Making the case for high speed data

Executive Briefing

EADS DEFENCE & SECURITY

Contents

Executive summary

Public safety professionals need radio communications to support them as they work to keep us all secure. Providing these professionals with more efficient data communications is a strategic investment in improving the safety of citizens, so investment decisions in this area can never be based solely on financial arguments.

Nevertheless, decision-makers do need to have an insight into the financial facts when making the case for investing in data services for public safety professionals. This study analyses the techno-economics of the main solutions for introducing high-speed data services to PMR networks: upgrading the current network infrastructure to support higher data speeds, or building a new, high-speed data network. The anticipated revenues gained from high-speed data public safety users are compared to the cost of introducing the solution.

This study looks at a TETRA network in detail as an example, but the analysis can be applied to any PMR technology that supports an upgrade path to high-speed data.

Calculations show that a single network for both voice and high-speed data is the optimal choice. It can be demonstrated to be economically feasible, and it is technically optimal for the network operator as well as to users. For TETRA networks in particular, the best approach is to upgrade them to support higher data speeds using the TETRA Enhanced Data Service (TEDS).

Calculations also show that building a separate, smaller-scale high-speed data network (overlay network) for special applications and coverage can be an economically feasible option. Such a network would have to offer one or more highly valued applications to attract a large number of users in a relatively small area of coverage.

Background

Although the earliest established public safety digital radio communication networks have been in operation for more than ten years, the networks are still mainly used for voice communication and short messaging. It is very difficult to predict how the use of other data services will develop. This is why operators of public safety radio networks consider it risky to make major investments in data services.

In addition to voice communications, today's networks support short messaging (such as Short Data Service (SDS) messaging in TETRA) and narrowband data transfer at speeds of around 1.2 ... 4.8 kbit/s.

The most popular data application for professional users today is Automatic Vehicle Location (AVL) together with its derivative, Automatic Person Location (APL). These enable control rooms to keep track of field operatives. For example, a radio terminal equipped with a GPS device can update its location to a server at specific time intervals. This allows an application to show the position of the terminal on a digital map.

Field operatives can also make database enquiries. They can check vehicle registrations for information on stolen cars or unpaid traffic violation tickets, for example, or criminal registers to see if a person has a criminal record.

Emerging applications include those for personal identification, such as fingerprint or biometric queries. These applications require a packet data connection with short response times. When there are only a few users at a time, today's PMR networks can often provide an adequate service, but when the applications are widely adopted, faster data speeds are called for. Already many public safety organisations use public cellular data services over GPRS or WCDMA networks for operational applications, when those services can provide the necessary security, reliability and coverage.

Governments or county officials in several European countries have made a centralised decision that their public safety professionals must adopt new data applications. Such coordinated decisions can make it easier to find the budget for the necessary investments in authority networks for data.

Public safety professionals have specific requirements for data

Services are often an on-off choice

Public safety professionals and consumers do not have the same requirements for data services. For example, consumers adopt new services based on individual choice, but when public safety organisations introduce a new service, they need to know that everyone in their organisation can use the service. As a rule, they subscribe to a service collectively, an entire organisation at a time.

Data needs to be mission critical

Public safety systems must work during major incidents and exceptional situations to safeguard life and property, making them mission-critical. In other words, the application must operate reliably in situations where public telecommunication services may not be guaranteed.

In addition to voice, short data messaging has already become a mission-critical application for public safety. In contrast, any application built on top of a public cellular network, for example, ticketing drivers based on licence plate recognition, is not mission-critical in nature.

Most of the time, non-mission-critical applications work well enough even for the most demanding of users, such as the police. However, as soon as normal conditions turn into an emergency, a best effort service may not be enough. In a crisis it is even more likely that the police will have to run background checks on suspects, identify explosives, or have to locate the closest backup unit.

In any country with an established nationwide radio communication network for public safety, decision-makers need insight into the total cost of providing data services to the users. Any new investment in the authority network needs to be compared with the cost of a similar service over a commercial cellular network. At the same time, it must be understood that a public cellular network may provide the data speed but not necessarily guarantee the availability of data services at critical moments (for example, cellular services were unavailable following the London and Madrid bombings). It is therefore important to see how much it costs to provide guaranteed, mission-critical data services that will continue to operate during major incidents.

TETRA network evolution to high speed data

Challenge: Today's TETRA networks are dimensioned for voice communications

Existing public safety TETRA networks are dimensioned for voice simply because this service is so dominant. As a rule, base station sites in urban areas therefore have two TETRA transmitter/receivers which means eight channels altogether for control and traffic.

Seven traffic channels are shared by telephony, circuit data, packet data, and trunked group communications, with dimensioning being based on voice. This means that the use of duplex telephony and data may be limited during high peaks of trunked group communications.

Several well-established authority networks are already experiencing an exponential increase in data traffic on the control channel, due to short data messages (SDSs). This is because authorities have widely adopted Automatic Vehicle Location (AVL) applications as well as register queries, which need less than one kilobyte of data transferred at a time.

In wide area TETRA networks, the average number of active users in one TETRA cell varies between 20 and 80. The cell capacities in urban areas are usually dimensioned to serve up to 150 simultaneous users who generate peak traffic. This means that the two transmitter/receivers provide:

- 2-4 duplex call channels for 15-30 mErl telephony traffic per user
- 3-4 channels for trunked group communications
- 1-2 channels for packet data (very lightly used in today's networks), and
- 1-2 control channels for signalling, control and SDS messaging.

The main control channel in a base station site serves 5-10 SDSs per second. This means that on average, full load is reached if each user sends one SDS every 15-30 seconds.

These estimates show that large numbers of SDS messages generated by the extensive use of AVL applications and register queries will mean a heavy load on the control channel. In many TETRA networks, this has already become a reality. Temporary relief for this situation can be gained if a second control channel is allocated for SDS messages. However, this only alleviates the problem. When more data applications generating more SDS messages are introduced, capacity will become an issue again.

The approaching maximum limit of SDS messages is leading TETRA network operators to look for solutions, such as data applications that use IP packet data instead of SDS, or ways to significantly increase the network capacity for SDS traffic. The latter solution has a significant benefit: applications over SDS are easier to implement reliably because maintaining an IP session is difficult while the user is on the move.

Solution for data evolution: TEDS capable network

There is one way to meet the SDS capacity challenge and also provide high speed IP packet data: TEDS evolution. A TEDS capable network, be it a TEDS upgraded TETRA network or a separate overlay data network, will yield significantly more spectrum-efficient data traffic.

One TEDS carrier will support as much as 40 times as much data as a single-slot carrier, and 10 times as much as a multi-slot carrier. TEDS will multiply the over-the-air SDS capacity of a base station by tenfold. This means that the base stations can handle the SDS traffic even at peak times such as during incidents when the movements of a very large number of operatives need to be tracked in the area of one or two base station sites.

A TEDS capable network can support high volumes of transactional narrowband data and provide high speed data services, such as transmitting photographic images, electronic reports from the field, and person identification information.

Key revenue parameters in analysing the techno-economics of TEDS

Public safety data applications, supported by the data speed and capacity of TEDS

In the techno-economic analysis of TEDS, it is assumed that there is one 50kHz TEDS carrier on every base station site, providing 80kbit/s capacity.

When there are 100 users per site, one TEDS carrier can deal with:

- data traffic of 50 MB per user per month (assuming eight hours/day and 20 working days/month) or
- data traffic of 250 MB per vehicle per month (scaled over continuous 24/7 use).
- Peak hour capacity provides 360 kbytes per user.

These estimations are comparable to heavy user commercial GPRS/EDGE services.

Public safety data service supported by TEDS capability

By far the most commonly used application in PMR networks today is Automatic Vehicle Location, AVL. This application uses SDS short messages, which are comparable to text messages (SMS) in public cellular networks. These SDS messages, containing the current position of the vehicle are sent at regular intervals to the control centre.

Tracking a field operative

It is assumed that a field operative works eight hours per day, and 20 working days per month, equalling 160 hours/month.

If the operative's position is updated once every five minutes (12 times in an hour):

12 messages/hour x 160 hours/month = 1,920 messages/month

Tracking a vehicle (a police car or an ambulance, for example)

It is assumed that a vehicle spends 16 hours/day on the road, every day. This equals 480 hours/month.

If a vehicle's position is updated once a minute (60 times in an hour):

60 messages/hour = 28,800 messages/month.

Transactional data services (narrowband and wideband)

The most commonly used data services in public safety today are register enquiries, field reporting and person identification. These require data transactions of some kbytes, or in case of file/picture transfer, up to 100kBytes.

Assuming up to 5-10 data transactions of (1-10 kbytes) and 2-3 high resolution pictures (100 kbytes) per peak hour results in 360 kbytes traffic, allocated for each user during peak hour.

Tracking and transactional data services put together create 50...250 MB of data per month per user. In this techno-economic analyisis, corresponding commercial tariffs for GPRS/EDGE data services are used as a reference.

Cost of using commercial cellular data services as an alternative

Using common tariffs for high-volume text messaging and GPRS/EDGE based IP packet data (in a public cellular network), costs would be as follows:

10-20 €/month for tracking a field operative (2,000 messages/month)

50-100 €/month for tracking a vehicle (30,000 messages/month)

10-50 €/month for IP packet data services (50-250MB/month).

AVL/APL applications generate a significant volume of tracking messages. The cost for such a large volume of messages sent over a public cellular network would be very high. The cost for IP data varies greatly between countries, the lowest prices being found in Western countries with aggressively competing cellular network operators.

Revenues for the operator for TEDS services

Information on PMR operator revenues gained from data services remains scarce: today's billing is largely based on a monthly fee that covers both voice and available data services (SDS, slow data). In addition, flat rate tariffs are used because there are limited mechanisms in PMR networks to base the billing on actual use of services. (Charging a flat rate with a monthly limit is also common for public cellular data services today.)

It is possible, however, to estimate feasible data tariffs for PMR networks. This can be based on the tariff for a comparable cellular data service, described in Section *"Cost of using commercial cellular data services as an alternative"*. A margin could be added to cover the cost of better reliability of services, especially during major incidents.

Based on typical tariffs for cellular wideband (GPRS/EDGE) data services with an additional margin for better reliability of service in TEDS, TEDS IP packet data service tariffs should be between 15 and 60 €/month and tariffs for TEDS high volume AVL tracking between 10 and 100€/month.

Table 1 Summary of revenue parameters generated by TEDS supported data services.

Nr of users per active site on average	0….100
Maximum nr of users per site	100
Tariff for packet data services TEDS max 80 kbit/s	15 €/month GPRS
Tariff for SDS in low volume	0 €/month included in basic TETRA voice + data fee
Tariff of AVL, update once in 5 min (Tracking field operatives, 2,000 messages/month)	15 €/month 80% users (handhelds)
Tariff of AVL, update once every minute (Tracking vehicles, 10,000 messages/month)	25 €/month 20% users (mobiles)
Other end user costs (Terminals, provisioning, …)	0 €/month not included in calculations

Key cost parameters in analysing the techno-economics of TEDS

Capital and implementation expenses, CAPEX and IMPEX

Capital and implementation expenses, CAPEX and IMPEX, include the cost of purchasing and building the network infrastructure. As far as the total cost of providing data services is concerned, there are two basic options: using the existing PMR network for high-speed data, or building a new, separate high-speed data network.

The first option, upgrading the current PMR network to support high-speed data is the most cost-effective way to introduce high speed data, as at best only additional radio capacity (TTRx) is needed and existing TETRA infrastructure can be used.

Adding more capacity as well as upgrading the TETRA core network may also be needed.

Depending on the scope of necessary upgrades for base stations and core network elements, the high-speed data upgrade would mean a 25-60% increase in the overall CAPEX. The CAPEX for a TEDS upgrade is therefore assumed to be in the range of 25-55k€.

Figure 1 illustrates the original and additional components of capital expenses when introducing TEDS high-speed data to an existing TETRA radio network.

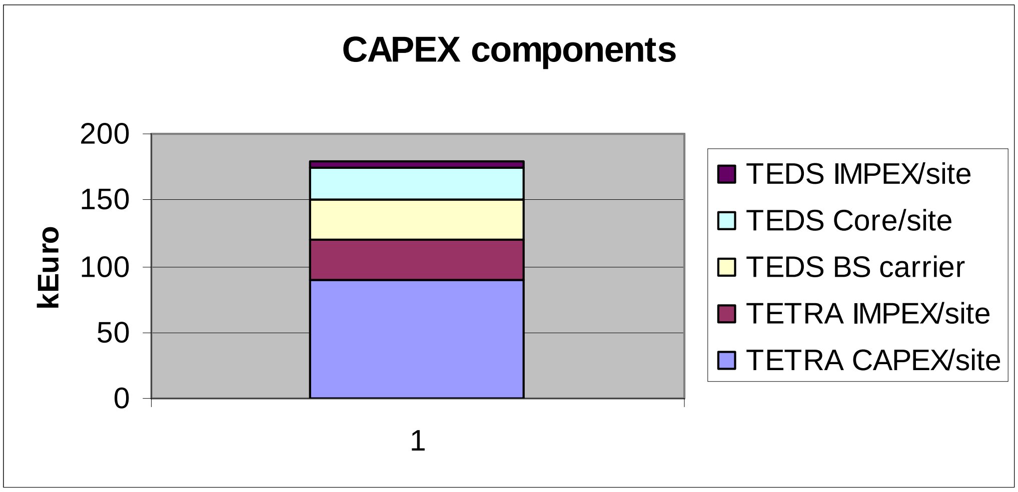

Figure 1 Costs included in CAPEX.

The second option, building a new network for high-speed data requires investment in another network comparable to the investment in the initial voice network, even when using the same radio sites. Re-using antenna equipment, power, base station and switch site equipment achieves synergy savings. We assume that building an overlay TEDS network would require 70-80% of the CAPEX for a similar size PMR voice network.

When the cell sizes of the overlay high speed data network are smaller than the existing PMR network cell sizes, the CAPEX can easily be many times that of the PMR network.

CAPEX, including IMPEX (implementation cost) for a new overlay data network would vary between 60 and 120 k€, depending on the synergies realised.

120 k€ CAPEX+IMPEX leads to 1000 €/site/month, for depreciation and 500€/site/month average interest (8% interest rate).

Operational expenses, OPEX

Operational expenses, OPEX, include the cost of keeping the network up and running: administration, technical staff, maintenance, site and antenna rentals, cost of leased lines, etc.

Figure 2 illustrates the operational expense components of a TETRA voice network and the additional OPEX components to also support high-speed data.

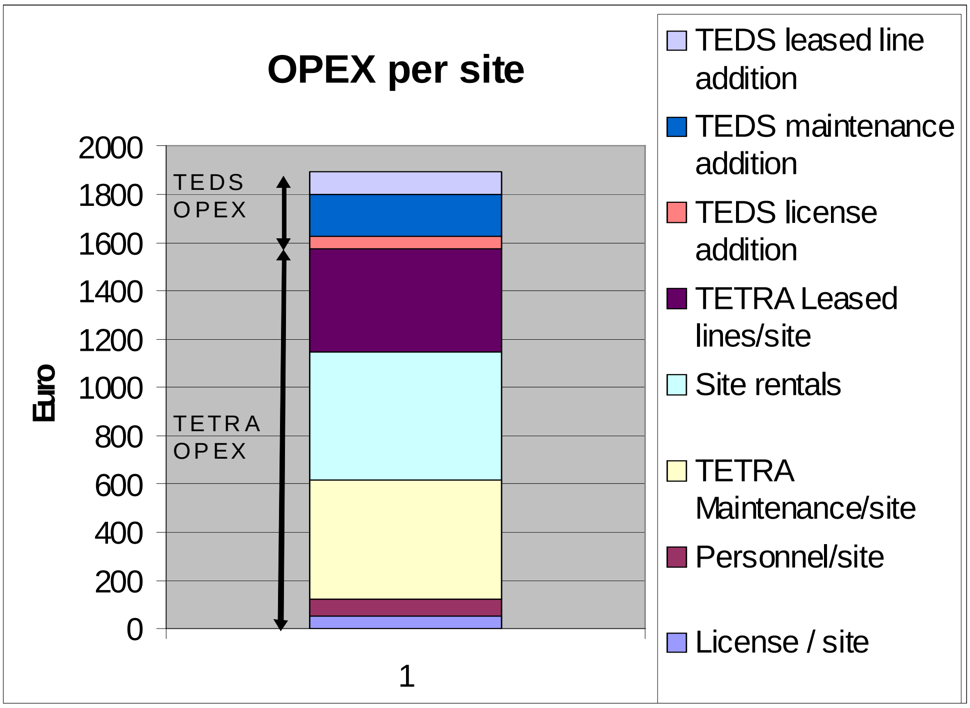

Figure 2 Operational costs per base station site.

In a typical PMR network, most operational costs are generated from base station site and mast rentals (30-40%), and the leased lines for BS access and core network (25-35%). Technical management of the network and maintenance services generate the remaining 25-45% of the OPEX.

As a rule, the monthly OPEX per site in a PMR network is in the range of 1.5 k€. This is the sum of 500 €/month for site rentals (mast, cables, floor space), 400 €/month for leased lines, 500 €/month for maintenance, and less than 100 €/month for various other costs.

Upgrading an existing TETRA network to support TEDS high-speed data will generate only a small increase in OPEX, resulting from slightly increased rental costs of leased lines and sites and slightly higher cost of maintenance. In the upgrade, the core network and base station elements as well as the network management solution remain unchanged. In addition, the base station sites, antennas, feeder cables, base station racks, and base station access connections can usually be re-used.

As shown in Figure 2, a TEDS upgrade results in about 280 €/month/site higher OPEX.

Another antenna solution may be needed if a new frequency band has to be used. Adding another antenna in existing masts would generate an additional 200 €/month/site. The actual OPEX increase of a TEDS upgrade in this case would be 480 €/month/site.

Building an overlay high speed data network, the OPEX of the initial voice network basically doubles: network maintenance, site rentals and leased lines generate OPEX of about 1500 €/site/month.

Total cost of ownership, TCO

The Total cost of ownership (TCO) of a network consists of capital expenditure (CAPEX), implementation expenditure (IMPEX) and operational expenditure (OPEX).

When considering the purchase of a PMR network, buyers often see start-up costs, CAPEX, as the key issue. This leads to the minimum investment necessary to fulfil their requirements. However, when you consider the TCO, operating expenses clearly outweigh capital and initial implementation costs.

Table 2 Summary of TCO parameters used in calculations on building TEDS evolution.

Upgrade to TEDS	OPEX increase, 275€/site/month
Leased line increment (from 128 kb/s to 256 kb/s)	100
Cost of maintaining additional TTRXs	175

	CAPEX+IMPEX increase, 750€/site/month
Cost of TEDS upgrade per site (all cost items in BS and core)	60,000€
CAPEX + IMPEX depreciation per month (depreciation over 10 years)	500 €/site/month
CAPEX + IMPEX interest per month (8% interest rate)	250 €/site/month

Table 3 Summary of TCO parameters
used to calculate the costs of building a separate high speed data network.

Overlay high speed data network	OPEX 1460€/site/month
Antenna leases	200
Leased lines	400
Site rentals (floor space, electricity, cabling)	335
Cost of maintaining additional equipment	525

Overlay broadband network	CAPEX+IMPEX cost, 1500€/site/month
Building the overlay network (CAPEX): all cost items in network	90,000€
Installing and commissioning the network (IMPEX)	30,000€
CAPEX + IMPEX depreciation per month (depreciation over 10 years)	1000 €/site/month
CAPEX + IMPEX interest per month (8% interest rate)	500 €/site/month

Techno-economic analysis: Total cost of ownership compared to revenues

To understand the relationship between the total cost of introducing high-speed data and the possible revenue gained from the users, it is best to analyse the costs and revenues per base station site. The total CAPEX and IMPEX for the entire network is divided by the number of base station sites. Also user revenues are scaled to the average number of data users per site.

In the following analysis, total OPEX costs are shared evenly between all the sites. In fact radio site related OPEX costs form the main part of total network OPEX: site rentals, leased lines to site and site equipment maintenance costs. Figures 3 and 4 show the OPEX components as straight lines.

CAPEX is distributed over a period of ten years (common lifetime for a PMR network) and further divided into CAPEX depreciation and interest per month, as shown separately in Figures 3 and 4 adding to the OPEX components, so that the effect of interest rate can be seen more clearly.

The load on a real network (number of users per site) varies from site to site, and therefore the maximum data capacity of a site must be significantly bigger than the load generated by the average number of users per site, ranging between 20 and 100.

The analysis shows the OPEX and CAPEX components per site per month as a function of the number of paying users per site.

Option 1 – Upgrading current network to TEDS

Figure 3 shows how the total cost (TCO) and possible revenues relate to each other when upgrading TETRA to a TEDS capable PMR network. OPEX and CAPEX components are added up, shown as horizontal lines, and independent of the number of users.

The OPEX increase resulting from a TEDS upgrade is relatively small, so most of the increase in TCO comes from CAPEX.

Revenues, shown as lines, depend linearly on the number of paying users per site. Separate lines are shown for IP packet data only and for combining revenues from both IP packet data and high volume AVL.

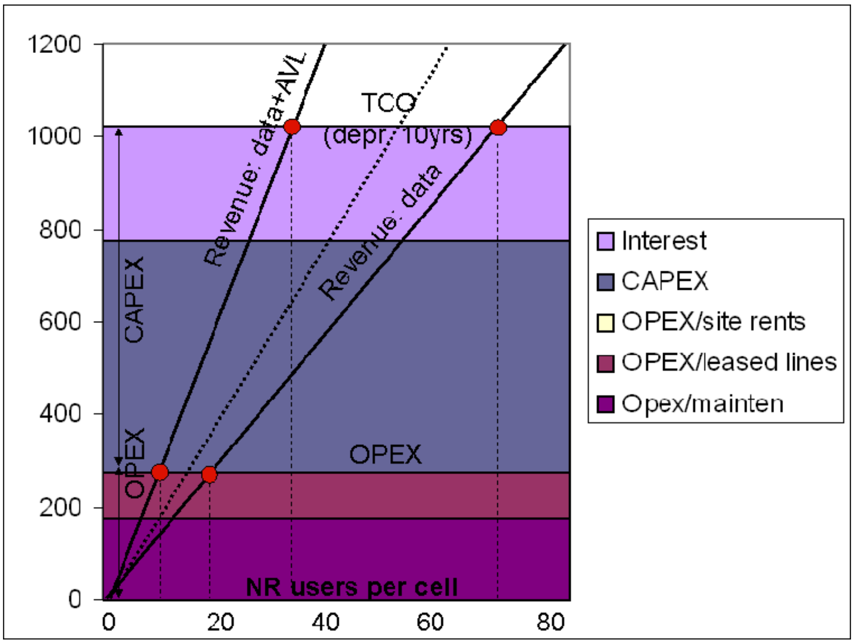

Figure 3 Option 1 – Upgrading current network to TEDS. Total cost vs. revenues.

Using the IP packet data revenues of 15 €/month per user, breakeven for OPEX is reached with 20 users per site on average. The total cost breakeven can be achieved with 65-70 users per site on average.

Introducing the additional AVL service, at 20€/month, as described in Section *"TETRA network evolution to high speed data,"* the OPEX breakeven point can be reached with just 10 paying users per site, and TCO breakeven with less than 40 users per site (data+AVL line). An additional 5€/month to the basic 15€/month IP packet data service fee improves the revenue as shown by the dotted line in Figure 3.

Insight

Considering OPEX only, establishing a TEDS capable PMR network is feasible at 10-20 users per site (on average). This means a 12-50% user penetration in a typical European nationwide TETRA network with average user densities of 20...80 users per site.

For full TCO cost break-even, 35-70 users per site are needed, meaning that most users should subscribe to the data service. Where user densities are low, TCO break-even is difficult to achieve, assuming data tariffs comparable to European cellular data tariffs.

The monthly increase in OPEX of around 15% resulting from a TEDS upgrade is a marginal cost and can be justified economically with relative ease. The CAPEX increase resulting from the upgrade would be 25-60% of the original voice PMR network CAPEX. This, too, is a very reasonable investment figure for modernising the current network and providing mission critical data applications, with availability during major incidents.

Option 2 – Building a separate high-speed data network (an overlay network)

Figure 4 shows how the total cost (TCO) and possible revenues relate to each other when building a separate PMR data network for high speed data. OPEX and CAPEX components are added up, shown as horizontal lines, again, independent of the number of users. Both the monthly OPEX and CAPEX compo

nents are significant and of the same order of magnitude, 1500€ per month.

Using the IP packet data revenues of 15 €/month per user, the OPEX breakeven is achieved with around 100 users per site on average, a relatively high number of users per site.

Introducing the additional AVL service, at 20€/month, as described in Section *"TETRA network evolution to high speed data,"* the OPEX breakeven point can be achieved with 40 paying users per site. TCO breakeven needs almost 100 users per site, all subscribing to both IP data and high volume AVL (data+AVL line).

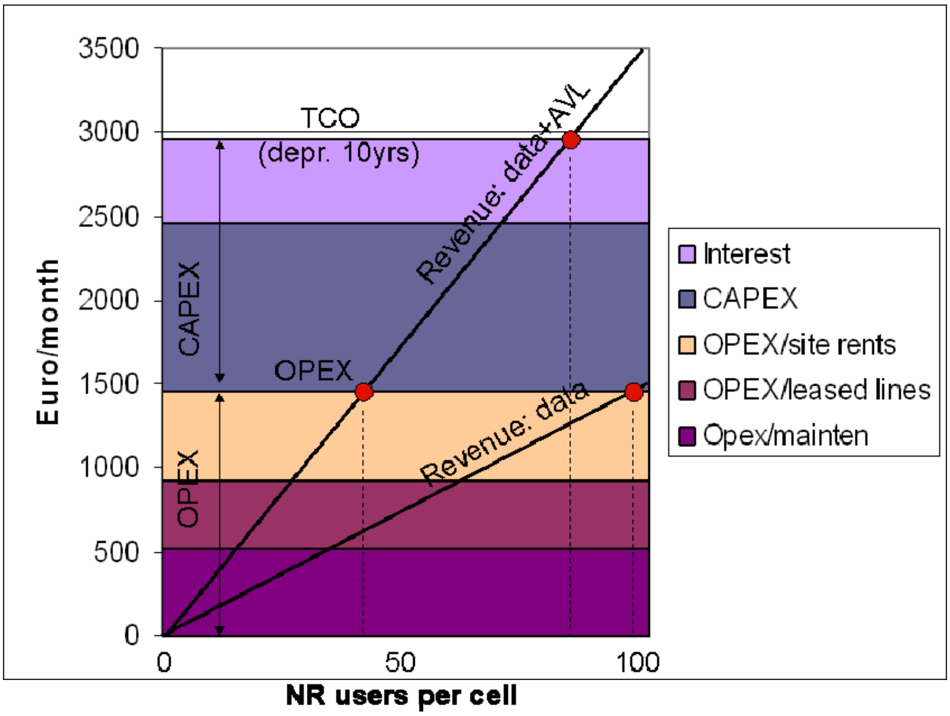

Figure 4 Option 2 – Building an overlay high speed data network. Total cost vs. revenues.

Insight

Building an overlay high speed TEDS data network would increase both OPEX and CAPEX by 1500€ per month, around 70-80% of the TETRA network investment cost. This is because practically all costs would be incurred twice: investment in equipment, site and mast rentals, cost for leased lines, network management and maintenance costs. This makes it very difficult to breakeven on TCO regardless of the number of paying users per site.

Considering OPEX only, establishing a TEDS capable PMR network is techno-economically feasible at 45-50 users per site (on average) when both IP data and AVL services are subscribed to. This means a 50-100% user penetration in a typical European nationwide TETRA network with average user densities of 20…80 users per site.

Achieving full TCO breakeven is difficult except in high user density (sub)/urban networks, assuming data tariffs comparable to European cellular data tariffs.

Providing nationwide coverage for mission critical data applications, that are available during major incidents, costs a government about 1500-2000 € per site, to carry the CAPEX and also part of the OPEX when data user penetration is low. An added value of the guaranteed data service during incidents of 15…100 €/month per user is needed to make the introduction of this data service feasible.

Generic cost breakeven summary

Figure 5 shows generic graphs of cost breakeven: the number of users per base station site versus the data tariff per user to cover OPEX and/or TCO. In Figure 5, the curves are drawn at 275€, 1000€, 1500€, 3000€ and 5000€ per site per month, reflecting the OPEX and TCO costs of the analyses in Sections *"Option 1 – Upgrading current network to TEDS"* and *"Option 2 – Building a separate high speed data network (an overlay network)"*.

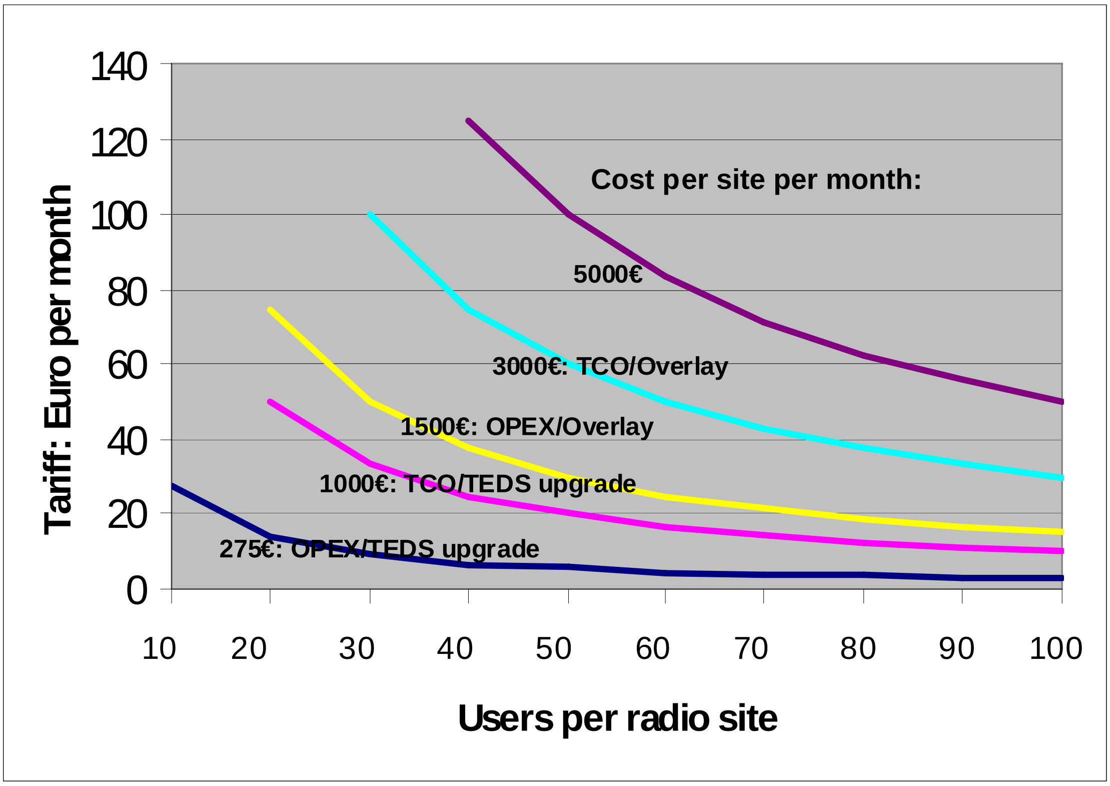

Figure 5 Generic cost-revenue breakeven curves

It is simple to evaluate the breakeven tariff versus the number of users per radio site: (Cost per month per radio site) = (Revenue per month per user) x (average number of users per radio site), when the capital investment and operational costs have been evaluated. Calculation of costs and revenues per radio site makes the analysis easily scalable: a local, city-area, regional or nationwide case can be analysed using the same method.

Recommendations

Established nationwide TETRA authority networks should adopt TEDS

Calculations show that TETRA networks established in large coverage countries can be upgraded to be TEDS-capable and continue to be operated with a reasonable operating profit (carrying OPEX costs) when a substantial part of network users subscribe to the data services. In higher user density European countries a high data user penetration can carry both OPEX and CAPEX costs.

Governments in countries that have built a nation-wide TETRA network should make coordinated decisions to introduce next generation data communication services to users of these networks. Establishing TEDS-capable networks will help guarantee mission-critical data services for all users with optimal cost. This, in turn, would enable terminal manufacturers to develop reasonably priced TEDS terminals that meet user needs.

The calculations show that a TEDS upgrade turns OPEX-positive with an average of 10...20 users per base station site. (As a rule, large TETRA networks have 20...80 users per base station site on average.) The results can be extended to apply to other established TETRA networks as well.

When tariffs are set at a level comparable to those on the public cellular side, full TCO breakeven for a TEDS upgrade is 25...70 users per base station site. When a high data subscriber penetration is reached, the TCO of the TEDS investment can be fully covered.

Building a separate high-speed data network for public safety users should not be argued on economic terms alone

The business case for building a separate, nationwide data network for public safety users will not be profitable if measured on financial terms only. Not even the operational costs could be covered assuming today's competitive cellular data user fees, except with near 100% user penetration or a high user density country (>40 users per site).

A separate high-speed data network turns OPEX-positive with an average of 40…100 users per base station site. A high density of users, most of whom pay for data services, is required to cover the operational costs of the separate network.

Covering the total cost of the separate nationwide data network is practically impossible with any density of users when data tariffs are set at a level comparable to those on the public cellular side. However, a data network built to serve urban areas with a high density of users may be able to carry the total cost with an average of 50...100 users per base station site.

However, a public safety radio network must first and foremost be considered as an investment in citizen safety and national security. Mission critical data applications must continue to work during major incidents when public cellular services become congested or drop out of service. Calculations suggest a 20...40€ subsidy per user per month to make a viable case. Because national safety and security issues cannot be assigned a price tag, this cost may very well be acceptable.

Appendix
Example of well-established Nordic nationwide TETRA network

An example case comes from the Nordic area, where the telecommunications environment is relatively serene: on one hand, extremely competitive public cellular data services are available, and on the other hand, reasonable prices for site rentals and leased lines ensure relatively good options for efficiently operating a PMR network.

Two options are considered: establishing a TEDS-capable network (TEDS upgrade) and building an overlay TEDS network.

CAPEX and OPEX costs in the calculations are presented as the average cost per TETRA network base station site. When costs are calculated per site, the results can be scaled to apply to any size network, from a smaller regional one to a large nationwide network.

TEDS upgrade and a TEDS overlay are both assumed to use the same base station and switch sites as the existing TETRA network, i.e. an identical radio range is assumed.

Because a public safety network must be highly available, it is necessary to also establish coverage to remote, sparsely populated areas, which will hardly ever have to serve any users except during major incidents. To take into account this "just in case" coverage, and yet to create a scalable analysis, two types of base station sites are assumed: "active sites" are ones that serve users all the time, and "passive sites" are ones located in remote areas. "Active sites" get a proportionate burden for the OPEX and CAPEX of building "passive sites".

In this case, users are distributed over an active area that includes 60% of the total coverage area (urban and suburban areas as well as main roads). Passive sites cover the remaining 40% of the total coverage area. These sites (forests and very sparsely populated areas) have no permanent users. From an economic point of view, these passive sites represent a cost burden on the active sites. Yet it is imperative to build complete coverage because an incident can take place anywhere, and in an incident, public safety operatives need their mission critical data services just much as voice.

All users are assumed to be distributed evenly among the cells covered by active sites. Hence revenues are calculated per active site per month, based on the data tariff and the data user penetration (%) in the active cell coverage, served by the active radio sites.

The number of users per active site is around 40. One TEDS carrier provides the capacity for high speed data for all sites. Passive sites will have only one carrier for TEDS.

An equivalent (although less reliable) public cellular data service is compared with both options (TEDS upgrade and TEDS overlay).

Option 1 – Upgrading current TETRA network to TEDS

Figure 6 shows the cost levels of OPEX and TCO per site per month, both being independent of the number of users.

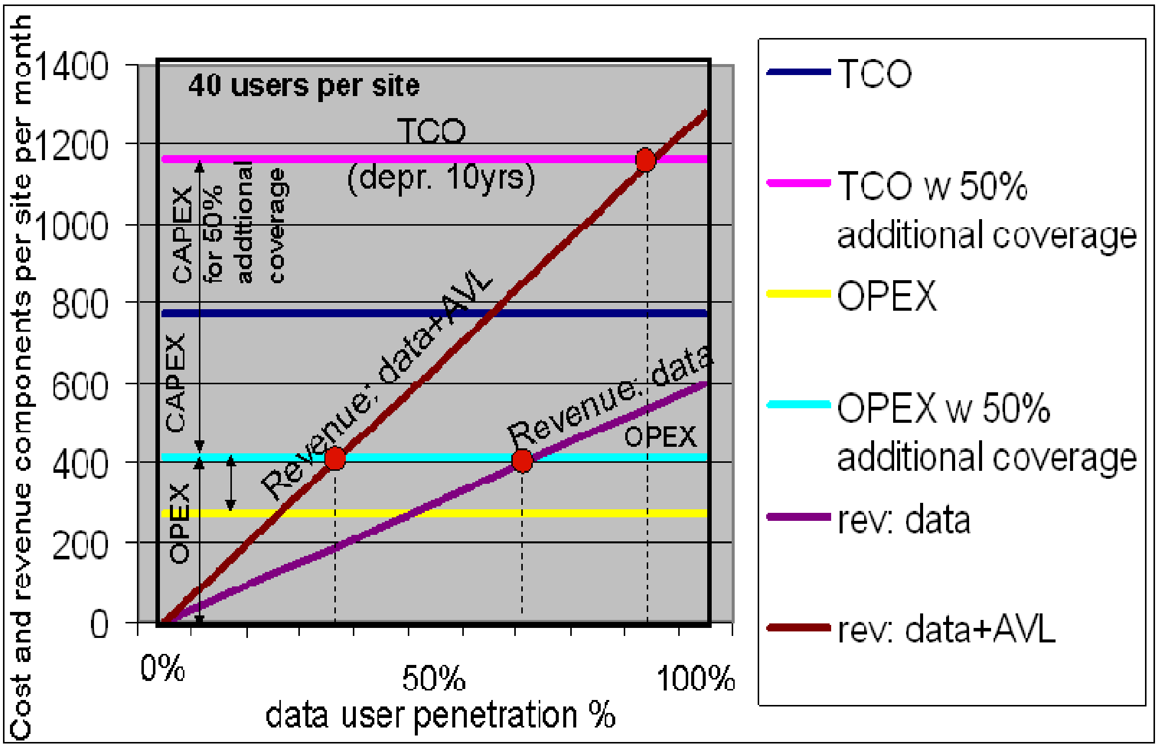

Figure 6 TEDS upgrade: Revenues (€) vs. cost for user penetration 0 .... 100%

Data service revenues per month (described in *"Revenues for the operator for TEDS services"*) increase linearly as more users adopt data services (user penetration).

The revenue lines show the nominal revenues from high speed IP packet data and for packet data added with AVL messaging.

OPEX breakeven:
If TEDS is used only for packet data, the upgrade becomes feasible at 70% penetration. When TEDS is used for IP packet data and high volume AVL messaging, 35% user penetration is enough.

TCO breakeven:
Using TEDS only for packet data means that breakeven cannot be achieved even with 100% penetration. When TEDS is also used for AVL messaging, 90% user penetration is needed for breakeven.

Option 2 – Building an overlay TEDS or broadband network

Figure 7 shows the revenues per month and per site as in Figure 6, the Option 1 case.

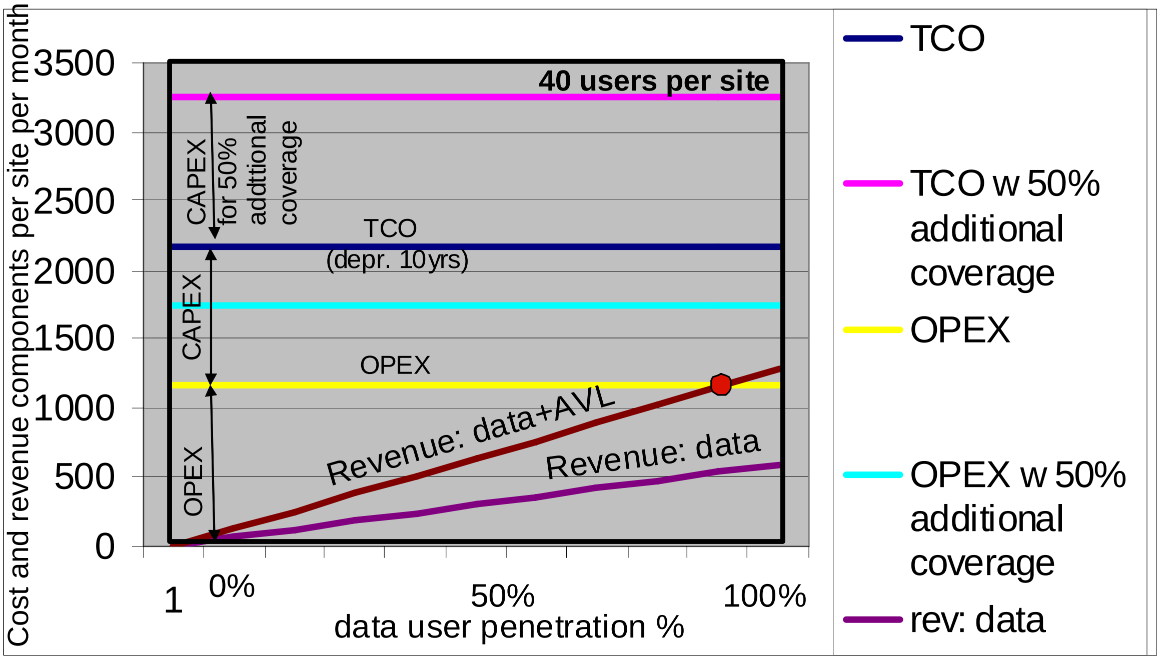

Figure 7 Overlay data network: Revenues (€) vs. cost for user penetration 0 …. 100%

From Figure 7, it is obvious that the cost of providing a wideband data service on an overlay network cannot be economically achieved at 15 €+20€/month fee for IP data and AVL (comparable to fees for data services over public cellular networks). It does not matter if OPEX or TCO is considered, nor what the user penetration is: an overlay network for data is not economically profitable. However, when only populated areas are covered, OPEX breakeven can be achieved when all users subscribe to both services.

Terms and abbreviations

AVL, APL
automatic vehicle/person location, system which locates vehicles/persons by using, for example, the global positioning system (GPS).

CAPEX
capital expenditure.

CDMA
code division multiple access.

EADS
European Aeronautic Defence and Space Company

GPRS/EDGE
General Packet Radio Service / Enhanced Data rates for GSM Evolution.

GPS
global positioning system.

IMPEX
implementation expenditure.

IP
Internet protocol.

OPEX
operational expenditure: ongoing cost for running a system.

PMR
professional mobile radio.

SDS
short data service.

SMS
short message service.

TCO
total cost of ownership.

TEDS
TETRA enhanced data service.

TETRA
Terrestrial Trunked Radio.

TTRX
TETRA transceiver.

WCDMA
Wideband Code Division Multiple Access.

EADS Secure Networks Oy
Hiomotie 32
FI-00380 Helsinki – Finland
Telephone: +358 10 4080 000
e-mail: securenetworks@eads.com

EADS Secure Networks
MetaPole – 1, Boulevard Jean Moulin – CS 40001
78996 Elancourt Cedex – France
Telephone: +33 (0) 1 61 38 50 00

EADS Secure Networks GmbH
Wörthstrasse 85
89077 Ulm – Germany
Telephone: +49 (0) 731 392 11

www.eads.com/tetra

Defence & Security, a division of EADS.