at one or few offices in the operation area [1].

The central data storages, information management systems and especially the information they contain comprise a huge potential which today is very ineffectively utilized. The services and stored information of the central systems are needed not only in the central office locations but even more so in the field, where most of the utility's daily operation actually takes place. In addition to this, the information which is stored and kept up-to-date in the data storages is to a substantial extent collected from the field. Today, this bidirectional information flow between the central systems and the field is far from optimal.

This paper presents an advanced solution, a concept called Mobile SIMS (Spatial Information Management Solution), to better utilizing the existing information and improving the mechanisms of exchanging information between the offices and the field. The concept's benefits in all areas of utility operation, i.e network planning, construction, operation and maintenance, are obvious. The areas of network operation and maintenance are especially discussed because of already existing implementations. The technology related to the concept is also described, and examples of implementations are presented.

## MOBILE SIMS – BASICS AND TECHNOLOGY

Mobile SIMS, which is a concept developed by Tekla Oy, is an efficient solution to releasing the vast, so far unutilized potential of the central data storages. Introducing Mobile SIMS means distributing an appropriate amount of GIS and NIS functionality and information to where it is most needed – in many cases, to the field. It also includes a substantial improvement in the information exchange between field personnel and the central offices. In its nature, the concept is a major extension to a "traditional" network management system.

In Mobile SIMS, the above-mentioned "appropriate" amount of functionality varies flexibly according to the user's needs; e.g. from an off-line maintenance application with background maps and network documentation for a maintenance crew to a full-scale on-line distribution management system capable of remote control operations and network calculations for an operator to be used outside office hours or in the field.

Mobile SIMS does not aim at replacing the central GIS or NIS systems; the objective of Mobile SIMS is to raise their utilization level by complementing and combining them in to a powerful entity, which effectively streamlines the utility's planning-construction-operation-maintenance cycles. Diagram 1 illustrates the mobile units' connection to central GIS/NIS systems.

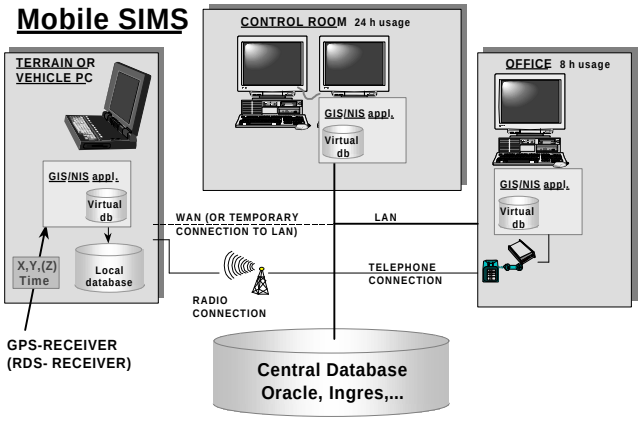


Diagram 1. Mobile SIMS' connections to central GIS/NIS systems.

While GIS and NIS systems are usually planned and optimised for 8-hour office use only, in this implementation the reliability and real-time requirements of a control room system have been taken into consideration from the very beginning of the planning of the system.

The technologies and principles of Mobile SIMS are described in the following.

**Integration levels**

The central and field systems can be integrated in three different ways or levels when implementing Mobile SIMS.

In its simplest form, Mobile SIMS consists of mobile computers which are periodically, e.g daily or weekly, connected via LAN or WAN to the central database.

An information-level connection, which means up- and downloading data between the central system and the mobile units via radio or telephone network, is a more advanced approach. This solution deals only with permanent data in the database.

The most sophisticated version of Mobile SIMS integration is the so called process-level connection, which means a solution in which a part or parts of a computation process are continuously being executed in a central system. The requirements for communication technology set by the solution are very high. Requesting real-time switch states from a control room application to a Mobile SIMS workstation is an example of this level.

A sophisticated solution for data handling by long transaction management takes care of data integrity, the maintaining of which is often problematic when the same data is being handled by two or more instances. This is even done without any data being locked.

**Hardware and peripherals**

The computer equipment for Mobile SIMS is highly variable depending on the conditions it is used in. For use outside vehicles the computers must be light-weight, sunlight-readable, water and impact resistant and preferably have the possibility for pen or touch operation. Demands for vehicle-mounted devices and laptops for indoor use are somewhat easier to meet. Minimum performance requirements are a 133-MHZ Pentium processor, 32 MB of RAM and a hard disk capacity of 200 MB. Especially vehicle-mounted devices should preferably utilize a permanent memory solution other than a rotating hard disk in order to avoid vibration-related problems.

The introduction of the concept sets no specific demands for the usually high-performance central network management systems. In order to ensure system usability hot-standby replication is recommendable.

Mobile SIMS includes various peripheral devices, the most common of which is a GPS-receiver which is connected to a mobile computer. The more accurate version of GPS, i.e. DGPS which utilizes a differential correction signal can be used when necessary (if the signal service is available). Other peripheral equipment may include, e.g., tachymeters and status or temperature sensors .

**Communication techniques**

Communication solution for Mobile SIMS varies depending on the implemented functionality. For the lowest level of integration no actual communication technology is needed; data is transferred from the central database to mobile units via LAN network into which they are temporarily connected. Information-level connection requires basic radio or telephone communication equipment, and a process-level connection requires an advanced radio communication network. At the moment, the only available and reliable technique that meets or exceeds the Mobile SIMS requirements for data transmission of a process-level connection is TETRA (Terrestrial Trunked Radio). TETRA is an open digital trunked radio standard defined by the European Telecommunication Standards Institute ETSI.

**Software**

The software in the mobile computers is essentially the same network information management software that is used in the central system or, as usually is the case, only appropriate modules of it. The operating system of the mobile computers is Windows 95 or Windows NT. In addition a compact relational database with an ODBC interface is needed. Currently a full-featured relational database Solid is used.

The user interface of the mobile computers is the same as in the central office applications and by far the same independent of used applications, which facilitates quick learning of new applications and switching tasks between persons.

In both the central office system and the mobile computers, software modules for possible telecommunication and data decentralization are needed. The software has been effectively optimized to minimize the amount of data to be transferred. As mentioned above, data integrity which is of substantial importance in any multi-instance data handling environment and even more so in real-time applications has also been especially emphasized during the development of the concept.

## MOBILE SIMS IN NETWORK MAINTENANCE

The concept strongly supports graphical creation and handling of maintenance and inspection tasks. An electrical distribution network, which is a structure situated in a

geographically large area and having a large number of mostly unlabeled components, is not a suitable application area for traditional time-based alphanumeric condition management systems. When a crew is sent to a distant location, the tasks it performs must be carefully determined in order to avoid repeated, unnecessary visits to the same area.

The graphical orders are delivered electronically to the crews' computers and the updated documentation is returned to the company database. Having the maintenance and inspections performed by e.g. specialized companies can be done by providing them with computer units containing the orders and all the relevant documentation of the target area.

**Mobile Maintenance**

Mobile SIMS for maintenance and inspections has already been introduced by several Nordic utilities, and the experiences are very encouraging. The adoption of new tools and working practices, which is often seen as the biggest obstacle to overcome, has been fast and effortless.

The maintenance and inspection tasks are planned graphically with central GIS/NIS systems. Planning is done by attaching previously created inspection schemes to selected components. The system guides the planner to create tasks for components in unsatisfactory condition. Input for the component's condition can be gathered from direct measurements or from ageing models. Planning is effortless and fast; an inspection task can also be created if a crew has other tasks to do in a certain area, e.g. installation of a service line.

The created maintenance and inspection tasks are delivered to the crews' computers accompanied with background maps and the network of the area. The crew thus has a complete documentation of the area and the inspection task to be performed on the selected components. The delivery can be done at the office, e.g. once a week for several tasks, or for urgent tasks immediately via radio or telephone network.

Performing and documenting the maintenance and inspection task can be done easily thanks to the graphical network presentation. The network presentation is identical to the one seen in the central GIS/NIS systems and has a similar graphical user interface for selecting components and viewing their properties. The selection and highlighting of components to be inspected can be done easily with a pen computer or with the aid of a GPS-device. The system guides the user to perform the task in the planned order and tracks the completeness of the task by reporting inspected and uninspected components.

The crew performs the maintenance and inspection task by checking the components and reporting the results to the system. In addition to the predefined inspection items also other data can be given. These include notes, urgency level and invalid or missing attribute data for the components. Even completely missing components can be inserted to the system. The position for the components can also be checked with a GPS device.

After performing the maintenance and inspection task the crew returns the modified data back to the central GIS/NIS systems. The data can be used in central office or by other work crews immediately after a correctness check.

## MOBILE SIMS IN NETWORK OPERATION

Difficulty of network operation is another drawback of the traditional approach to GIS-functionality. All too often the operators don't know the crews' locations accurately enough to be able to conduct their actions in the most effective manner. Another problem of both the operators and the crews is insufficient or delayed knowledge of network switching situation. The above, in turn, can affect both the way the crews work on the field and the way the operator conducts the crews' work or operates remote controllable switches. Combined with the operator's inadequate knowledge of the crews' locations and the crews' inadequate knowledge of their own and other crews' locations, this may not only lead to unoptimal network operation but even cause hazardous situations especially if safety regulations are ignored.

Introducing Mobile SIMS concept in network operation increases efficiency both for operators and crews. The operator benefits from tracking the crews' locations and the crews from having the distribution management functionality available in the field. Due to the operator's increased knowledge of the crews' locations, the upcoming tasks can be given to the nearest or most appropriate crew, thus eliminating unnecessary driving.

**Mobile Operation**

Mobile SIMS for operation can be fully utilized in fault situations. The operator sees the location of all crews and can select the most suitable one for the task. The work order for the fault is filled in the central office and sent to the selected crew via radio or telephone network.

The crew then moves to the faulted area utilizing driving instructions given by the operator or even using a route optimization with a GPS device. In the faulted area the crew can use the computational fault location functionality to get the estimated fault locations. The crew can view the switching situation in the area and run a network analysis with changed switching situation for recovering purposes. The analysis may include e.g. load grades, voltage levels and viability of relay protection settings. The crew can then change some switch states manually and even control the primary substation breakers with remote control functionality. When the fault has been repaired the work order can be returned to central office filled with the appropriate repair data.

The maintenance or construction tasks that require network operations are planned graphically with central GIS/NIS systems. These task lists can be delivered to crews' computers and they can be executed on the field. The system always shows the current switching situation, thus increasing work safety.

The crews can be assigned a maintenance and inspection task while they are in the correct area. They can also gather all kinds of information even without any given task. This includes invalid or missing data of the components, maintenance data, notes on optimal paths etc.

## FURTHER BENEFITS AND USES OF MOBILE SIMS

Introducing Mobile SIMS in a utility improves operational efficiency not only in network maintenance and operation but also in the problematic areas of planning, construction and customer service. It also involves a significant change in working practices.

### Network planning and construction

Network projects' lead-time, i.e. the time from the start of planning to a finished and documented construction can be substantially reduced utilizing Mobile SIMS.

Documentation created using the mobile PC during a site visit, including both alphanumeric or attribute data and geographical information (e.g. drafted plans), is immediately validated and does not need to be repeated at the office. The concept's built-in principle of saving data only once drastically reduces the number of human errors during data capture. In addition, the person performing the site visit has the latest versions of all the relevant documentation that exists available in the mobile computer. The concept strongly advocates giving up paper documents in the field whenever possible.

The results of the site visit are transferred electronically into the company database and are available to all those performing planning in the area. When finished, the plans are in turn delivered electronically to executing crews who can easily make necessary changes in them during construction, thus creating the final documentation of the project. In surveying, connections to external devices such as tachymeters can be utilized. For many documentation and planning purposes the accuracy of DGPS is adequate, and the person moving and using the application in the field actually acts himself as a pointing device.

### Customer service

Due to improvements in network operation, the customers will perceive an upgrade in their service level as the utility can react to network problems faster than before. Crews, when sent to the customer's, find their way faster and have all the relevant network data, real-time data and customer data available, including possible history records of the customer point.

Network planning, which especially in urban areas often deals with delicate environmental situations, can at least partly be performed on site, letting customers and landowners affected by the project participate in the planning and thus acquire their approval for it.

### Other benefits

In addition to those mentioned above, other benefits are increased work motivation of personnel and natural rationalization of operation. The former originates from increased importance of the field workers duties – she or he creates and validates the final corporate asset records and assumes more decision-making authority than previously ; and the latter is a consequence of reduction in the field personnel's need for daily support.

## CONCLUSIONS

Electric utilities are constantly expected and even legislatively required to reduce their operation costs, due to increasing deregulation and privatization of the market. Simultaneously, customers' demands for better level of service and improved voltage quality are growing.

In order to meet these partly contradictory demands, utilities have to inspect their working practices and find the procedures and methods that can be improved and rationalized. Current practices of spatial information management and handling are clearly far from optimal. Especially documentation tasks are unnecessarily repeated. Often important information exists in central systems but it is not available where and when it would be most needed.

The presented solution, Mobile SIMS, is a highly cost-effective way to address these problems. With the help of the concept, the demand for increased efficiency is answered by savings in operation and labor costs and reduction of unsold energy; and customer service is improved as the utility can react to eventual network problems faster and take customers' environmental point of view better into consideration. The underlying idea of Mobile SIMS is to derive added value from moving information instead of moving people.

## REFERENCES

[1] T. Laine, M. Biström, P.Laine, "Improving the efficiency of utility operation by mobilizing GIS functionality", in *Proceedings 1998 Distributech DA/DSM Europe*.