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Digital economy and structural change

Germany's broadband networks – innovation on hold

- **Advances in technology are whipping up competition between formerly unrelated segments**: as a means of internet access, fixed-line telephone networks could potentially be challenged by broadband TV cable and powerline.
- Germany's **cable network is handicapped** here **by its technical structure**. It is designed for large-scale, general dissemination of images rather than direct contact between specific individual connections. So it urgently needs upgrading.
- Fragmented organisation and ownership of the German cable network are blocking essential investment; outdated infrastructure is obstructing promising new fields of business. The **network must be totally restructured**.
- The cost of modernisation is enormous; all cable business in Germany hence entails high risk. Ultimately, only big players with long-term business models have a realistic chance of weathering the competition. To be successful at all, **network operators will have to market the advantages of their technology** much **more effectively**.
- Powerline is another means of accessing the web. It is offered by electricity utilities: data are delivered on piggyback with electricity. **Customers were not sufficiently keen on powerline**, however. But its lack of success was largely due to technical problems, and is not a reason for abandoning the idea of using powerlines for data transmission.
- **Inhouse powerline**, a powerline offshoot, is an alternative with prospects in certain areas. Inhouse powerline combines powerline technology within the premises with telephony beyond the premises. It is not suitable for the large household market. But it does have **good prospects in public buildings where multiple web access is required**.
- In the medium term, the **telephone network will remain the main means of internet access for the bulk of customers in Germany** and elsewhere, for technological and economic reasons. But alternatives such as cable or inhouse powerline have good chances of being successful in certain niches.

Stefan Heng, +49 69 910-31774 (stefan.heng@db.com)

www.dbresearch.com

Editor
Antje Stobbe
+49 69 910-31847
antje.stobbe@db.com

Technical Assistant
Sabine Kaiser
+49 69 910-31831
sabine.kaiser@db.com

Deutsche Bank Research
Frankfurt am Main
Germany
Internet: www.dbresearch.com
E-mail: marketing.dbr@db.com
Fax: +49 69 910-31877

Managing Director
Norbert Walter

Germany's broadband networks – innovation on hold

Cable market in flux

The market for information and communication technologies (ICT) is changing rapidly. Products and applications that used to be completely separate are becoming almost interchangeable. Sweeping change lies ahead in voice and data telephony, specifically as regards internet access. The fixed-line telephone network faces potentially new competition here from innovative technologies; analogue phone connections and the ISDN service are likely to lose importance. The line-up of potential alternatives to the phone network includes not only wireless technologies such as UMTS/3G or wireless local area networks (WLAN) but also broadband[1] TV and powerline networks.

In this report we concentrate on analysing the economic potential of cable and powerline networks as internet-access media, and discuss the prospects for the communications market. Besides looking into the technological developments, we examine the market relevance of existing ownership and competitive structures.

German cable business heavily dominated

In Germany the communications segment is dominated by Deutsche Telekom AG. Its share of total telephone minutes is currently over 75%, and in local calls an amazing 96%. One reason for its commanding position is that, to date, deregulation in Germany has liberalised services rather than networks. For many years both the telephone and the TV-cable network were in the hands of the state-owned Deutsche Bundespost or its successor Deutsche Telekom. The common ownership of the two networks prevented competition from developing between them. For a long time the TV cable network was used only for transmission of radio signals, and the fixed-line phone network for bi-directional communication.

With its proprietary strategy, Deutsche Telekom ran up a loss in TV-cable business in 1998 equivalent to one-fifth of turnover. When considering the outlook for the cable networks, however, this should not be seen as an argument against profitability, but rather as a result of a failure to innovate. A modernised network tailored to customers' needs as regards speed, security and user costs would hold new potential.

Speed depends on load

Unlike the telecommunications network, which was designed originally for individual voice telephony, i.e. communication based on dialling up specific individual connections, the TV-cable network focuses on mass communication. The cable network is usually structured as a tree: the nodes branch off one after the other from the same cable (see chart p. 4); all users have access to the same service range and share the bandwidth. The transmission rate falls as the number of users rises. In practice, internet speed will hence not be greater than 10 Mbit/s (approximately 10 million bits per second). But even then the TV cable is still almost 200 times more powerful than the customary analogue phone line. This argues very much in cable's favour.

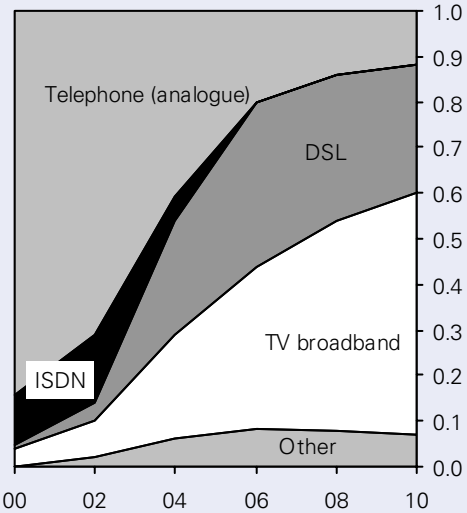
[1] Broadband refers to technologies that operate at a transmission speed of more than 64 kbit/s; this means they are more powerful than the fixed-line phone channels (from analogue connections to ISDN) now mostly used.

Glossary

ADSL	Asymmetric Digital Subscriber Line
DeTeKS	Deutsche Telekom Kabel-Service
DSL	Digital Subscriber Line
GSM	Global System for Mobile Communications
IBCN	Integrated Broadband Communication Network
ISDN	Integrated Services Digital Network
MHP	Multimedia Home Platform
PLC	Powerline Communications
UMTS	Universal Mobile Telecommunications System
WLAN	Wireless Local Area Network

No competition between phone and cable networks for a long time

Network technologies in Europe*



*Breakdown of use by households and small and medium-sized enterprises

Source: Business Data Resource Company, 2001

Secure transmission has high priority

Besides data speed, security is also crucial for the acceptance of a transmission technology. A network with a star topology, which is designed to allow direct contact with the individual user, can provide a level of security that a tree topology, as a shared medium, can only achieve by making use of encryption. Additional data protection is advisable for all shared media, such as UMTS, WLAN or powerline as well as the tree-structured TV-cable network.

The providers of pay-TV resorted to encryption of the content to enable them to conduct business based on the shared medium of the tree-structured cable network. Programmes can only be accessed by paying customers who have registered beforehand. This business model, in which only certain parties can use services and content, is interesting for the TV sector, but even more so for the internet.

Fees designed for heavy surfers

The cable network supports an "always-on" internet connection. In Germany, the fees vary among the regional providers. Most of them charge flat rates that do not depend on the time spent online or the volume of data transmitted. The monthly price per connection is now usually more than EUR 30, but for heavy surfers this is still much cheaper than DSL (Digital Subscriber Line), a digital fixed-line telephone technology that is becoming increasingly popular in Germany.

So far, the German cable TV network operators have not been able to exploit the advantages of their technology over alternative transmission media. Their services have not been adequately marketed as they are regionally very fragmented. Most customers have therefore stuck to surfing via the phone network. Only one German household in 500 currently uses the cable network to access the web. In the USA and the Netherlands the ratio is more than 30 times higher. This international comparison gives some indication of cable's great business potential, especially in Germany where its market penetration is high.

Not all that glisters is gold

TV cable has been laid past 78% of all TV households in Germany and 53% of them are connected. The German cable network is thus much more dense than that in the UK (52% passed, 14% connected) or France (37% and 13%, respectively). The high acceptance of cable TV in Germany is a result of the extensive network and low end-customer prices.

But this very positive picture needs to be scrutinised critically: while the cable infrastructure is well developed in the household sector, the situation in the corporate sector is not nearly as rosy. Most firms have fixed lines that give them internet access independently of telephone or TV cables.

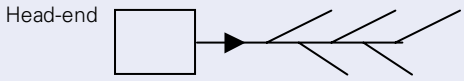
Within their technical means, the cable network operators cater primarily for the information and entertainment requirements of private customers. The outdated German TV cable network is at present not ready for modern e-business applications.

Back channel essential

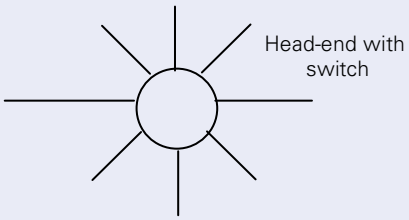
Interactive multimedia applications via a TV set – an electronic programme guide or online shopping, for instance – cannot be used without further ado at present in Germany. The situation is completely different in the UK, where such services have become very popular.

Cable topology

Tree structure



Star structure



Source: Horrocks et al., 1993

Network operators cannot exploit cable's advantages

Cable market: Germany, 2000

Population, '000	82,143
Households, '000	38,123
TV households, % of total	98.7
Number of channels received by 70% of population	38
Households passed by cable, % of TV households	77.5
Households connected	53.3
Digital TV subscribers, % of TV households	5.1

Source: GfK, 2001

Cable market: United Kingdom, 2000

Population, '000	59,501
Households, '000	25,105
TV households, % of total	97.0
Number of channels received by 70% of population	5
Households passed by cable, % of TV households	51.9
Households connected	13.6
Digital TV subscribers, % of TV households	25.8

Source: ITC, 2000

One major handicap of the German network as far as modern e-business applications are concerned is the lack of a convenient, high-speed back channel. Enormous sums need to be invested quickly in the aged infrastructure. The cost of upgrading for network operators alone is estimated at more than EUR 500 per connection by Deutsche Telekom, while Iesy, the network operator in the state of Hesse, gives an even higher EUR 640. Going by these figures it would cost at least EUR 9 bn to equip the German cable network for bi-directional data transfer. The amount would even be higher if the network were to handle not only data transfer but also voice telephony. Upgrading for voice telephony is technically much more involved than upgrading for data transfer, and therefore also more expensive.

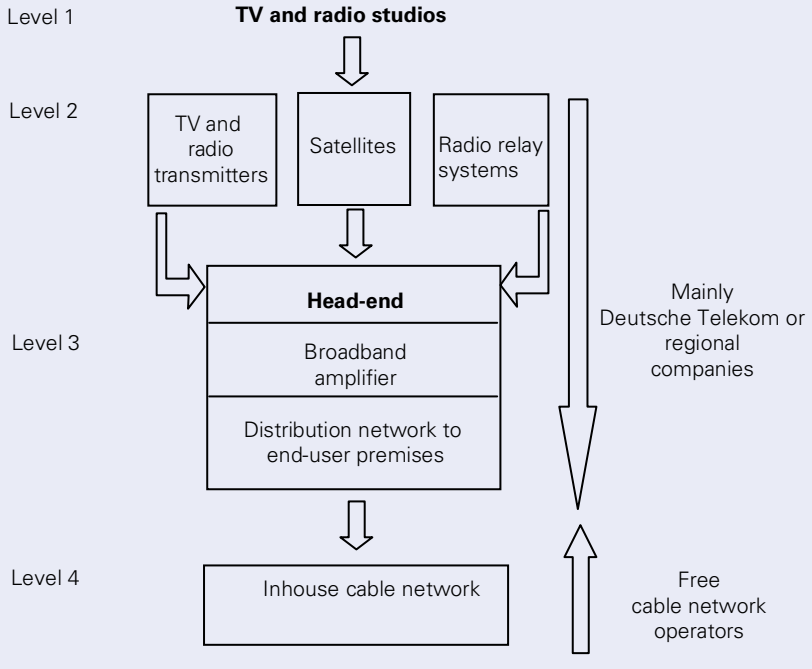
Private investors would have to take on a high risk in order to position themselves in the market with a modern cable network. Over the years a very fragmented competitive and ownership situation has evolved that is hampering urgently needed investment.

Germany's cable jungle – a tough legacy

The fragmentation of the German market goes back to political decisions in the 1980s that were intended to encourage competition in radio and television. Additional frequencies enabled new, private providers to penetrate the market, which was then in the hands of public-sector broadcasters. Nearly EUR 20 bn was pumped into the infrastructure and 400,000 km of cable were laid to link residential areas to the broadband TV cable network.

Germany's cable network was divided into a four-level hierarchy. At the top, in Level 1, the radio signal is fed into the national backbone network. Level 1 refers to the network from the TV studio to the cable head-ends of Level 2. In Level 2, signals are transported over long distances and then fed into Level 3, which is the local distribution network ("the last mile") to the front door of the end-customer. The in-house connection that delivers the signal to the end-customer is Level 4, the lowest level of the hierarchy.

TV cable network



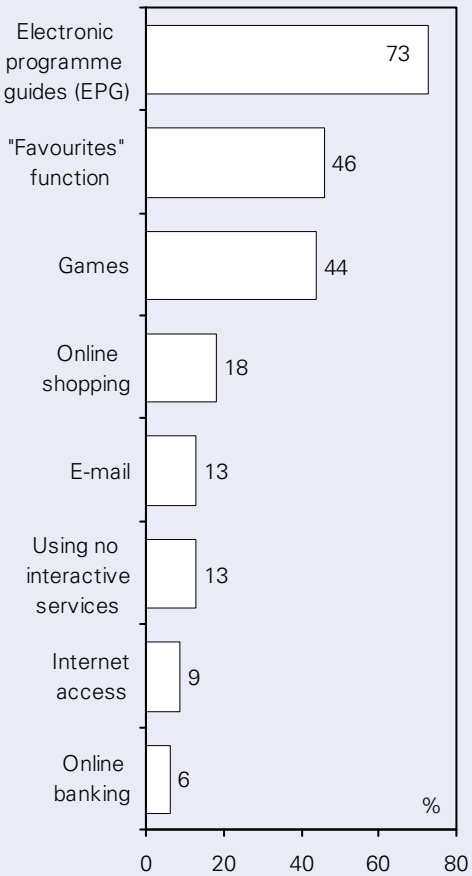
Source: ANGA, 2000

Cable market: France, 2000

Population, '000	60,628
Households, '000	24,400
TV households, % of total	93.6
Number of channels received by 70% of population	7
Households passed by cable, % of TV households	36.8
Households connected	13.2
Digital TV subscribers, % of TV households	13.6

Source: Mediametrie, 2000

Most commonly used digital TV services, UK, 2000



Base: homes with digital TV (n=250)

Source: OFTEL, 2000

Whereas services on Levels 1 and 2 have proved to generate little value-added, business in Level 3 and more especially Level 4 is considered highly lucrative. In addition to the big players such as Deutsche Telekom and the international consortia that operate on Level 3, more than 5,000 local providers – often local housing companies – are also active in Level 4. Together, these local providers hold roughly two-thirds of the Level 4 market.

Business on the lowest level is highly lucrative

International cable operators on Level 3 in Germany

Buyer	Apax et al.	Iesy	Ish
Region	All states except HES, NRW, BW*	HES	NRW, BW
Purchase price EUR bn	1.725	1	4.6
Dwellings, m (passed/ connected)	14.8 / 10.4	1.6 / 1.2	9.4 / 6.5
Internet and cable telephony	tba	Planned	Planned

* HES = Hesse; NRW = North Rhine-Westphalia; BW = Baden-Wuerttemberg

Source: DBR, 2002

This set-up hinders a fundamental restructuring of the German network. International operators demand that the German government should curtail the dominant role of Deutsche Telekom and encourage the liberalisation of the cable network. The division between Levels 3 and 4 should be eliminated and steps taken to speed up the consolidation of the very fragmented market at the bottom level.

Delays in restructuring of cable market

In the 1990s, under pressure from the German cartel authority, Deutsche Telekom had to split its regional cable business. This was intended as a preparatory step towards privatisation of the entire network.

Deutsche Telekom group began by spinning off the networks in the states of North Rhine-Westphalia, Baden-Wuerttemberg and Hesse. In these three regions the TV cable was to be upgraded to allow access to internet and telephony services. A single investor initially sought to take over the remainder of the German network. This company would then have supplied over 10 million households at Level 3, and 3 million of them also at Level 4. In view of the market dominance and the lack of plans for modernisation, the German cartel authority stopped the deal. It was not until February 2003, after lengthy negotiations, that Deutsche Telekom found a strong new group of buyers; however, they paid only a fraction of the first bid for the regional networks. The urgently needed restructuring has been thus severely delayed.

Cable regions in Germany

	Cable households, m	
	Passed	**Connected**
Baden-Wuerttemberg	3.2	2.3
Bavaria	3.6	2.5
Berlin/Brandenburg	2.3	1.6
Bremen/Lower Saxony	2.7	1.7
HH/SW/MVP*	2.5	1.7
Hesse	1.6	1.2
North Rhine-Westphalia	6.2	4.1
Rhineland-Palatinate/ Saarland	1.7	1.1
Saxony/Saxony-Anhalt/Thuringia	2.2	1.4

*Hamburg, Schleswig-Holstein, Mecklenburg-West Pomerania

Source: Reg TP, 2002

Network split into regions in preperation for privatisation

Digital TV moving away from stand-alone solutions

For many users, digital television is a major step towards customised, interactive e-business. In Germany, all TV and radio programmes are to be broadcast digitally by 2010.

Around the globe, the TV landscape varies greatly. In countries where pay-TV has been common for some time, such as the UK or the USA, acceptance of digital TV is higher than elsewhere. The high-tech company SCM MICROSYSTEMS estimates that 36% of British households and 30% of US households currently receive digital TV programmes, but only 6% German households.

No uniform standard yet for encryption

No uniform standard has yet become established for the encryption of pay-TV. There are a number of competing procedures such as BETACRYPT, CONAX, CRYPTOWORKS, IRDETO NAGRA, SECA or VIACESS. Originally, each individual encryption algorithm required a particular type of digital receiver (set-top box). The choice of set-top box tied the customer to a single provider. If he wanted to change provider, he had to buy entirely new hardware. This scared off some potential customers.

More recent developments move away from proprietory hardware as encryption solution

More recent developments mean that most digital receivers are no longer proprietary hardware. Modern set-top boxes can be easily adjusted from the outside to several different encryption algorithms. This quantum leap in data security, away from stand-alone solutions of individual providers, should increase acceptance of digital TV.

Multimedia Home Platform as a device-independent digital standard

Another step that should open up new market potential in digital TV was the agreement reached among providers on the data format Multimedia Home Platform (MHP). MHP will probably become established as a device-independent digital standard, not only for radio and TV: it would make interactive services accessible on PC, TV set, video recorder and telephone alike. This would mean that TV set and PC should converge in the medium term. In future, it will become increasingly easy for users to get internet content and regular TV/radio programmes on both their TV set and their computer. In other words: "Broadcast goes online, online goes broadcast". TV sets and PCs will not, however, merge completely, given that they tend to be used in different situations and have differing features (e.g. screen size).

Operation of cable networks – a risky business

To sum up, we list the main arguments regarding the prospects for Germany's cable network.

The following points speak in favour of broader acceptance of cable as a means of accessing the web:

1) Most German households are on cable; Germans are familiar with this medium.
2) Cable offers stable data transmission with high bandwidth and always-on convenience. Pricing is mainly aimed at customers who use the internet a lot.
3) The data encryption required for e-business has already been practised for a long time in (cable) pay-TV.
4) It should be possible to apply the standard used in digital TV transmission to other digital devices, too, in future.

Besides these positive factors there are also negatives that argue against more extensive use and rapid development of the German cable network:

1) The cost of upgrading the network to bi-directional, interactive communication is enormous.
2) Ownership of the network remains myriad; the lucrative Level 4 market in particular is still highly fragmented.
3) Cable really only has prospects in the private-customer sector. The technology is not very attractive for firms.
4) It has not been possible to adequately market cable's value as a modern internet-access technology, owing partly to the fragmentation of the market.

The German cable market has reached a critical point. Modernisation of the network, which is absolutely necessary, will entail huge investment and great risks. The upgrading should be carried out gradually, starting with the most profitable regions and applications.

Network operators could probably increase their share in niche markets through carefully targeted marketing. Entertainment business with private customers is an obvious candidate. But despite the e-business, television remains the network operators' cash cow. High-quality pay-TV or video-on-demand are still core areas of cable TV business.

Staying power necessary for business

A well ordered cable market is essential both for promising innovation and for new business potential. Until the German market is revamped, it will be hard to find strong network operators willing to shoulder the huge investment the cable network requires. For e-business the network needs to be modernised, but this is very unlikely on the basis of the present ownership and property rights. Cable certainly has potential as an internet access medium, but this will materialise less quickly in Germany, and elsewhere, than optimistic forecasts would suggest. Companies will need staying power in this business.

Other alternatives to the telephone network in sight

Debate over internet access is not confined to fixed-line telephony and the TV-cable network. Transport firms and utilities, for instance, also have a clear affinity to the communications business. Their interest in this field is obvious since apart from the infrastructure needed for their original core business (empty pipe systems, cable conduits) they often set up internal information infrastructure of their own anyway. These channels are usually not fully utilised and are therefore to be offered to external customers. Deutsche Bahn AG has a 40,000 km long nationwide communications network, so it offers considerable potential.

Besides Deutsche Bahn, municipal transport companies and energy utilities are tapping the market. These regionally established companies are usually familiar with specific features of the local area and can thus obtain a foothold in the local communications market as regional carriers pretty quickly. Prominent examples of such carriers with a strong regional background are HanseNet, ISIS Multimedia Net and NetCologne.

Germany's cable segment at a critical point

Regional carriers with licences for Level 3 and Level 4 in Germany*

Firm	Licence area	Shareholders
HanseNet	Hamburg and environs	Hamburgische Elektrizitäts-werke AG
ISISMulti-media Net	Düsseldorf, Neuss, Duis-burg, Essen etc.	Arcor, West LB, municipal utilities of Düsseldorf, Neuss and Duisburg, Rheinbahn
NetCologne	Cologne	GEW Köln, Spar-kasse Köln

* A selection
Source: Reg TP, 11/2002

Competition at local-authority level

As regards market strength, the activities of the municipal companies in the communications sector may prove to harbour problems in the medium to long term. Municipal companies:

1) usually enjoy a commanding position in their core business and could cross-subsidise their telecommunications activities, crowding rivals out of the market through price battles.
2) are in most cases public-sector bodies. Market entrants from the private sector have extreme difficulties establishing a local presence owing to the way the public firms are structured and how their personal contacts have grown over time. In the case of home connections, for instance, transport firms or utilities are obviously likely to cooperate closely with municipal housing companies.

Given these links at the local level, the competition actually desired – with all its positive effects on the market and prices – could ultimately fail to materialise. The targeted objective would even be thwarted if the activities resulted in municipal providers gathering local market clout and then pushing through monopolistic price models.

Data via powerline – only successful in forecasts

Powerline communication (PLC) is a widely known service offered by electricity utilities. With powerline, data are delivered to households on piggyback with their electricity. Within the home, internet access is available via any socket by using a modem.

Powerline needs no additional internal cabling. Compared with the conventional way of connecting to the internet, the cost is up to 90% lower. However, the electricity networks were not set up to be used for high frequency data transmission. Signals become much weaker over fairly long distances; mobile telephony services can be distorted. In the worst case, powerline may even have a negative impact on the flow of electricity and on connected electrical appliances.

TV cable and powerline both offer always-on functionality. Both are shared media, i.e. all households connected to the same splitter share the maximum bandwidth of 10 Mbit/s. In practice the transmission rate with powerline is unlikely to be higher than 2 Mbit/s. There is hence no practical advantage over ADSL (Asymmetric Digital Subscriber Line) telephone technology.

Powerline's rating among customers was much poorer than had been predicted. The market showed little interest in pilot projects in the UK, Canada and Germany. Technical shortcomings were mainly to blame. In addition, all the pilot projects were designed as a niche product at the local level rather than as supraregional bulk business. The technology is therefore available in only a few cities. It is unlikely that the schemes will be widened, and some major promoters are already withdrawing. Powerline came too late to have a real chance against innovations in the other transmission technologies, especially the DSL phone service.

It is not only in Germany that powerline has been dogged by a difficult market environment. The expiry of the pilot projects does not mean, though, that the idea of using powerlines for data transmission should be abandoned.

Inhouse powerline: a promising niche

Utilities are looking for other ways in which powerline can be used profitably. One example that stands out is inhouse powerline communication. The target group is large public buildings, such as schools, public offices or hospitals. These require multiple access to the internet, but often have no special cable infrastructure.

Inhouse powerline combines powerline with DSL telephony. Within the premises the internet is accessed through a powerline modem plugged into a power socket – just as with powerline. Beyond the premises, however, access is via broadband phone cable.

Neither powerline nor inhouse powerline requires any additional cabling within the premises. Inhouse powerline has the double attraction of always-on functionality and high speed: in a pilot project a transmission rate of 14 Mbit/s was possible with nearly 20 computers online. This is 200 times faster than with a conventional analogue phone connection and still almost twice as high as with a modern ADSL connection.

In view of the advantages of this technology, the US research institute In-Stat/MDR estimates that within a year global sales with inhouse powerline will rise from the present USD 18 m to USD 190 m; for 2006 it anticipates as much as USD 700 m.

Powerline: data via the electricity network

Rating among customers much poorer than predicted

Comparison of technologies

	Technology		Mbit/s*
Cellular	GSM	Global System for Mobile Communications	0.0096
	UMTS**	Universal Mobile Telecommunications System	0.384
Fixed-line telephone	Analogue		0.056
	ISDN	Integrated Services Digital Network	0.064
	ADSL	Asymmetric Digital Subscriber Line	8
TV cable	IBCN**	Integrated Broadband Communication Network	10
Powerline	PLC**	Powerline Communication	2
Powerline (hybrid)	IPLC**	Inhouse Powerline Communication	14

* Max. transmission rate in practice
**Shared medium

Inhouse powerline takes an auspicious direction

Inhouse powerline is currently still at the development stage. While progress may not be as fast as predicted by some market research institutes, the underlying business idea is attractive. Despite not being a product for the mass market of private customers, inhouse powerline should capture significant market share in the targeted niche, i.e. large public buildings without special cable infrastructure.

Alternatives currently offer only limited prospects

The advances in ICT are intensifying competition between products that used to be completely separate. Fixed-line telephony faces potential new rivals – particularly services based on broadband cable and powerline networks.

Germany has high cable penetration but network needs upgrading

Owing to historical developments Germany has high cable penetration but a network seriously in need of upgrading. A modernised network should have great potential among households as a means of accessing entertainment applications in the internet. Nonetheless, cable will not achieve the market breakthrough here as quickly as the optimistic forecasts would suggest.

Cable's market breakthrough will not come fast

Besides cable, the electricity network is also often mentioned as competition for the phone network. The idea of using the electricity network looks attractive because of the simplicity and low cost, but there are problems in practice. Powerline's rating among customers was much poorer than predicted. Pilot projects are already being discontinued.

Utilities are now looking for alternative fields in which they can use their idea of transporting data via powerlines. Inhouse powerline combines powerline with DSL; the main focus is on large public buildings which require multiple internet access but have no special infrastructure. Thanks to high speed and low investment costs, this technology has prospects in the targeted niche.

Telephone network will remain main internet access medium in foreseeable future

Despite the emergence of alternative transmission technologies, the telephone network will remain the main internet access medium in the foreseeable future, not only in Germany. Even the fixed-line alternatives with good prospects, such as the broadband cable network or inhouse powerline, still have to overcome high hurdles and will probably succeed in the medium term only as niche technologies.

Only large players have a chance of weathering tough competition

The cost of modernising the cable network is enormous, so cable business entails considerable risk. Ultimately, only large global players with long-term business models have a realistic chance of weathering the fierce competition against fixed-line telephony – not to speak of wireless access technologies in the future. However, even this partial success will only be achieved if pricing becomes attractive and public marketing of the alternative network technologies is improved.

Stefan Heng, +49 69 910-31774 (stefan.heng@db.com)

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