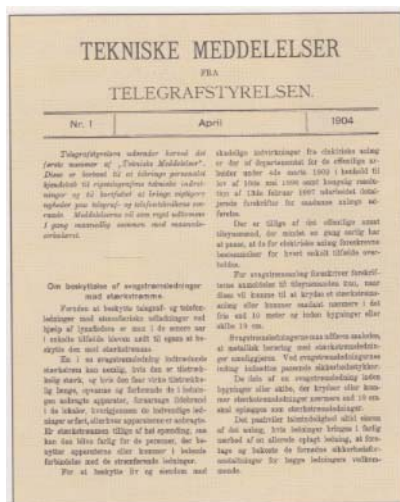


Early beginnings, 1904 – 1909

The first issue of *TEKNISKE MEDDELSER fra Telegrafstyrelsen* (TECHNICAL INFORMATION from the Telegraph Administration) appeared in April 1904, and was introduced by a short statement of objectives:

“The Telegraph Administration herewith produce the first issue of the news sheet *Technical Information*. It is intended that this will impart knowledge, to all personnel, of the State Telegraph technical installations, and will, in short, supply the more important news in the areas of telegraphic and telephonic technology. As a rule, the news sheet will appear once a month, at the same time as the monthly circular.”

The first *Technical Information* was entitled ‘On the protection of telephone cables from power lines’, and extended to two issues. Even this early in its history there was introduced the editorial mark of the journal that it should contain both short and long articles concerning technical matters, and small announcements on technical news.



Facsimile of the front page of the first issue of *Technical Information* from the Telegraph Administration, 1904

This first period is characterised by an anonymous strongly official production style, which occasionally has the appearance of technical decrees. It is only in the next stage of this organ's life that ascribed articles appear.

Eight issues appear in 1904, and six in 1905. Thereafter the production flow ebbs away, with a decline in frequency to the point of only one issue in each of 1908 and 1909. Thereafter the official mouthpiece is struck dumb for six years.

Interlude, 1916 – 1921

A new edition came out again in January 1916, with a tiny change to the title *TEKNISKE MEDDELSER fra Telegrafstyret*.

It is at this point that ascribed articles first appear. As in the previous period, the contents are dominated by descriptions of new types of equipment and technical solutions in circuitry.

The idea was continued that *Technical Information* should appear once a month, and indeed this frequency was maintained until 1920. The three last numbers for this period were in fact marked up beforehand as belonging to 1921, but apparently were first printed in 1925 in order to complete an already commenced production run.

Again this journal takes a break, this time for five years.



Photo: Norwegian Telecommunications Museum



This design set the trend for many years to come. A plaster cast of Jean Heiberg's bakelite telephone from 1934

Serious production, 1927 – 1945

Technical Information re-appeared with a new first issue in January 1927, under a more obvious editorial control, even though the editor is never named in the publication itself.

For the first time there is an incentive for contributing to the publication, in the form of payment:

“For original work, which is assumed to be based on the author's own research, per column 15.00 kroner

For articles based on both original work and non-Norwegian sources, per column 10.00 kroner

For items translated from non-Norwegian sources, per column 7.50 kroner”

In his introduction to the first issue, the editor declared that “In those intervening years when *Technical Information* did not appear, there have been significant technical developments in both fixed and wireless telegraphy and telephony”, and he goes on to say that:

“In order to secure a common level of knowledge within our readership, we must lay the basic foundations first in order to build on them in future articles. So we must provide lengthier explanations of developments within all the different branches of telegraphic and telephonic technology, from the earliest beginnings to the later devel-

opments, as well as providing other items of interest.”

This objective is pursued over a considerable period of time, with long theoretical descriptions, occasionally stuffed with mathematics, which apparently some of the Telegraph Administration's own teaching staff enjoyed, so it seems, from an assumption that countrywide, a host of ‘starving’ engineers hunger for this schoolbook feast.

Technical Information appeared to have a certain unbalance in its coverage of the various specialist areas. At that time the three main areas of technology were: line/transmission technology, telephony, and radio. The first mentioned was predominant, but gradually, a range of subjects was added, to wit, the economics of technical development, and status information from the cooperative work in the international telecommunications organisations.

There was a little irregularity in production frequency, and occasionally, bundled issues, but the journal continued smoothly and sweetly through the thirties and even during the war. The latter had little apparent effect on the journal except that from 1943 to 1945 the name changed to *TEKNISKE MEDDELELSER fra Generaldirektoratet for Telegrafverket* (Technical Information from Telegrafverket's General Directorate).



Broken telegraph pole – a picture of the ingenuity that had to be shown with the scarcity of resources in the reconstruction work after the Second World War, Finnmarksvidda in Northern Norway 1945

The post-war years, 1945 – 1958

Until 1947 – 1948 the first years after the war are sparsely represented. Like all other professionals, those capable of technical authorship within Telegrafverket (the Norwegian Telecommunication Administration), are fully occupied with rebuilding the telecommunication networks after the lack of maintenance and destruction of the war years.

After many years of a static and limited portfolio of services came signs of a new awakening. *Technical Information* wrote about a new service ‘A subscriber network for teleprinters’, which was later to become telex (telex under the Norwegian spelling system.) Automation of the service began in 1957, and telex developed into Telegrafverket's prestige service through many difficult years.

At the end of the 1940s, and into the 1950s, a new source of ready-made arti-



Manual telex exchange, Oslo 1952

cles pop onto the scene. A steady stream of Telegrafverket's employees go abroad on study tours, especially in the US. Many articles from that time are based on information from these travels, that throw light on various subjects, lines of development and future possibilities for re-building and revitalising the telecommunication networks. There is hesitant mention of the potential for radio link networks in Norway, and possibly even television!

Three extremely early articles in *Technical Information* anticipate the technical development which will be used in the

application of new technology. The first article in 1951 talks of the principles of PCM (Pulse Code Modulation), the second in 1953 discusses new switching principles in relation to telephone exchange ITT 8A, and the third in 1956 introduces the transistor as "a new aid in transmission technology".

In 1952 Telegrafverket's comprehensive achievements in supporting the VIth Olympic Winter Games in Oslo are described. A large centenary issue in 1955 called '100 years of Telegrafverket – characteristic features of technical development', provides an exhaustive

status description of the state owned corporation's operations.

On 14–17 June 1956, the Third Norwegian Telephone Engineer's Conference is covered, with the articles heavily indebted to the lectures and follow-up discussions. The journal also finds the internal District Engineers' Meetings to be a good source of material.

The reconstruction of the Northern Norway telecommunications network is described, also the development in the use of overhead lines and buried cables. The provision of co-axial cable in Southern Norway is extensively documented in equal detail.

But not everything politically important for the technology sector is reflected directly in the columns of *Technical Information*, for example the important resolution in the Storting in 1953 concerning test television transmissions, and the later resolution in 1957 on permanent transmissions. There is no mention of these in any articles until much later.

Ramping up, 1959 – 1970

It was getting to be time for a name change. For many years, and especially after the war, the publication gradually adapted more and more so as to come to deserve its appellation as Telegrafverket's technical journal. The original limited subject matter was retained and



Trunk cable to replace overhead lines in post-war Norway



The official opening of Norwegian television in the presence of King Olav and the Prime Minister, Einar Gerhardsen 20 August 1960

gradually extended. The need to document the intense development and changes which were involved in Telegrafverket's operations, were followed up.

From 1959 the journal is called *Telektronikk*, after a name competition. The editor pleaded

"Yes, this is creating a new word in our vocabulary, but we hope and believe that it will introduce the new concepts contained in our journal.

The new name begins with 'tele', which is beginning to gain ground here in Norway as a word that encompasses the idea of telecommunications.

We also have the word 'elektronikk' (electronic) included, a word that most

of our readership will be familiar with."

In the year previous to the change of name, the ambitious level of output of 12 editions per year was adjusted down to 4, but it was plainly intended that these should be comprehensive issues.

Throughout the 1960s and 1970s, the biennial Norwegian Telephone Engineers' Conferences – and also to some extent those of the annual Radio Engineers – continued to be important sources for articles for *Telektronikk*. These meetings were used to energise the whole electronic environment in Norway by cross-pollinating telecommunications, radio and television development, acoustics, etc. They provided a forum for suppliers and customers, co-operating infra-

structure organisations, research institutes and technological universities. Also invited to the meetings were foreign experts from both research and industry and – to the Telephone Engineers' Conferences – representatives from the other Scandinavian PTTs.

This increases the areas covered, both by subject and author. At the same time lectures and reports from Telegrafverket's District Engineers' meetings continue to provide the 'bread and butter' articles. But there is also a continuous stream of articles either commissioned through editorial activities or spontaneously contributed, with perhaps a mixture of guilty enthusiasm or dutiful inspiration.

With a gradual increase in quality and subject matter throughout the 1960s, the



Tryvannstårnet (the Tryvann tower), radio link HUB and TV transmitting station. The tower was completed in 1961

Telegrafverket suffered a considerable drop in prestige when Forsvarets Fellesamband (Norwegian Joint Signals Administration), a defence agency, was set up in 1953, in reality as a competitor to the state monopoly. The main reason for its construction was Telegrafverket's unwillingness to consider the use of radio links as a means of connecting transmission networks, which had to be constructed extremely quickly using finance from NATO funds.

Even so, the laborious task of transforming a decrepit Telegrafverket to the modern Televerket is now in process, and carried through with grim determination. This indeed is reflected in *Telelektronikk*. The presentation of a plan to develop a broadband network in 1959 is hailed as a saviour. Broadband radio link connections in the telephone network are a precondition both for speedy development of trunk dialling and for a core network for television and FM broadcasting.

Telegrafverket comes in a little late, but proceeds with an enormous deployment of radio links. The radio technology part of the administration regains its representation again through articles in *Telelektronikk*. The immense struggle to provide Norway with television is less documented, but all aspects of the construction of the radio link networks are written about enthusiastically in articles in 1962, 1963, and 1967. The 'radio men' were still allowed to be proud of their pioneering spirit.

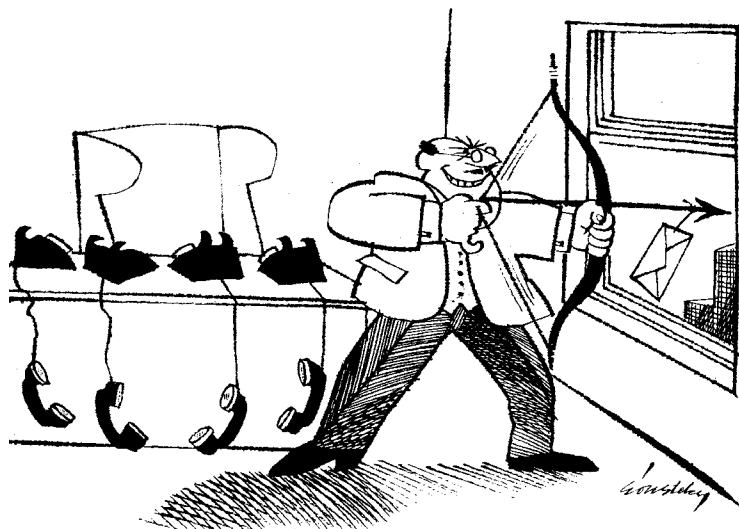
There are also many articles on telephony automation. In one period (1962, 1964, 1965 and 1966) there are some reports on long distance call automation, which later become known as subscriber trunk dialling, and later just trunk dialling. Cross-bar exchanges for both local and trunk dialling are covered in an article in 1963. Two articles on traffic theory concerning Engset's formula are produced in 1966 and 1968, a subject which is later developed for a doctoral thesis.

New telephony systems were presented at two Telephone Engineers' Conferences. The first in 1962 (referred to in 1963) was what was later to become the ill-reputed ITT System 8B, and in 1968 a very important presentation by both of the main telephone exchange suppliers on their new SPC (Stored Program Controlled) telephony systems, namely Ericsson's AKE and ITT's 10C.

Early experiences with plastic insulated cables were discussed in 1962. Then comes a whole series of articles on subjects in the early stages of development that were later to become important to Telegrafverket: in 1962 on data transmission (early international collaboration), and in 1964 on satellite communications (Scandinavian co-operation had already begun in 1961), on the application of PCM, and in 1967 on 'The public land based mobile VHF radio telephone service', a rigorous exposition of the manual service which after automation was called more shortly mobile telephony. An

journal builds itself up towards its golden age. However, there was one area which found no coverage in either *Technical Information* or *Telelektronikk*, namely Telegrafverket's problems and suffering public reputation.

The waiting list for a telephone line had reached its first peak of around 78,000 in 1956, and decreased for a short while before it began to climb again towards a second peak. A flawed policy called 'the BMV plan' (Bring down the waiting list), led to an imbalance between the connection of subscribers and the development of the network. Subscribers experienced this as a lack of dialling tone, and unreliable grade of service. The main cause of the problems was too small governmental appropriations for a long period after the war, but there was also some speculation as to Telegrafverket's efficiency level.



— This one is going straight to the Telegraph Director!
One of a series of sarcastic newspaper drawings criticising the long waiting lists and the poor service in the 1970s.



Televerket's Research Institute (TF). The first building phase of TF's own premises near completion in September 1973

article in 1970 was an overview of plausible perspectives for telecommunication technology.

The earlier imbalance in the journal's coverage of various specialisms is finally evened out. But then new integrated technologies come in, blurring the traditional lines between disciplines. That is also one of the premises that were laid down in the total re-organisation of Telegrafverket in the early years of the 1970s, in which also Telegrafverket is re-named Televerket.

First peak period, 1971 – 1980

Televerket's reputation is perhaps not what it should be. There are complaints about the high prices for telephony, and the waiting-list only seems to increase, until it peaks in 1979. At that point it goes over the top, with 120,000 people waiting to be connected, who are for the most part from the domestic sector. Business customers have first priority. The worst problem for these latter subscribers is the poor grade of service in the trunk network, which is not at all satisfactory.

But the size of *Teletronikk's* editions increases steadily, with a steadily increasing in-flow of articles. Soon there is no professional skill subject that is not covered in one or more articles. What are the reasons for the excess energy, all the enthusiasm within the company, despite the problems?

The re-organisation of Televerket basically revitalises the company and its internal processes, but while it continues it demands much resource and is a strain for many people. The re-organisation began at the top, when Televerket received a government appointed board from 1st January 1969. At the start of the 1970s, local units are reduced from around 150 to 27, and the number of regional organisations comes down to 6 from 12. The traditional specialist groups are torn apart in the head administration, which is strengthened in the areas of planning and finance.

A second factor in the new operational style is Televerket's Forskningsinstitutt, TF (Televerket's Research Institute), which was created at the end of 1967 after much heart-searching both in and outside the company. By establishing a research institute, Televerket proclaims its intention, both inside the company and to the world at large, that it intends to achieve more than just clearing the waiting-list for telephones and the problems with obsolete automation equipment.

With the benefit of hindsight as we consider the value of TF, it is useful to distinguish between the debate as to what TF qua research institute 'added to the agenda', and on the other hand what the new introduction of TF implied within the organisation. It is obvious that the influx of young, ambitious researchers necessarily had to lead to a new keenness in all the professional operations of the company, far beyond the technical areas

alone. And this is indeed the case when later reviewed, for we can see that many, large projects are the result of close co-operation across many disciplines, and that many also appear at a Nordic level.

The first two prestige projects for TF in its initial phase are data transmission and PCM. Already in 1969 *Teletronikk* contained overview articles on both subjects. In the 1971 edition there is a whole stream of articles on PCM, and not all of them came from TF.

PCM is so comprehensively covered in the journal that it was extensively used as an educational handbook, not only in Norway, but by technical personnel in the other Scandinavian PTTs. Was this a little re-payment for Telegrafverket's old dependence on Danish and Swedish skills?

It was in no small measure Danish and Swedish input to the theoretical treatment of traffic management that had laid the basis for calculations for automatic telephone exchanges. Historically, the Danes and Swedes possessed skills in these areas which we lacked, with one notable exception.

Engset's formula, however, is an interesting example of original work of international standing that comes from Norway, and was published in 1918 in a German journal. (An English translation: 'The probability calculation to determine the number of switches in automatic telephone exchanges' was printed with commentary in *Teletronikk* No. 1.1992.) T. Engset was promoted to Director of the Telegraph Administration from 1930 to 1935, after a long career in the company, beginning as an eighteen-year-old in 1883.

More articles in *Teletronikk* bring Engset's formula forward into the limelight. Already mentioned are those in 1966 and 1968. The author, L.A. Joys, from the Telecommunications Administration in Bergen, in 1972 took a doctorate based on further development of Engset's work.

One of these articles is called 'A comparison of analytical methods and simulations for dimensioning telephone systems'. Simulation is one of the methods that TF had just started to use in the institute's third input area – switching and teletraffic. A practical application was needed shortly. In a collaborative effort between TF and technical units within the Teledirectorate and the regions, an

offensive was launched to find a speedy solution to the problems of trunk telephone network. The problem solutions gave rise to many articles in *Teletronikk*, for example on grading, signalling investigations and traffic measurements, all with reference to 8B exchanges.

Europe is in need of traffic and O&M (Operations & Maintenance) measurements to serve as a basis for network design and planning. During the 1970s one of TF's largest research efforts is on this issue, putting the teletraffic research group at the international forefront at this time. Articles from 1978 and 1979 deal with operational control systems and traffic recording, the beginning of a subject that later was to become very important for telecommunications administrations and the object of international collaboration under the acronym TMN (Telecommunications Management Network).

The external Telephone and Radio Engineers' Conferences continue to be the sources of many articles, but the District Engineers' meetings, an internal forum, are discontinued after the re-organisation, and so one of the sources of material for articles disappears.

However, there is another possible reason for the increase in the flow of articles to the journal. With an administration under an appointed board, the new organisation of Televerket needs a higher degree of formalisation of work proposals, in comparison with previously. At the same time project work is becoming the norm in the whole company. With increasing need for documentation, planning and other proposal documentation may be used as a basis for articles for *Teletronikk*, even though it is not always easy to trace this origin.

Two examples from 1975 can be given: One article describes the whole range of the automated telephony systems in the Norwegian network (looking forward to 1982), and a second article describes the structure of the future digital telephone network. The articles are based on the preliminary work for the long-term plan of Televerket, which is completed by the turn of 1979.

The development of the digital telephone network is covered in a series of articles, beginning in 1972 with an article based on a Swedish input to the Radio Engineers' Conference in 1971, and thereafter covered as a subject in *Teletronikk*

almost annually including articles on ISDN in 1977, 1978, and 1980. The ISDN concept (Integrated Services Digital Network) was formulated by a study group in CCITT in 1972 and was held up by many people over the years as the ultimate goal for all telecommunication network development.

Many stages in the process, from planning to experimental development and on to actual construction, are described in articles, in 1972, 1973, 1976, and 1978, about the Nordic partnership project NPDN (Nordic Public Data Network). Later, datex came to mean this line switched connection service. A competitive service, more internationally acceptable, for data transfer based on packet switching, was described in an article in 1980, some years before the service was launched as datapak.

The development of NMT (Nordic Mobile Telephone) is not as fully covered in *Teletronikk* as the data network project. As a Nordic partnership project it is even more successful and had a great following. In 1979 the first article on NMT appears, when the project is already at a late stage of development.

There is frequent coverage of various aspects of satellites and their application – already in 1967 an article on transmission delay in geostationary satellites, on the influence of the troposphere beyond the 10 GHz frequency (1975), on earth-station antennae (also 1975) and on to the first articles on NORSAT in 1976 and 1977. With the NORSAT system for transmission to oil-platforms in the North Sea and later on to Spitzbergen, Norway



An NMT mobile phone in practical use on board a small coasting vessel in the 1970s



Push buttons and multi frequency signalling was the key to a multitude of new telephone services. "Tastafon" was developed in the late seventies and introduced in 1981

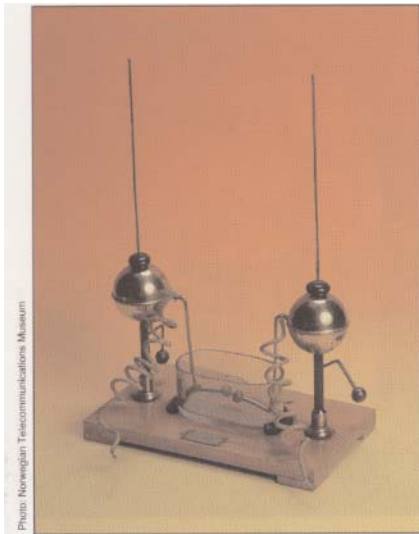
becomes the first country in Europe to use satellite communications for national purposes.

In articles in 1978, 1979 and 1980 new telecommunications services are presented, telefax, teletex and teledata, respectively. With hindsight, telefax is a great success, teledata would never take off, but teletex was a regular fiasco.

Amongst all these modern items in *Teletronikk*, there was one article that harked back to a previous era, 'Accumulator batteries, a trusty work horse in Televerket's network'!

A review of part of the technical forum can be found in a broadly-based centenary issue in 1980 with the main leader being '100 years of Norwegian telephony'. In the introduction to the issue we find a paragraph "Televerket stands at a watershed before converting to new technology, with even more extensive changes than previously. The new telecommunications network is growing and displays the whole technical sector against the background of new and exciting possibilities and challenges." *Teletronikk* would not spend too much time on the past achievements.

The journal continues its reporting back on the plenary meetings of CCITT and CCIR, and exceptionally also from other international telecommunication conferences.



Spark transmitter from 1905

In the consideration of all the material in *Teletronikk's* volumes, obviously many subject areas cannot be recorded in this overview article, but thorough articles appeared on e.g. optical telecommunications in 1975 and 1979, the grounding of telecom installations in 1976, on satellite broadcasting and on SPC telephone exchanges in 1977, on aviation navigational systems and on new telephones in 1978, new developments in short- and medium wave transmission and also cable television in 1979, and on new cable types in 1980.

It looks as though a small attempt was made to thematise the issues. In 1972 there is an issue on the introduction of colour television, and in 1974 one with

many articles on the theme of teletraffic systems.

Perspectives in teletechnology were covered in overview articles in 1972, 1974 and 1976. Right at the other end of the scale we find lectures with highly theoretical and in-depth discussions, not listed here. The overwhelming mass of articles deal with more or less practical subjects.

The time lag between important events in the technical sector and the journal's coverage of it becomes ever shorter, be that decisions, operations or actual achievements. *Teletronikk* thus becomes better matched as source material.

But the total impression of the material is still that of a kaleidoscope; the editing of individual issues and the succession of articles over a period, is accidental and mostly indicative of the date of manuscript production. Here is an area of work waiting in the wings – the systematic organisation of articles in *Teletronikk* by theme from early beginnings and through stages of development till final results.

Second peak period, 1981 – 1987

Televerket's long term plan was already completed and made public in 1980. The ground rules were laid for the debate which should provide a final clarification of the role of telecommunications in a

modern society, and so remove all the financial problems for the company – so they thought.

However, quite a few more premises were to emerge, in the form of a series of official reports initiated by the Ministry of Transport and Communications, and inspired by the wind of liberalisation that was blowing in the USA and had been taken up by the European Community, which in turn was pushing hard for European development. In Norway proposals from appointed public committees comes out with astonishing regularity in the official reports about Televerket every year over a five year period.

Thanks to the comprehensive preparation that has gone into Televerket's long-term plan, the company has ready made answers to all the questions that are raised in the public committees. For example, there is an article in *Teletronikk* in 1981 about utilisation and number capacity in automatic telephone exchanges, based on a statement to Teleutvalget (the Telecommunications Committee), which had been rather critical.

Teletronikk's annual output now gives the impression of an increasingly self-confident company. A long series of articles describes the good results in both well-established and new areas of expansion for the business. Perhaps the habit of contributing to the journal is becoming more established? The annual output is maintained at a stable size. Earlier, these occasions had been sporadic, but now we see more themed editions, i.e. where articles relating to a theme are edited together to provide the main contents. The editorial function becomes more visible.

There are two themed issues in 1981, the first containing three articles on satellite communications – one for each of INTELSAT, INMARSAT and NORSAT. Norway has a considerable share in INMARSAT because of its shipping interests. The second themed issue is on telex, on the occasion of a new completely digital exchange for the telex network, with coverage of the range of services and the standards for a prioritised business sector. In 1982 there is another themed issue on the expansion of the communications network in Northern Norway, including an article on the subscriber network in Longyearbyen, Spitzbergen.

A themed issue in 1986 contains a thorough run-through of most of the planning



Medium and short wave antennas at Kvitsøy transmitting station, on the air from June 1982



First in the world as a fully automatic INMARSAT coastal earth station, Eik in Rogaland was operational from 1982

phases for technology and finance, and the strategies for the necessary training. The articles include fundamental policy statements at a high organisational level, right down to a run-through of practical aids to planning.

Back to the Telecommunications Committee, which sets its mark on *Telektronikk*. On its journeys in its deliberation phase, it visited France, where it was seduced by the idea of telematics. The committee touted the idea of building a broadband network, to be called a telematics network, with cable television installations as one of its elements. Televerket is given a grudging order to calculate the costs of this broadly outlined plan. In 1985 many articles give an account of the plan and its preparatory phases. In the same year, however, the Committee's concept of a telematics network is written off in the Parliamentary statement on the future organisation and activities of Televerket.

Otherwise, 1985 is a memorable year for Televerket, not because of any special celebrations, but the telephone waiting list is brought down to zero, and Norway becomes fully automated. The process of fully automating the telephone network had been delayed by political considerations, so the date of 1985 is a little bit of embarrassing window-dressing.

Televerket's reputation rapidly improves and soon the only criticism is of the tariffs, which are kept relatively high since

the board has a policy of gradually becoming self-financing. After 1987 Televerket is de facto completely self-financing and independent of state resources.

Many articles in *Telektronikk* present new services: there are two in 1983, one on teleconferencing and one on a test service for videoconferencing. There are also articles on paging (1984 and 1986), two on mobile data services in 1986, and a series (1984–1986) on electronic funds transfer.



Isfjord Radio, 78° N, on the island of Spitzbergen. Telecommunications to and from the island started in 1911. Experimental satellite communication started 1982

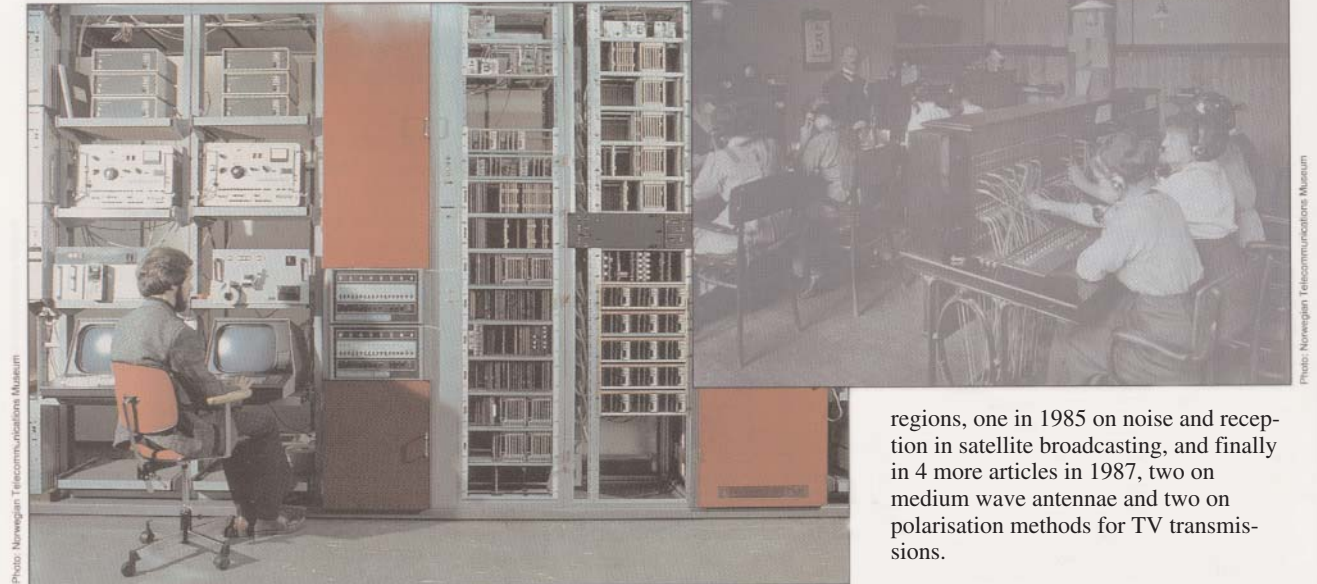
Televerket becomes involved in cable TV, which is reflected in two articles in 1983 and two in 1985. The latter two form part of the collection of articles in connection with the proposals for the telematics network.

The Telecommunications Committee defined business communications as being open to competition in the future. So the journal also has articles on this subject in 1983, 1984, 1985, and 1986. As a prelude to competition Televerket starts Televerket Bedriftskommunikasjon, TBK (Norwegian Telecom Business Communications), as a project in 1984, and in addition to providing terminal equipment and business communications, TBK also takes over the company interests in cable TV.

It is indeed the Telecommunications Committee that mapped out Televerket's future development, as subsequent committees limit themselves mainly to formalising and spelling out in detail what the proposals meant.

It was the Telecommunications Committee's proposals that led to free competition in terminal equipment, which in turn led to repercussions on the organisation of the company, and also to Televerket shedding some regulatory functions. The Telecommunications Committee also led to political pressure being applied to the rate of replacement of automatic telephone equipment. Televerket had to put out an international request for bids for completely digital exchanges.

A telephone exchange from 1913 compared to a modern automatic exchange



In 1984 *Teletronikk* issues a comprehensive edition on ITT1240 – a completely digital telephony system, which won the bid competition. Twenty articles, covering almost 200 pages, describe a long series of features: the system architecture, management system and software, traffic and processor capacity, mechanical construction and installation, operations and maintenance, support systems, signalling, and so forth. However, it took two years before the first digital exchange was installed in Trondheim.

If there is a revolution in exchange operation, it is no less in the transmission area – it just takes longer. Digitalisation has rapidly increased in the local networks, but is held back for long distance. However, a necessary impetus comes with the deployment of a new generation of radio link connections. *Teletronikk* describes the new digital radio link transmission systems, which have a capacity of up to 1920 channels, in 1983, and in 1985 there are a further three articles on new digital radio link transmission networks.

Fibre cables was a new option at that time, but Televerket made careful preparations, with test installations in 1980 and 1982, and a year later laid the first ordinary fibre cable. Thereafter it gradually increased in penetration, although it was to take approximately 10 years before the backbone in the core network was completely converted. *Teletronikk* contained a series of articles on optical fibres, fibre

technology and fibre cable: 3 in 1981, 2 in 1982, 1985, 1986, and 6 in a double themed issue in 1987.

The other theme in this latter issue is GSM, the new Pan-European digital mobile telephony system. The details of the international co-operation in this area are all given in the journal in 1985, followed by 4 articles in 1986, and then the double theme issue in 1987 consisting of 10 articles.

If we look at the subject of partnership work on the Nordic level, there are articles on Tele-X in 1985, on NORDSAT in the same year, and six articles on ISDN in 1987. On ISDN the Nordic PTTs have a certain degree of common policy and strategies. Tele-X is a much discussed project for launching a common Nordic satellite, and NORDSAT is an equally discussed proposal for common Nordic TV transmissions via satellite. It is perhaps the article in 1985 which provides the final insight and burial of NORDSAT, with its outstanding frankness in describing the project which had been driven forward by the Nordic Council.

Many articles cover radio transmission and broadcasting. Here are a few examples: two in 1981 on short wave transmissions in the Pacific Ocean, and on short wave broadcasting, one in 1982 on the Northern lights and radio wave transmission, two in 1984, both on the problems of FM broadcasting in coastal

regions, one in 1985 on noise and reception in satellite broadcasting, and finally in 4 more articles in 1987, two on medium wave antennae and two on polarisation methods for TV transmissions.

Teletronikk continues to report the plenary committees in CCITT and CCIR, and gives detailed coverage of the Telephone Engineers' Conferences. Many more subjects are covered by the journal, but in this article it is possible only to comment on the most important development areas.

By the end of 1987 Televerket faces the organisational consequences of the intense public debates of the first half of the eighties.

Changing times, 1988 onwards

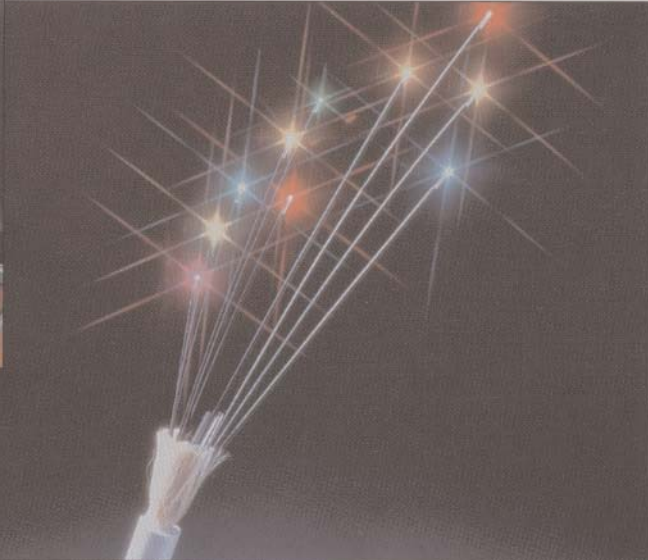
Competitive operations are split off from Televerket's core organisation after January 1st 1988, and are taken over by their wholly owned subsidiary, TBK A/S. At the same time regulatory responsibilities are transferred to a newly created body, Statens teleforvaltning, STF (The Norwegian Telecommunications Regulatory Authority). Now begins a long-lasting period of transformation to a new style of company.

If we look at the contents of *Teletronikk* we can see a tendency for a decrease in issue size. It is difficult to point to any one moment in time when this began but a 'slimmer' journal seems to coincide with the changes in Televerket's organisation and activities.

In 1989 three different digital telephone systems are reviewed in three articles:



A telegraph station around 1900 seen here in a museum. The development of optical fibres (below) has meant an enormous increase in cable capacity since the start in 1980



Siemens' EWSD, Ericsson's AXE, and Alcatel's System 12. The time has come for a new round of bids for automatic telephone exchanges. The speed of digitalisation is to be maintained, and also the image of Televerket as a company at the leading edge of technology is to be reinforced. The winner of this contract competition is Ericsson, and so the first AXE exchanges are installed in 1992 in Gjøvik, Trondheim and Bodø.

When it comes to the transmission sector, there are two articles on digital radio link communications in 1988, on optical transmission systems in 1988 and 1989, on optical components in 1989, and articles on fibre in the subscriber network in 1989 and 1991.

In 1991 *Teletronikk* publishes as a theme number, a series of articles on telecommunications in the Oslo Telephone District, covering a range of topics, from forecasting and planning to utilisation and optimisation in various sectors, the subscriber network, the local loop and the exchanges. There is also some discussion on the technical preparations for local broadcasting.

The moment of truth for ISDN is coming nearer. A test service is set up in 1990, with commercial operations planned for 1993. Both before and after the test service was established *Teletronikk* runs a series of articles covering a whole range of ISDN questions: six in 1988, four in 1989, six in 1990, and two in 1991. Many of the articles contain food for thought, and are a little hesitant. Similar questions are also raised in international circles, it is not a peculiarly Norwegian attitude: Is ISDN technology driven? What about applications?

Norway makes two bold commitments: the ISDN videophone, which is discussed

in an article in 1989, and telemedicine which is covered in two articles the same year.

But the question of *utilisation* of the telecommunications network now occupies the journal far more than previously, with a change of emphasis in the contents of the articles from techniques and technology to applications. The old service ideas and principles are too restricting, there is a search for new ways to attack the problems, and to provide solutions. New acronyms continually pop up in articles – IN and UPT as well as the already well known VØT.

The first appearance of the idea of the Intelligent Network (IN) is in an article in 1988, which is followed by two more in 1989 and 1990. There are articles on each of Value-added Services (VØT) and Universal Personal Telephone (UPT) in 1990. Information security, a subject with a close involvement in service definitions, is covered in 1988. In 1989 there is a theoretical article on prime numbers, one of the basic elements for encryption.

If we consider abbreviations and acronyms, some of the essential new ones are: NICAM, DAB, RDS, ATM, and GPS. *Teletronikk* explains some of these terms with an article in 1989 on digital sound in television transmission (NICAM), articles in 1990 and 1991 on digital audio broadcasting (DAB), in 1990 on data transmission via FM transmitter stations (RDS), with two articles

in 1991 on factors concerning transfer techniques via broadband channels (ATM), and finally in 1991 an article on terrestrial satellite navigation (GPS). Also to be mentioned are articles on Centrex in 1988, TMN in 1988 and 1990, and a new generation mobile telephone system (successor to GSM) in 1990. There may be a considerable range of subject matter, but the size of the journal is steadily decreasing.

One great item of interest is satellites and their communications applications, and Norway was indeed one of the pioneering nations in this area. In addition to the afore-mentioned article on particular satellite applications there is another on cable mapping via satellite in 1988, and in 1991 on communication satellites in new orbits, and finally, two overview articles. In 1990 there is a complete review, and in 1991 a review of mobile satellite communications.

As before, *Teletronikk* continues its coverage of references to NTIM (the Norwegian Telephone Engineers' Conferences) and overviews of the work of CCITT and CCIR and other international telecommunication fora.

But what is the reason for the stream of manuscripts into *Teletronikk's* offices being reduced?

Another watershed is reached. A great period of revitalisation within Televerket is more or less complete, and the objectives which had been formulated at the



C-MAC, the new standard for transmitting sound and pictures with the use of multiplexed analogue components (MAC) was first used in Norway in 1984 for satellite transmission of television and radio to Spitzbergen

beginning of the 1980s are about to be reached, without being replaced by new goals which will awaken enthusiasm. Instead, a scenario of new threats is presented, which Televerket had to arm itself against.

The remedy of course is again to reorganise, and in addition to competition, there is now a new problem within the organisation: overmanning. The reorganisation would be a long, disturbing process which would affect every employee – directly or indirectly. To individuals this means less surplus energy, which is a prime condition to experts finding the time to write articles.

New deal in 1992

Televerket's technical journal began purely as a reporter on operations, cf. its original objectives, which are reviewed at the beginning of this article. Over the years the journal developed and gradually spread its coverage to include the whole national communication technical scene, and also made some inroads on the international environment. The Norwegian telecommunication environment was not of great size, chiefly because it was limited to the monopolistic Televerket, a few of Televerket's suppliers and NTH (Norwegian Institute of Technol-

ogy). This situation continued well into the 1970s.

But the dividing lines between electronics, data- and information-technology are becoming blurred. The technical possibilities for telecommunications and information exchange open up such wide perspectives that they become areas of concern for both politicians and public.

So how should *Teletronikk* proceed? Should it compete in a large marketplace, should it change its profile, and how should it position itself in relation to scientific journals on the one hand and news-reporting journalism on the other hand, or should *Teletronikk* merely be an in-house circular?

Televerket is indeed in the midst of change, and as a result of this on-going process there is a new organisation from January 1st 1993. But that is only one stage in its development. Within two years it was hoped to organise it as a limited liability company. What would be the effect on *Teletronikk* in this move of Televerket from a controlled environment to market management?

These questions surrounding *Teletronikk* are thoroughly analysed and result in revised objectives:

- 1 *Teletronikk* shall be the leading Norwegian telecommunications journal.
- 2 *Teletronikk* shall, through its choice of subjects and presentation format, contribute to synchronize professionals in the Norwegian telecommunications scene with reference to the development of telecommunications techniques.

The thorough development of an expanded range of subjects should now be the corner-stone of the journal's business ideal – its particular niche. Each issue will normally contain one main topic, which will allow the journal to position itself between the quickly outdated textbooks on new professional skills, and scientific papers and articles published in a range of journals, where the exposition can be more demanding. The articles in these themed issues will be written up in an educational style, so that there is no requirement for special knowledge amongst *Teletronikk*'s normal readership. Each issue will have a specialist editor with an international reputation. By limiting the contents to the selected topics, the journal can in great measure tap the reservoir of skills existing among the telecommunications professionals both in Televerket and the rest of the country – and partners internationally.

Teletronikk will also concentrate on international co-operation and standards work in telecommunications. As the former PTTs are preparing for competition in all their services, there is no less need for international co-operation, co-ordination and standardisation. The PTTs' transformation to competitors and operators of telecommunications services will certainly provide some constraints, but international partnerships and strategies, research and development, must all be in place, but at a pre-competition stage. The transfer of regulatory functions from the PTTs has led to new players entering the arena of international co-operation. Of the international telecom organisations, some of them are reorganised, some have disappeared and a few new ones have entered the arena. No longer is it an easy task to be aware of the international developments and to stay informed. Amongst the employees being assigned to different international tasks, *Teletronikk* has appointed a group of rapporteurs. Their reports are processed and systematized before appearing in the journal.

The journal has had a face-lift. Graphic design experts have created a new front cover of outstanding quality, which is a basic pattern of traversing lines with sophisticated use of colours, and will ensure that the journal has a well-defined image in the output of journals. The cover's 'graphical notation' is used as the basis for the designer's variations on a theme inspired by the main topic in each of the journal's issues. The layout of the text and illustrations has also gone up in quality.

There is now more continuity in the editorial style, with four sections with abbreviated titles, viz.: Feature, Special, Status, and Kaleidoscope. Already discussed are the Feature and Status (international activities) above. The Special section is available for articles of variable content at different skill levels, often spontaneously written by the contributors, i.e. like the articles that were contained in the earlier editions of *Teletronikk*. Kaleidoscope is regarded as a section for series or topics which do not easily fit into the other sections, e.g. articles on historical aspects, or commenting on pioneering scientific work in telecommunications and information theory (Maxwell, Erlang, Shannon a.o.).

The output continues to be four issues per year. The first in the new style, No. 1.92, contains tailor-made articles in all the four sections, and has optical networks as its theme. The Special section contains articles on switching theory as applied to network structure, on the conversion to continuous or centralized charging, and a very useful article on the precise use of specialist terminology in high-speed communications. The Status section covers two new Pan-European partnership organisations, EURESCOM and ETSI. The Kaleidoscope section is occupied by a discussion of Engset's formula. Nos. 2.92 and 4.92 contain original work on their chosen topics, namely Intelligent Networks, and Satellite Communications, and have been produced in English. No. 3.92 is a special edition containing a full report of the proceedings at NTIM 1992, the 21st Norwegian Telephone Engineers Conference, which also marks the institution's 40th anniversary.

The 1993 series opens with an exclusive issue on Telemedicine. This application of telecommunications, based in Tromsø, was an ambitious TF project which aroused considerable international interest. No. 2/3.1993 is a double issue on



The videophone developed through a joint co-operation project between TF and Tandberg Vision was completed in 1991

Information Systems, and is limited to a consideration of telecommunications systems software. Several articles refer to the international recommendations and extensive coverage is given to TMN. Cyberspace is the rather speculative title for the last of the 1993 issues and concerns itself with multimedia. The articles cover the increasingly global networks of PCs and discuss possibilities and development trends, and also cover virtual reality, which inhabits the borders of telecommunications. In that issue the Status section discusses the logistics of reporting back from international standards fora, with an overview of the division into study areas, and the titles of all the rapporteurs in the specialist subjects. All the 1993 issues are produced in English.

Teletronikk's 90th year begins with a large edition, No. 1.94, concentrating on the topic of Forecasting, and is almost a textbook on the subject with 169 pages, containing practical examples on the application of prognosis theory to telecommunications. The feature section is in Norwegian, but the rest in English. No. 2.94 is about Broadcasting, and most of the articles talk about the changeover to digital technology in the different areas of technical radio and TV production.

No. 3.94 features a rarely covered topic, being a little different from the other issues, namely Arctic Telecommunications, and covers the experience gained during the construction and operation of telecommunication systems in Spitzbergen and Greenland, and also the Russo-Norwegian joint project for building a modern telecommunications system in North-West Russia. The last issue in its celebration year, No. 4.94 is on Electromagnetic Compatibility, which is covered from the points of view of both theory and practice, as seen from construction and production to operational responsibility.

All the editions in this 90th anniversary year contain reports and orientation from international standards fora and joint research projects, and the Status sections consist respectively of 17, 19, 35, and 11 pages. The first and last issues contain Special sections – on broadband services in No. 1.94 and in No. 4.94 one article on travelling wave antennae and two articles on IT, one covering information retrieval and a second on database management systems. One last article deals with a mathematical tool for network planning and routing.

What about the production team?

Being editor of either *Technical Information from the Telegraph Administration*, or *Teletronikk* (after 1959) has always been a sideline in addition to a normal position within the company. In chronological order the editors have been:

- 1904 – 1909 Hermod Petersen
- 1916 – 1921 Johannes Storstrøm
- 1927 – 1942 Sverre Rynning Tønnesen
- 1942 – 1957 Julius Ringstad
- 1957 – 1978 Nils Taranger
- 1978 – 1991 Bjørn Sandnes
- 1991 – Ola Espvik

Thumbnail sketches of each editor will be found beneath their pictures, but it is interesting to note that they all have a common interest in, and dealings with, education and training.

Hermod Petersen, the first editor, only produced the journal for 6 years, as explained earlier. It is likely that this had some connection with his work as a 'radio man' during the hectic pioneering years, when Telegrafverket embarked on radio technology. More information on that can be found in *Telegrafverkets historie* (The history of Telegrafverket, 1855 – 1955) by Thorolf Rafto.

Most of the other editors were recruited from the telegraph or transmission areas of the business, as a consequence of the historical development of Telegrafverket's main businesses, the telegraph service and the long distance telephone service. In the beginning the administration was indifferent as to the local loop. After the private telephone companies were taken over, the administration proceeded to split the telegraph and long distance telephone from the local loop telephone service in many places. In Oslo, for example, the two local administrations were only brought together as late as 1958.

In addition to being so busy, Hermod Petersen as a 'radio man' would have had problems in collecting the 'correct' material for the journal. This is also mentioned in the *History of Telegrafverket* on page 398:

"In 1904 the administration started a technical journal, *Technical Information*. This should publish the progress and inventions in technical fields. Several issues contained items of interest to all and were well received, but there was a criticism around that the personnel had received 'stones and not bread', especially considering the lack of textbooks on telegraphy and telephony."

The second editor, Johannes Storstrøm, had no great luck in his efforts, even though he came from the 'right background', and he also has a reference in the company history:

"What the journal contained was indeed excellent, but *T.M.* did not fulfil its promises. The new plan for 1916 to produce an issue every month, could not be achieved, and the material was not as comprehensive as could be wished."

When the journal disappeared for another six years, in 1921, it is not hard to see the reason why if one looks at the date. 1921 was the beginning of a serious economic crisis in Norway, and opened an era of restrictions, strikes, lack of exports, and bank failures. Telegrafverket itself, additionally, had suffered a series of swingeing cuts in all areas.

When Sverre Rynning Tønnesen became the third editor and took responsibility for the journal, he got it going again in 1927 and instilled some sort of order. With his yen for the theoretical and interest in education, and his later 'international inclination', he must also take some responsibility for having begun the long development of the journal in taking it to a higher level and broadening its subject matter. Many thought that this was at a cost to the 'bread and meat' for Telegrafverket's technicians, but it led to the journal widening its distribution far beyond the company's limits.

The drawing office in the Technical Department helped with the illustrations, a job that became an editor's secretary's sphere. Here is a list of them in chronological order:

- 1934 – 1963 Peder Stenseth Klepppestø
- 1964 – 1975 Olav Jensen Aares
- 1975 – 1991 John Sigvald Johnsen
- 1992 – Gunhild Luke

The first three had all been leaders of the drawing office in the Technical Department, but when a new editor was employed within Televerket's Research Institute (TF), naturally the TF drawing office took over the illustration work. The present editor's secretary also functions in the Information section within TF.

From 1957 an editorial committee was created to support the editor, and its members have been:

- 1957 – 1966 Julius Ringstad
Nicolai Sjøberg
- 1967 – 1969 Nicolai Sjøberg
Karsten Lagset
- 1969 – 1973 Per Mortensen
Karsten Lagset
- 1973 – 1986 Per Mortensen
Dr. Nic Knudtzon
- 1986 – 1990 Dr. Nic Knudtzon
- 1990 – 1991 Dr. Nic Knudtzon
Ole Petter Håkonsen
- 1992 – Ole Petter Håkonsen
Karl Klingsheim
Bjørn Løken

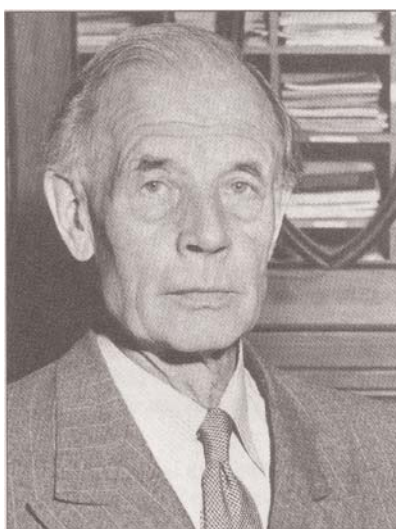
The directors of the Technical Department sat on the editorial committee until 1973. Then the Director of Research was counted as being on the 'technical side' in the management, following a reorganisation of the head administration.

The nomenclature 'editorial committee' was somewhat misleading as to the body's function, and from 1992 was corrected to a more fitting 'editorial board', and at the same time extended to include a chief of research.



Editor 1904 – 1909

Hermod Petersen, with education sponsored by the company, graduated from Karlsruhe Technical University in 1900, was Headmaster at The Telegraph Administration's Training Institute in Christiania 1900 – 1913, an Engineer in the Telegraph Headquarters Administration from 1913, Senior Engineer and Head of the Radio Department (later the Radio Office) from 1920, Chief Engineer and in charge of the Technical Department from 1931, and Director of the Telegraph Administration 1935 – 1938. Hermod Petersen was a radio technology expert of international repute. He worked on the tests which allowed Telegrafverket to open a wireless connection between Røst and Sørvågen in 1906, by which Norway became the second country in the world to have radio connections as a permanent feature in its telecommunications network. In 1911 he spent the winter as installation leader when the world's first Arctic radio station opened for business in Spitzbergen. In 1922 he was again busy with pioneering work building Norway's first broadcasting transmitter.



Editor 1916 – 1921

Johannes Storstrøm, with education sponsored by the company, graduated from Hannover Technical University in 1905, was an Engineer in the Telegraph Headquarters Administration from 1906, promoted to Senior Engineer and Head of the Construction Office, later Chief Engineer and Head of the Technical Department (later the Line Technology Department) 1935 – 1951. From circa 1930 his name was closely connected with the introduction of new 'electric' teleprinters as part of the modernisation of the telegram service. Johannes Storstrøm involved himself for many years with the education at the Telegraph College and wrote many textbooks on technical skills.



Editor 1927 – 1942

Sverre Rynning Tønnesen, with education sponsored by the company, graduated from NTH (Norwegian Technical University) in 1922, was an Operations Engineer at the Telegraph and Long Distance Telephone Station in Christiania from 1923, Engineer in the Telegraph Headquarters Administration from 1926, Senior Engineer from 1935, and Head of the Construction Office from 1939. He involved himself with education at the Telegraph College, and amongst other activities, wrote a textbook on line transmission. Rynning Tønnesen also actively participated in international telecommunications collaboration. During the war he was called to London, in 1942, where the Norwegian government appointed him Director of the Telegraph Administration to secure Telegrafverket's interests outside German-occupied territory. After the war he continued in this position until he retired in 1962.



Editor 1942 – 1957

Julius Ringstad, with education sponsored by the company, graduated from NTH in 1924, worked for a short time at Møre district office in Molde, Operations Engineer at the Oslo Telegraph and Long Distance Telephone Station from 1926, Engineer in the Telegraph Headquarters Administration from 1939, Senior Engineer and Head of the Construction Office (later the Transmission Office) from 1945, Chief Engineer in 1956 and Director of the Line Technology Department from 1959, until he retired in 1966. Julius Ringstad was for many years a part-time teacher at the Telegraph College.



Editor 1957 – 1978

Nils Taranger, with education sponsored by the company, graduated from Dresden Technical University in 1943, served at the Drammen District Office, Engineer in the Telegraph Headquarters Administration from 1946, Senior Engineer from 1961, Chief Engineer and Head of the Transmission Office from 1967, Section Head of the Line Section from 1962 until he retired from Televerket in 1981. After the war Nils Taranger was in charge of the construction and automation of the telex network. For many years he was involved with education at the Telegraph College.



Editor 1978 – 1991

Bjørn Sandnes, with education sponsored by the company, graduated from NTH in 1963, was an Engineer in the Telegraph Headquarters Administration at the Transmission Office from 1963, for two years an Instructor at the Telecom College. He became Senior Engineer and Head of the Line Transmission Office from 1972, Chief Engineer and Head of the Telex Group from 1977, Leader of the Telephony Unit, later the Trunk Network Division from 1983. He was on leave for many activities abroad, the longest duration being 1977 – 1980. From 1994 he became Director of Corporate Strategy & International Affairs.



Editor from 1991

Ola Espvik, graduated in physics from NTH in 1968, is a research scientist at Televerket's Research Institute (TF) since 1970. He has been project leader of a series of research projects in the area of traffic and reliability dimensioning as well as operational control of the telecommunications network, and has been an active participator in international research cooperation. On leave from TF he was engaged by Televerket's Personnel Department from 1985 – 1988, to develop a training programme for network planning, and was Director for the Joint Technical College Centre at Kjeller in 1988 – 1989. Since 1985 he has also been a Lecturer and Study Advisor in telecommunications and computer science at UNIK – the University of Oslo's graduate Study Centre at Kjeller.

Has the journal achieved its aims?

In this short overview article there is not space for more than a cursory analysis as a finale.

The objectives for the journal were spelled out three times: in 1904, when it originated, in 1927 with its re-birth, and in 1992 when it was revised after the last change of editors. The formulations are referred to in the examination of the annual publications, but the essence of it can be gleaned from the references collected here for the sake of continuity:

1904:

"...It is intended that this will impart knowledge to all personnel of the State Telegraphs, and will, in short, supply the more important news in the areas of telegraphic and telephonic technology."

1927:

"In order to secure a common level of knowledge within our readership, we must lay the basic foundations first in order to build on them in future articles. So we must provide lengthier explanations of developments within all the different branches of telegraphic and telephonic technology, from the earliest beginnings to the later developments, as well as providing other items of interest."

1992:

1 *Teletronikk* shall be the leading Norwegian telecommunications journal.

2 *Teletronikk* shall through its choice of subjects and presentation format contribute to synchronize professionals in the Norwegian telecommunications scene with reference to the development of telecommunications techniques.

The objectives from 1904 and 1927 were published, but that of 1992 was set out in an internal memo approved by the editorial board.

As mentioned earlier, when discussing the editors, the evaluation seems obvious enough for the first two periods of the journal's existence, it did not perform and so disappeared. The choice of material was too biased, according to the company history by Thorolf Rafto.

After the new beginning in 1927, it seemed as though it had got organised, with an unbroken production through to the present day, but its sights were set too high as regards the number of issues per year. But having got the contents right, it was sensible to adjust the production down from 12 to 4 each year.

Why did people write? If we look at the first series of articles for *Telegrafverket's* technicians, and especially after 1927, it was with an almost idealistic desire to inform and improve their technical ability. The second impetus was the need for the local administrators and technical middle management to have some technical knowledge to be able to understand

the tremendous developments, with the introduction of multi-channel systems and the change from overhead lines to cables. The description of multi-channel systems in *Technical Information* was often prescribed texts in the Telegraph Administration's educational courses.

But the gradual change in the journal began, a change which took a long time and was especially apparent with the mobilisation of the technological environments in post-war Norway. The increasing number of engineers in *Telegrafverket* with higher education are a target group for the journal, and with the raised level of content, the journal becomes of interest to environments other than the company. It is also distributed abroad, where it gains a good reputation.

Other countries' journals have certainly also been of influence, and over these years *Teletronikk* has had much in common with its sister journals in the Swedish and Danish PTTs. Perhaps it can also be seen to have some relationship to corresponding journals in other countries as well, namely the Netherlands, Switzerland and Australia.

Which language should be used in *Teletronikk* – Norwegian or English? The gradual changeover to full production in English has come about amongst the other changes. This changeover seems to be an inevitable consequence of the journal's development, English being the

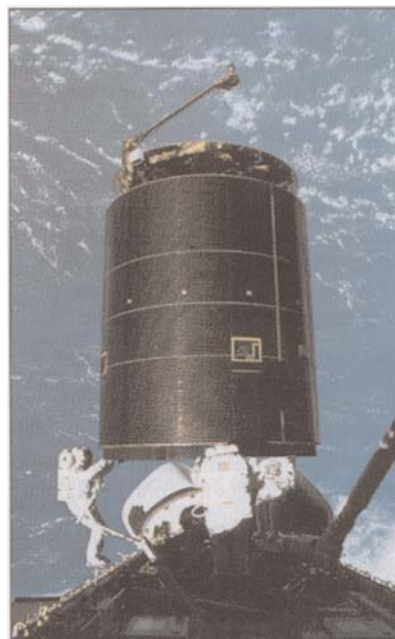


Some of Teletronikk's front covers since 1992

world language for technical matters. Reaching a wider audience with articles in English is of course an important incentive for writers.

Has the journal achieved its objective? The interest demonstrated both in Norway and abroad is very encouraging. Educational institutions ask for sets of copies to supplement other training material. The same goes for manufacturers working in the area covered by related themes. And serious professionals report back their use of the journal.

It is still too early to read the signs as to how the journal will succeed in the future. Producing themed issues is in accordance with its original ideal: to be educational. Now, however, that is achieved by entering a more all-embracing and higher level than expected originally, so the objectives of 1992 can be seen to have drawn level with *Teletronikk's* development.



The technology has come a long way. A telecommunication satellite is repaired in space June 1992