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# WHITE PAPER

## Mobitex Technology

A short introduction for application developers

# Contents

# Preface

This document describes the Mobitex system where the intended reader is an application developer looking for more information about Mobitex.

The relevant interfaces to the Mobitex Wireless Data Network are described in brief.

Also described are some general considerations that are valid when designing applications for a mobile environment such as Mobitex.

# 1 Background

Mobitex is a dedicated wireless data communication network. It is the leading narrow-band wireless data network communication technology worldwide. The system has been refined since the start in the mid-eighties and has been proven to work efficiently on all continents. The number of Mobitex users worldwide is growing, as is the number of network operators. This document will give the reader an insight to why the Mobitex network has become the world leader in narrow-band wireless data communication.

Mobitex provides a safe and reliable method of transmitting mobile wireless data to and from mobile terminals. The main function is to transmit user messages, packets of data called MPAK, which are further described in later chapters. In order to provide even more functionality for the end users, other functionality has been added and is described in the “Mobitex Features” chapter.

# 2 Network overview

The Mobitex uses a hierarchy of switches and base stations to route data packets to and from end users. This picture is an overview of the system where the internal parts are described below.

## 2.1 Mobile terminals

The mobile terminals communicate with the base stations. Data can be sent to both servers and other mobile terminals. However direct mobile-mobile traffic is not possible, the traffic is always routed via the base station even if sender and receiver is roamed in to the same base station. The mobile terminals only communicate with the base stations

## 2.2 Base stations

The base stations communicate with the mobile terminals roamed in to them. The base stations are connected to local switches (MOX), which routes traffic to other regions.

The main function of the base stations is to route traffic in their coverage area. It schedules the traffic on the radio path so that the usage of radio media is as efficient as possible.

## 2.3 Servers

In Mobitex, the servers for user applications are called fixed terminals (or FSTs). They are connected to the local level of switches (MOXs), via TCP/IP.

This is the hardware that is running the actual application. Several options exist for interconnection to the Mobitex network, all described later.

## 2.4 Switches

The switch (MOX) routes traffic to and from the base stations and provides connections between wireless devices and fixed terminals. The switch also provides an important gateway function to other networks.

## 2.5 Network Control Centre

The entire network is supervised and managed from the Mobitex network management centre (NCC).

1. The NCC handles all operation and maintenance tasks, including network configuration, alarm handling, subscriber administration and billing information

2. Individual base stations and other network components can be reconfigured from this central site, which minimizes the need for costly and time-consuming site visits.

# 3 Mobitex features

Mobitex provides network layer services up to and including layer three in the OSI model. The application developer implements layer four and upon both server and client side.

The basic principle of Mobitex is to provide a reliable and as secure as possible wireless network to ensure that data is not garbled or lost from the sender to the receiver of messages.

## 3.1 Open interface

The Mobitex network offers packet-switched data through an open interface maintained through the Mobitex Association (MA).

The associates in MA are network operators from both private and public backgrounds. One of the most important objectives for MA is to maintain the MIS (Mobitex Interface Specification). The MIS is the complete interface description for the Mobitex network, for both client and server sides of applications, as well as information for device developers.

Due to the nature of the information for the device developers the MIS is divided into two parts. One includes in-depth information about the radio link interface and is covered by a license agreement. The other is a free version of the MIS that any device developer or person can acquire in order to develop Mobitex applications.

The fact that MA maintains the MIS ensures that the interface protocols are ‘alive’ and constantly developed by the people using the network, the network operators themselves.

The MIS can be obtained from Mobitex Technology’s homepage:
http://www.mobitex.com

## 3.2 Routing

Routing in Mobitex is achieved by a layer three protocol called MPAK (Mobitex PAcKet). Every handheld device or server application has its own specific number, called MAN number. This is similar to an IP address and is unique in the network.

The Mobitex network is a hierarchical network; therefore traffic is routed in a hierarchy of switches. The basic principle is that if the base station or network node does not have any knowledge of the intended addressee, it will route the packet upwards. Since the network structure is a tree structure the packet will reach a node where the intended addressee is known and the packet will be routed down the correct network branch to the addressee.

## 3.3 Seamless handover

The mobile terminal, not the base station as in some other systems, decides Handover or roaming in Mobitex. This means that when the quality of communication is too poor on a certain base station, the mobile terminal will select a new one.

PDAs and other mobile terminals are often used by mobile professionals that are always on the move by feet, car or maybe train. They will therefore change base station, roam, more or less frequently. If they are doing some work on their device they do not accept communication being broken just because they are on the move.

Handover in Mobitex is handled without the applications performance being affected. Whether the application is sending and receiving data when it is on the move, traffic is not being lost. Packets are delivered even if the device is moving due to the routing protocol built in to the network.

One feature that helps implement the seamless handover is the Mailbox functionality described below.

## 3.4 Mailbox functionality

The mailbox functionality makes it possible to handle messages that cannot be delivered due to the fact that the addressed device is out of coverage or has just roamed to another base station.

The functionality is a store-and-forward functionality, which stores the message until it can be delivered to the addressee. This minimizes the disturbance for both sender and addressee, giving the end user a higher grade of service.

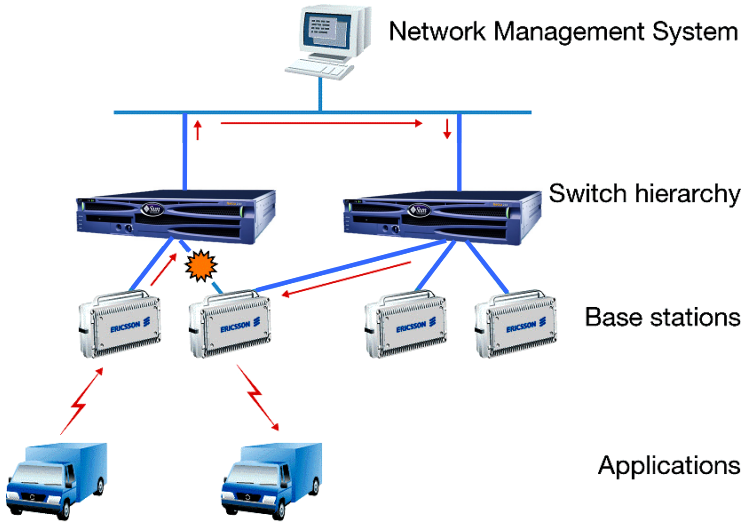
## 3.5 Group functionality

The group message functionality implements a way of transmitting multicast messages to a large number of subscribers. The group messages are a targeted type of multicast with a certain geographical area as the target area.

This functionality is useful when a certain messages have to be transmitted to a large number of subscribers in a certain area. A typical use for the functionality is for taxi dispatch systems where data about an ordered fare is transmitted to any taxis in that area.

## 3.6 Redundancy

Redundancy is a key issue for reliable communication. Redundancy in Mobitex is implemented in both the network and also as functionality that is aimed towards redundancy for applications.




On the network side there is redundancy on all levels. The network can be configured to ensure node redundancy, so that a node breakdown does not impair the switch capability of the Mobitex network. This functionality is not enough, since line breakdown can occur for transmission lines used to connect the Mobitex nodes. This means that the nodes can be configured to use alternative pathways for routing traffic. These methods assure that traffic is not lost due to breakdowns and minimises disturbances for the end user in the network.

Redundancy is also important for applications. If there is only one access point to the network, that will become a single point of failure, which is most undesirable from a redundancy viewpoint. To facilitate an easy way for the application provider to ensure reliable communication the HG (Host Group) functionality may be used. The HG functionality is an intelligent routing mechanism that not only facilitates multiple redundant entry points to the Mobitex network but also provides a more efficient routing. Packets are transmitted to the nearest exit point in the Mobitex network if the HG functionality is used, thus providing the users with quicker access to the application servers.

## 3.7 Traffic security and integrity

The MPAK protocol is a layer three protocol and the Mobitex system is a network service according to the OSI model. Although a lot of steps have been taken to ensure secure transmission, the service has to be considered a best-effort service. This implies that both the network and the application will have to provide some functionality in order to provide efficient communication. These are described below.

### 3.7.1 Transport layer functionality

Depending on the nature of the application it may have to be able to ensure that packets are received in the correct order. This functionality will have to be implemented in the application.

### 3.7.2 Acknowledgements

The network utilises negative acknowledgment for normal packet. This means that it is assumed that the transmission has succeeded if no error message is received. If, however, something should go wrong there are a number of negative acknowledgement messages that helps the transport layer in the application decide what steps to take to get the message through. The negative acknowledgements state the cause of the unsuccessful transmission, e.g. congestion, network problems or addressee out of coverage.

It is also possible to acquire positive acknowledgements for successful transmission if that is necessary for the application. The sender will get a receipt indicating that the receiver has indeed received the packet.

### 3.7.3 Encryption

Although it is somewhat of a hassle to eavesdrop on Mobitex radio communication it is still feasible for the tenacious ill doer. For a critical application or an application where sensitive information such as credit card information is being transmitted, it is suggested that some form of end-to-end encryption is used.

### 3.7.4 Security

The Mobitex network has built-in function that ensures that only the intended users can use the network. Validation is made using an Electronic Serial Number (ESN) programmed into the wireless device. This number is validated, ensuring that the ESN number corresponds to the correct unique MAN number.

It is also possible to set up a kind of VPN (Virtual Private Network) using built-in network functionality. This functionality is called CUG (Closed User Group). Only members of the group can communicate with each other. This functionality is ideal for police or other public service applications, enabling only authorised traffic.

## 3.8 Radio link

The radio link in Mobitex is what makes Mobitex what it is. The most critical part of a wireless data network is the radio link. The radio ether is a volatile environment for digital data. The radio link and protocol in Mobitex is an extremely robust protocol, which has proven to work for the most critical of applications. The radio protocol is called ROSI which is a refined version of the slotted aloha technique. The physical layer of the air interface is a modified version of GMSK.

The most prominent features for procuring safe and reliable data transmission over the radio are:

- Block coding
- Interleaving
- Selective ARQ (Automatic Repetition Request)
- Viterbi functionality

The radio protocol has been much improved in the range of power saving for the mobile terminals, giving device manufacturers the ability to provide smaller and more battery-efficient devices. This has lead to the small size devices we see today for Mobitex. It would not be possible to design the devices using so little battery power had it not been for the meticulously designed radio protocol, favouring power consumption for handheld devices.

Smaller, more energy-efficient devices often lead to a more appealing device, which potentially increases the customer base.

Mobitex is a narrow-band system using two channels with a bandwidth of 12.5kHz for uplink and downlink. Due to the sophisticated radio protocol it is possible to transmit data reliably with 8kbps.

# 4 Mobitex interfaces

In order to develop a new application for Mobitex or port an existing application to Mobitex it is necessary to develop or change current interfaces for network services to those of Mobitex. This chapter describes this in general from two viewpoints, server and client side, where the latter is the mobile terminal or handheld device.

## 4.1 Common interfaces

In order to send data messages using the Mobitex network all devices must implement the MPAK protocol. The main function of the MPAK protocol is to route messages from the sender to the intended receiver. The protocol also handles various delivery errors that can occur

The MPAK protocol comprises of not much more than the sender and addressee MAN numbers, time stamp information and some routing options. All in all, the overhead introduced by the MPAK protocol is only 11 bytes. A small overhead is essential for efficient wireless communication. More on this in the “Wireless considerations” chapter.

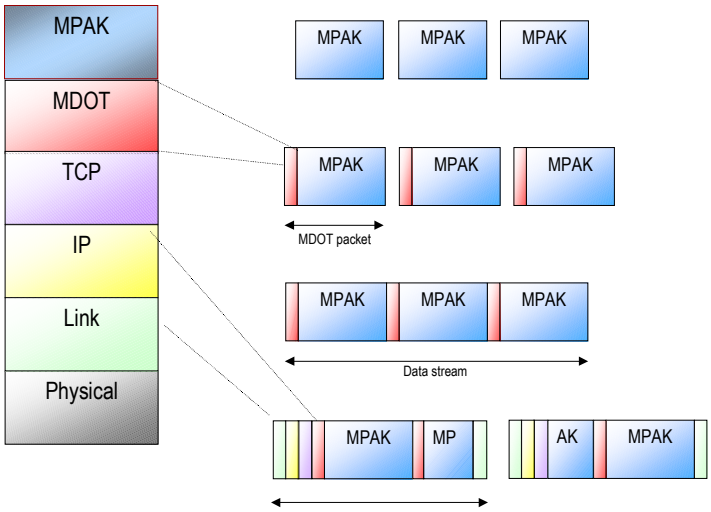
## 4.2 Server interfaces

Servers can be connected to the Mobitex network using TCP/IP.

### 4.2.1 IP connectivity - MDOT

A lot of the information an end user wants to acquire is on the Internet or at an intranet connected to the Internet. It is also practical for the application server itself to be located at the company that maintains it. Therefore, the need to connect to the Mobitex network from the Internet is rather important. This is solved, as it is possible to connect to the Mobitex network using the MDOT interface.

The MDOT interface is a very simple protocol mainly acting as a glue between TCP/IP and the Mobitex network. For the application developer this means that an MDOT driver will have to be implemented on the server side of the application, encapsulating the MPAK data but uses TCP/IP and Ethernet to connect instead of X.25, which has dominated historically.




It is important to note, however, that the MDOT-TCP/IP connectivity does not mean end-to-end TCP/IP communication between mobile terminals. MDOT and TCP/IP headers are stripped in the switch and the MPAK data is forwarded to the receiver. The reason for this is that TCP/IP is unsuitable for a mobile wireless data network due the inherent protocol functionality. TCP/IP was originally designed for data link with static characteristics and low risk of data loss or corruption. On a wireless link ,the link characteristics are constantly changes as the mobile terminal moves around in and out of the coverage area.

## 4.3 Client interfaces

The client interfaces describe the way a typical mobile application connects to a radio modem for Mobitex. The mobile application is typically running on some kind of computer, either a laptop or some type of single board computers, all depending on the application. They all have one thing in common though, since they use the MASC protocol for communication.

Not covered in this document is the way client applications are designed for specific PDAs or similar devices. Most such devices will have APIs or SDKs that allow application programmers to use the devices built-in functions in order to communicate using the Mobitex network. A special variant of this, the OBA functionality is available in some Mobitex radio modems and is briefly described below.

### 4.3.1 MASC

The main communication interface for mobile terminals is the MASC protocol. MASC stands for Mobitex Asynchronous Communication.

As the name states, MASC is an asynchronous protocol that uses an RS232 serial line for communication with the radio modem. Its primary objective is to be simple, since it should be possible to run the protocol on a device with limited memory and processing power. Another reason for keeping the protocol simple is for the ease of application developers. Being able to develop an application in a short time is always attractive.

The MASC protocol uses 9600bps data rate, which is good enough since the radio path uses 8000bps. The protocol procures mainly two things, the standard functions of a protocol (e.g. error handling) and also commands for communicating with the radio modem.

The protocol itself is as already stated simple and the functions it procures are mainly for asserting proper communication between the host and radio modem. The features are mainly for simple frame handling. The MASC protocol is a link layer protocol for encapsulating MPAK DATA.

The commands of the MASC protocol are used to obtain information from the radio modem. This information can be passed on to higher layers of the application so that it can react to different situations that can occur. Information that normally is interesting for the application is to know whether the radio modem is in coverage or not. There is a lot of information that could prove important to procure from the radio modem, which information is needed could only be determined on behalf of the application in question. Thorough description of all commands can be found in the MIS.

## 4.4 OBA “interface”

The M3000 as well as the Wavenet Boomer III radio modem has a feature that can eliminate the laptop or computer in a wireless Mobitex application. It is possible to run the application using the internal processing power of the radio modem.

The built-in functions makes, accessed through an API, makes it possible to access e.g. the sending of MPAK without having to implement a MASC driver on a PC.

Another feature of these modem is that they has a number of analogue and digital inputs and outputs, which can be use for numerous types of applications such as telemetry applications turning on and off equipment or measuring temperature.

# 5 Wireless considerations

Applications for a mobile wireless environment are somewhat different than applications design for fixed wired communication. The main difference is the radio path. Being the critical part of the network, this is often where the bottleneck in the system is located. The radio path is also a shared resource, which means that a misbehaving application will disturb other users as well as producing poor performance for its own user. In order to get as much out of the own application it will have to be designed with the conservation of radio capacity in mind.

As stated earlier, bandwidth intensive protocols such as TCP/IP does not work very well on wireless networks, at least not unmodified. It is possible to adapt the protocol using some kind of middleware that compresses the protocol, stripping off unnecessary overhead so that only the essential information is transmitted on the wireless network. Other factors to why the TCP/IP protocol does not work very well on wireless network are the slow-start algorithm and timer handling. Latency can be higher in a wireless network, which means that when the protocol tries to turn up the speed with which it transmits data and leaves a number of frames unacknowledged, the wireless network will take longer time to transmit the data than the protocol expects. Therefore TCP/IP will then consider the data lost and try to start over, thus introducing even more traffic, leading to serious switching problems in the network.

# 6 More information

More information about Mobitex can be found on:

www.mobitex.com
www.mobitex.org

It is also possible to get application support from the End-to-end solutions support group at Mobitex Technology in Gothenburg by sending an email to:


Mobitex.Tac@mobitex.com