The development of distribution automation and information technology (IT) has changed the possibilities to develop and implement new applications for distribution network management. A total concept has arisen: distribution management system (DMS) - a software application, which is based on the integration of distribution SCADA and network databases and provides advanced functionality for network monitoring, fault management and operations planning. Pekka Verho, Product Manager at ABB Substation Automation Oy, provides this report on IT and distribution network management.

There are several fundamental differences in distribution systems worldwide. These differences also affect the concept of DMS, the level of distribution automation and the tradition of information systems. In Finland, the foundations have been very good for the development of DMS. The concept of network information systems (NIS), which means a system having network calculations and planning integrated to a network database, originates, more or less, from Finland. This tradition comes from the 1980s and also has another special form of integration - the use of customer energy consumption data (available in customer information systems) in load assessment. Another important factor is the long tradition and the high levels of distribution automation. The use of SCADA systems in distribution also became common in the 1980’s and not only in substations, but also at network level, together with remote controlled disconnectors.

THE DMS CONCEPT
In order to understand the system development process, distribution network management without DMS, needs to be reviewed. In the early 1990s, there were some advanced applications like distribution SCADA and NIS available, but there were still some problems, or at least inconveniences, in regards to network management.

The distribution network normally has a partially looped structure, but it is operated radially by having open points in the network. The open points are of particular importance in network operations as they offer the possibility to reconfigure the network in maintenance outage and fault situations. Thus the management of open points is an extremely important task.

The previous method of open points data management was to have pins in paper maps on the wall. In this situation, there were only off-line network calculations made mainly for network planning purposes. The fault location was laborious with limited information available and in operations planning the main tools were intuition and experience. Thus, there was also a great need to develop a support system for network management.

Development
An extensive development of DMS was carried out in Finland over the last decade, with system suppliers, the Tampere University of Technology and a Finnish utility, which has made a strategic decision to focus on the maximum use of distribution automation instead of putting money into primary networks. As a result, an advanced and integrated DMS was developed, where SCADA and NIS are the main information sources. The system provides application functions for network monitoring, operations planning and fault management purposes. The foundation of most functions lies on the system integration, which means using process data together with network information to generate more information. The network monitoring means topology management and real time network analysis.

Fault location
One of the best examples of integration based functionality is fault location. In the case of faults in distribution networks, the fault current...
The situation was analysed and a long-term development plan for the organisation was small and flexible enough for changes to be made. Those in charge were open to new ideas and the network operations amongst utilities were rather low. In Finland in the late 1980s, the level of automation and the overall number of customer calls is also small.

Improving customer service
An important part of fault management is handling the calls of customers. Most calls simply mean additional work and are a waste of the operator’s time in MV-feeder faults. Automatic telephone answering machine results in improved customer service and allow the operator more time to concentrate on fault location and network restoration. The DMS informs the answering machine how to respond depending on the outage situation. The information includes the reason and the range of interruption, and the phase and expected time of restoration. In the case of faults in LV network, the operator is not aware of the fault until the customer calls. In this case the customer call is used in fault location. This functionality is usually called Trouble Call Management (TCM).

The main reason for the different prioritisation of the functionality is the awareness of the faults in MV networks. In Finland, only in the case of LV vaults is the trouble call based fault location needed and in those cases the number of interrupted customers is limited and in turn, the number of customer calls is also small.

DISTRIBUTION AUTOMATION AS A UTILITY’S CORE STRATEGY
In Finland in the late 1980s, the level of automation and the overall organisation of network operations amongst utilities were rather low and old-fashioned. However, the situation was favorable for remarkable changes. Those in charge were open to new ideas and the organisation was small and flexible enough for changes to be made. The situation was analysed and a long-term development plan for future network operations was made. The plan stated that investments should be focused on distribution automation instead of the primary network.

A new Network Information System (NIS) was acquired in 1987. The system was PC-based, offering inexpensive solutions for data management and network calculations. The old-fashioned SCADA system was replaced in 1988 with a modern and inexpensive PC-based system. In this context, the revolutionary selection was the remote terminal technology. Instead of traditional remote terminal units (RTU) a new concept was chosen; integrated secondary technology. This allows for the use of new feeder terminals for both relay protection and remote control. The shift to the new technology was made step-by-step between 1988-1992, so that in the end, all relays (feeder terminals) in all substations were identical.

In addition to the substation control the building of remote controlled disconnector stations was initiated. There are about 600 line disconnectors of which today, 100 are remote controlled.

One of the results achieved by the implementation of the strategy was the development of the mean outage time per fault, which is good measure of operational efficiency. The figure has decreased by 100 per cent over ten years, while at the same time labour cost savings were achieved.

New focus
Looking at the present situation a number of new directions can be found. With regards to faults, the main focus in terms of new development will be on fault prevention instead of fault location. Future applications will be able to indicate some faults before they cause a trip and consequently an interruption to the customer. Another part of preventive fault indication is overall condition monitoring and the optimisation of maintenance. Nowadays, most maintenance is carried out in a similar way to calendar based car maintenance.

The importance of power quality is growing all the time. There is a constant need to improve or at least maintain power quality, as well as a dramatic need for power quality monitoring. A primary requirement for the power companies is the responsibility to prove the adequacy of their power quality, including outages and voltage quality. This information can also be applied to network planning in order to allocate investments to the right parts of network.

The huge development of mobile communication technology also brings about a number of new possibilities that can be applied in distribution network management. At first it provides advanced communication for field crews and may even lead to mobile control centres. There is still a centralised processing requirement, but at least part of the control centre operations can become mobile. Together with the preventive fault indication there is a vision that some faults can be cleared without disturbing the customers and even the control centre.

FUTURE DIRECTION
IT already plays an important role in distribution management and its role is expected to increase in the future as IT continues to develop providing more openness, more capacity, more information and as a consequence, an increasing number of possibilities. The Internet and especially mobile IT technology offer great potential.

However, IT is not a driving force in the development of electricity distribution, but just an instrument. The most important driving force is the market requirement, along with the continued deregulation of the power markets, the awareness of power quality and the effectiveness of network operation. Ultimately, the development of new IT applications is based on a third factor – innovations. The intelligent application of new possibilities in a changing environment.