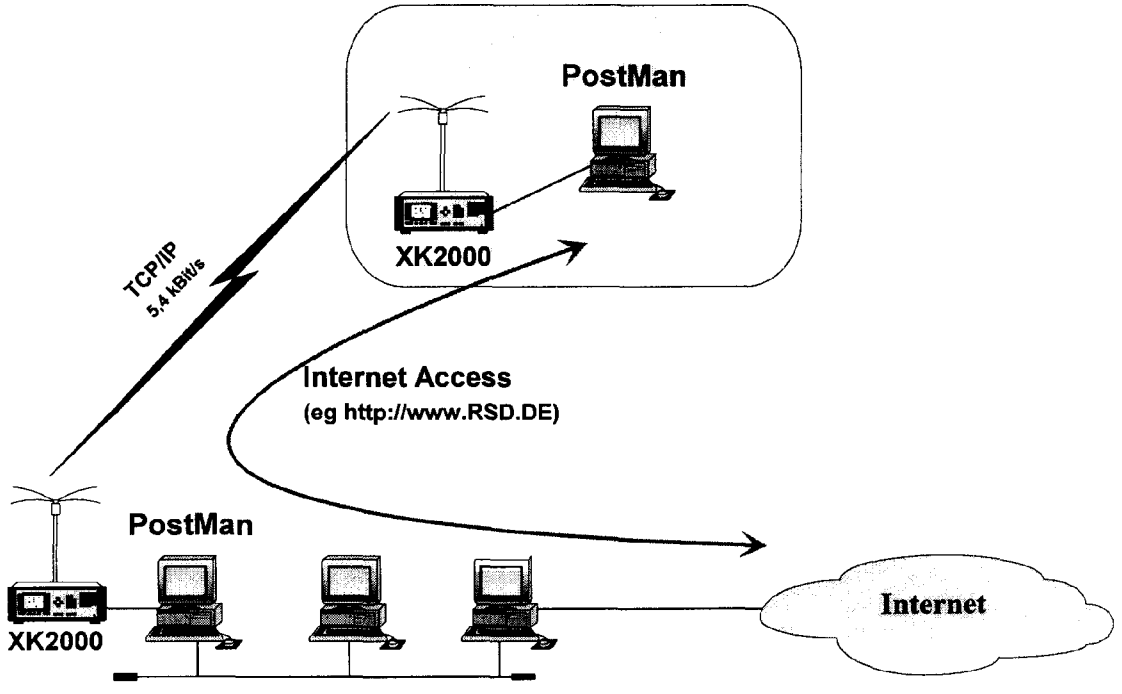
Wireless TCP/IP and Combination with Broadband Media

Thomas A. Kneidel
ROHDE & SCHWARZ GmbH & Co.KG
Abt. 2WFM
Mühldorfstrasse 15
81671 München, Germany

Objectives:
The presentation shows products for new applications (mobile IP) by using cots hardware and software components. This cots-components are implemented and adapted to fulfil services in the commercial and military field.
The following part describes the technique more in detail.

Up to now the demands of the military command were implemented in special – mostly analog – communication networks. These, however, present the great disadvantage that they are not interoperable or only to a limited extent due to the different proprietary protocols used. Among all these protocols the **TCP/IP protocol** is evolving as the **international standard** for data exchange across network borders. The TCP/IP protocol used worldwide on Internet or in X.400 networks guarantees interoperability on different computer platforms irrespective of manufacturer and operating system.

Rohde & Schwarz developed a software solution, called *PostMan* that enables **transparent implementation of the TCP/IP protocol** at the HF air interface and so ensures unhindered transmission from wire to radio communication networks. For the first time in history, for example, E-mails to or from any Internet address can be sent or received from a ship across thousands of kilometres. Even Internet surfing via short-wave with commercially available browsers is possible for every mobile station. Every TCP/IP-based application can be carried out via radio using *PostMan* which covers the entire HF/VHF/UHF band.



Paper presented at the RTO IST Symposium on "Commercial Off-the-Shelf Products in Defence Applications "The Ruthless Pursuit of COTS"", held in Brussels, Belgium, 3-5 April 2000, and published in RTO MP-48.

Fig. 1: Wireless TCP/IP via HF

In some regionally limited radio networks TCP/IP-based communications are already being implemented. PostMan allows these networks to be interconnected even across large distances to obtain a full-coverage network. Within the framework of a trial at the material inspection agency of the US Army Communications Electronics Command (CECOM) this **interoperability** was tested using existing VHF/UHF data radio networks. Separately operating radio networks of the SINCGARS (Single Channel Ground and Airborne Radio System) and EPLRS (Enhanced Position Location Reporting System) type were interconnected by means of PostMan and data were exchanged across different radio links without any interaction.PostMan not only links the individual radio networks but also enables access to wire communication networks as for example Secure Intranet (SIPRNET).

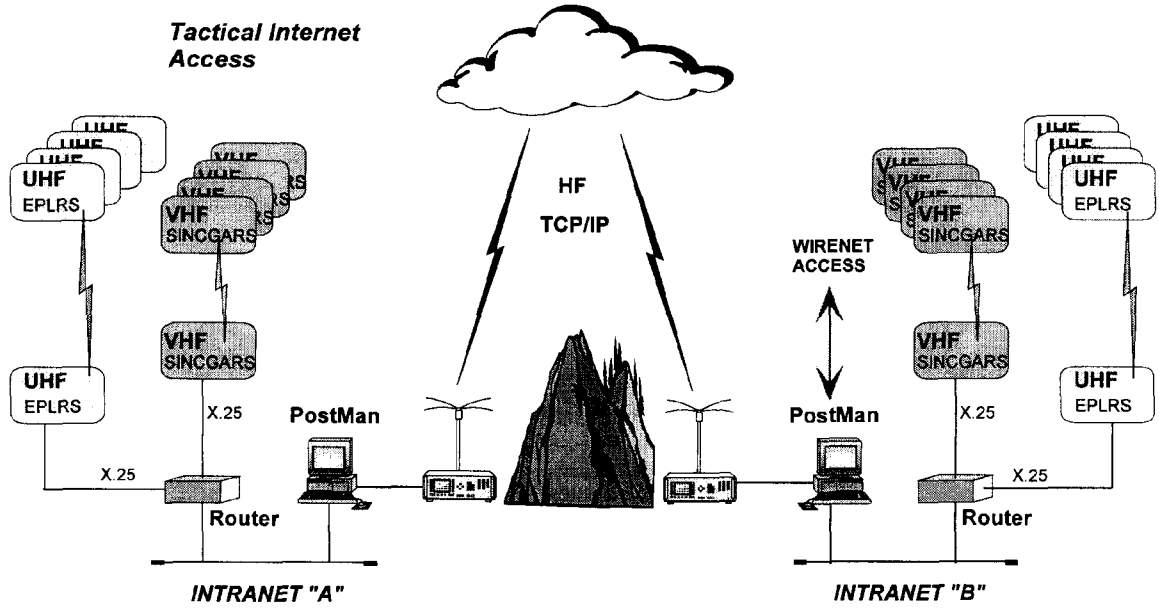


Fig. 2: CECOM Trail

In addition to transparent TCP/IP access via radio, the software package *PostMan* contains an intelligent E-mail system. This **E-mail client** is especially adapted to the requirements of a radio-based communication network (based on message application programable interface – MAPI – of MS Exchange).
In this connection, the E-mail-client contains a new **address format RSPeer** that ensures the direct delivery of the message to the computer of the addressee. The message is physically available on the hard disk of the recipient, the usual detour to the central post office being avoided. This delivery procedure excludes any misuse of and unauthorized access to the mail traffic of a network. Moreover this format ensures that one's own information is secure. This type of addressing also minimizes the data exchange on the frequencies available and so eases the traffic load of the radio network.

The messages exchanged are furthermore protected by integrated **encryption** with an algorithm that is stored on a PCMCIA card.

PostMan allows structures and **network configurations** to be defined as required. Traditional hierarchical **official channels** can be implemented. If requested, the horizontal distribution of E-mails, which is often regarded as a disadvantage in military applications, can be suppressed.

In addition to HF/VHF/UHF radio, various other transmission media such as SatCom, ISDN or GSM may be used. *PostMan* optimizes the utilization of the available media by **alternative routing**. Should the medium intended for information transmission be interrupted, *PostMan* dynamically and automatically selects an

alternative medium (according to a priority list) and continues transmission. Prior to selecting another medium *PostMan* checks whether the addressed station can be reached otherwise, eg via a relay station (**alternative paths**). The automatic change to alternative transmission media is a special feature of *PostMan* which no other E-mail system offers.

The E-mail client of *PostMan* possesses all the functions a modern E-mail system has to provide. This includes logging of all actions in a log book and assignment of different priorities to messages and addressees. Additional transmission acknowledgement and individual preselection of the time at which the message is to be transmitted support the use of *PostMan* in radio networks.

The *PostMan* software package from Rohde & Schwarz gives radio networks access to the existing worldwide wire communication networks and their applications. The E-mail client moreover optimizes the utilization of electronic messages in military applications.

Combination with broadband media

The ever increasing volume of information in the data networks congests the available transmission channels. Modern broadband transmission media point the way out of this bottleneck. Especially in conjunction with conventional narrowband media, the new media ensure efficient utilization of the channels and achieve so far unattained data rates.

For stationary applications, the data highway to the office or living room can take on a variety of forms. Wireless local loops can be implemented via the air interface using microwave links or the access to data can be accelerated by means of fiber optics, power lines or TV cables. Mobile applications face serious limitations with the data transmission bottleneck and the low data rates being at the root of the problem. Modern technologies (eg ADSL), intelligent management systems, complex coding methods and adapted protocols (eg WAP) open up new approaches. Same as in the case of stationary applications, considerable improvements are expected of the use of new broadband transmission media. At present, the role that third-generation mobile radio with UMTS (universal mobile telecommunication system) is going to play in this scenario is not yet clear. The following media look promising in easing the situation:

- DAB - Digital Audio Broadcast
- DVB-T - Digital Video Broadcast Terrestrial
- GBS - Global Broadcast Service
- GSS - Global Satellite Service

The new media are suitable for both broadcast applications and point-to-point connections.

Broadcast

In broadcast operation, individual subscribers or entire groups receive data from a center without having to have access to the source of information. Internet contents such as newspapers or market reports are emitted to subscribers via Internet push services. The subscribers store the received data in their PCs. Using standard web browsers the data in the PC can be read at any time. This fast and unidirectional way of distributing information is of great advantage in military applications since the recipient of the message does not have to send an acknowledgement which could enable the enemy to intercept and locate.

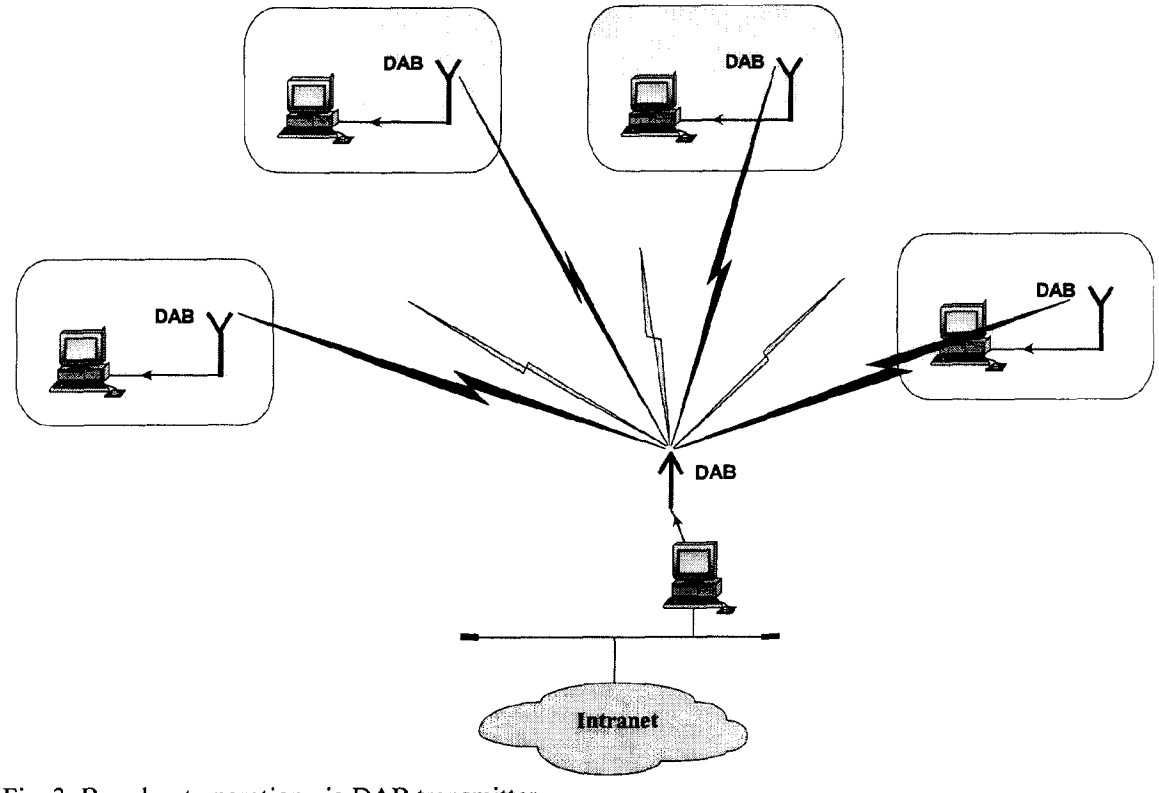


Fig. 3: Broadcast operation via DAB transmitter

Point-to-point connections
With point-to-point connections, the desired information can be called from an interactive data network, provided that the user is connected to the information source. Broadband media however have the disadvantage that they normally require considerable technical outlay (weight, space, power supply, ...) at the transmitter end. Moreover they are often only partly suited for mobile applications. A solution that can easily be implemented on an aircraft carrier, for example, may well be literally unbearable for an infantryman. The fact that most interactive multimedia applications are however based on asymmetrical communication involving short queries and extensive replies favours hybrid solutions. The access to the Internet, for example, can be implemented via narrowband media such as shortwave, tactical radio, TETRA or GSM, while the data themselves, which are usually quite voluminous, are returned via broadband media. This ensures an extremely efficient utilization of the available resources and at the same time makes a virtue of necessity.

The choice of the transmission media is essentially determined by the distances to be covered. Additional decision criteria are data volume, transmission speed and security.

LOS range
DAB is regarded as the most promising broadband media for the LOS (line of sight) range. DAB was originally designed for the transmission of sound to mobile and portable receivers, but it is also an ideal platform for the secure transmission of digital data of any kind. DAB networks operate as single frequency networks (SFN) and so ensure frequency economy. Information is distributed from various transmitters in program multiplex to different receivers at the same frequency. OFDM (orthogonal frequency division multiplexing) coding as the modulation method provides excellent transmission quality, which ensures reception even at high speed (up to 900 km/h).
The data are transmitted in band III and L band (174 MHz to 227 MHz/ $\approx$ 1.5 GHz) at rates of up to 1.5 Mbps (megabit per second). The information in IP (Internet protocol) format is inserted into the ETI

(ensemble transport interface) data stream in line with ETSI-ES-201-735 (European Telecommunications Standards Institute).

The DAB counterpart for the transmission of TV signals is DVB-T that has similar characteristics and capabilities as DVB but enables mobile reception at low speed only.

To distribute information, for example in the deployment of rapid crisis reaction forces, mobile DAB transmitters can be set up without any problems even in remote areas.

As regards point-to-point connections in military applications, the narrowband back channel is preferably by means of VHF/UHF radio links. Basically, GSM (global system for mobile communications) could also be used for this purpose. GSM however requires an intact infrastructure that cannot be guaranteed in military scenarios. Combat net radios on the contrary set up reliable links even under conditions of jamming and impede interception.

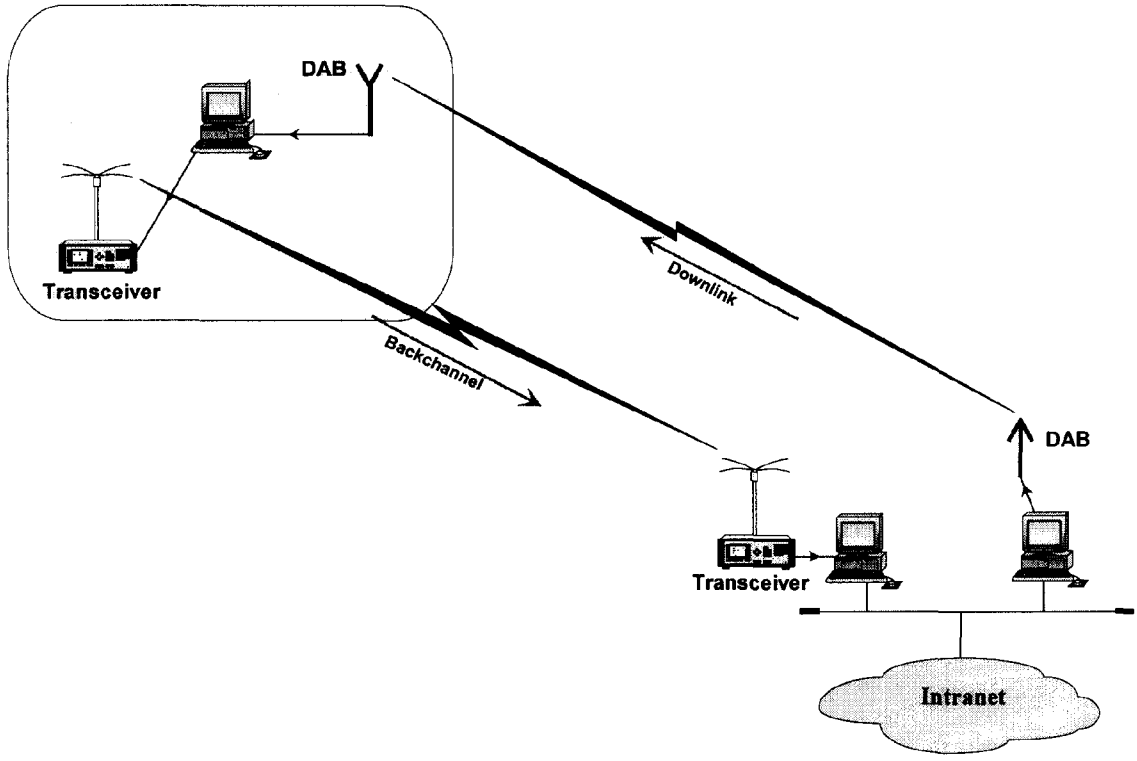


Fig. 4: The Rohde & Schwarz product range includes all components necessary for point-to-point operation: tactical M3TR radios, DAB and DVB transmitters and IT product PostMan.

The mix of DAB and tactical radio opens up a wide variety of applications. If a battalion command post has to be relocated for example, database updates can be transmitted to the new site within seconds. Awkward troop movements required at present for database update would so become a thing of the past.

Supraregional sector
Another already frequently used method is the integration of digital TV into the world of communications. With this approach, the desired information is requested from the Internet via the usual transmission paths. The reply data stream, however, is routed from the source (server) to the operation center of the satellite network and transmitted to the user via a fast, broadband satellite downlink.
This technique of course permits the pinpointed transmission of information in broadcast mode to individual users or groups.

It is basically intended for the wide-base and consumer market, but can also be employed in mobile radiocommunications. Data are called via HF for example and returned via satellite.

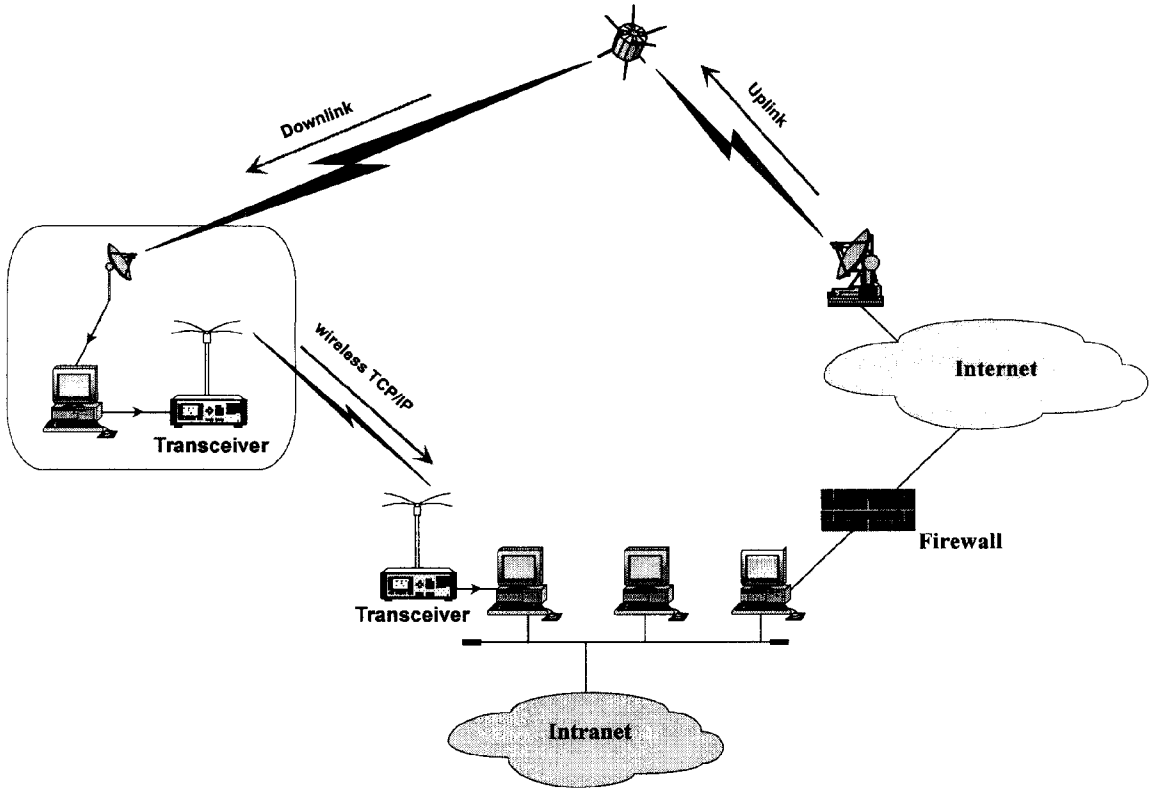


Fig. 5: Combined shortwave satellite transmission with SpaceMan from Rohde & Schwarz

Routing the Internet data stream in this way becomes possible by modifying the Internet protocol (IP), which is responsible for route selection in the Internet. Using what is called IP encapsulation, the IP packages are put into an "envelope" addressed to the operation center. The operation center reads and routes on the envelope contents and, acting as a new user with respect to the addressed Web server, sends the information to the requesting party via satellite. Satellite transmission is unidirectional in this case, ie information can be received but not sent via this path. With Internet requests usually being very short (eg http://www.rsd.de) and the reply data volume comparatively large, the advantages of this technique make themselves felt all the more.

SpaceMan combines the above commercial principle with radiocommunication. Requests to the Internet are made via radio (HF/VHF/UHF) and the help of *PostMan*, and transmission of requested data via fast satellite links. Access to this modern information technology (IT) with radio linkup is realized by means of PostMan, which allows transparent TCP/IP radio data transmission. PostMan in conjunction with shortwave transceivers of the XK2000 family provides unrestricted access to wired communication networks via radio links from any point on the earth. Reception of satellite signals is implemented in SpaceMan by commercial system solutions adapted to radio technology. This provides wireless Internet access unimpeded by the constraints of low data rates.

System components and technology
Apart from the radio equipment, the user requires a dish for the reception of satellite signals and a decoder, which is in the form of an extension card installed in the PC. PostMan together with control software sends user's requests via radio and handles download of data from the Internet to the PC via satellite. In most cases, a commercial elliptical 60 cm dish or similar will do for the reception of satellite signals.

Satellite transmission is via free channels - the socalled transponders - of TV satellites such as ASTRA or EUTELSAT. Data transmission is based on DVB/MPEG2 (digital video broadcasting/MPEG2 is a method for moving picture compression). At the protocol level, a special ADBS (advanced data broadcasting system) extension is used, among other things, to provide filter functions in addition to addressing and routing. ADBS offers various protected access modes (conditional access, security, privacy). This allows individual hardware addressing of any station.

Data rates
The broadband satellite links allow transmission of Internet data at rates up to 400 kbit/s. This is several times the data rate of conventional V.34 modems with max. 56 kbit/s or ISDN with 64 kbit/s. The data rate of 5.4 kbit/s afforded by shortwave appears modest in comparison, but is of little consequence considering that Internet requests are rather short.

Problem-free operation is guaranteed as long as the user is within the footprint of the satellite. This combination of radio and satellite transmission can also be used on ships with the benefit of undreamed-of data rates at low charges.

Safety
The transmitted information is encrypted to protect it against unauthorized interception. In addition, end-to-end encryption provides a high degree of safety.

Conclusion
The approaches described above open up completely new perspectives to mobile users who in the past had no access to wired communications because of poor infrastructure.