



COLLOQUIUMS PAPERS 1983-2005

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Papers from the 1983 Tokyo Colloquium

- Paper **C83_1.1:**
Present and future practices in protection signalling in Australia;
A. Campain, A. Horsley, A. Palamarzuck., Australia.
- Paper **C83_1.2:**
Belgium experience and evaluation of communication links;
F. Bardiaux, Belgium..
- Paper **C83_1.3:**
EHV-CEMIG teleprotection system application - proposed methods for performance evaluation;
E. Nery, Brazil.
- Paper **C83_1.4:**
Measures to avoid misinterpretation of teleprotection signals in spite of noise and disturbances in Power Line Carrier links;
E. Schumm, Germany.
- Paper **C83_1.5:**
Microwave communication for realities of power system in developing countries;
B S Sharma, M A Narasimhan, India.

- Paper **C83_1.6:**
Reliability of new digital type current differential relaying system via Microwave Channels;
T. Yaguchi, S. Kawano, M. Itoh, N. Yamaura, K. Chiba, Japan.
- Paper **C83_1.7:**
Employment results of optical fiber communication for phase comparison relaying system;
S. Kubota, T. Yaguchi, I. Mitani, T. Nakazawa, Japan.
- Paper **C83_2.1:**
Substation computers - actual practice and trends in Belgium;
P Van Migroet, Belgium.
- Paper **C83_2.2:**
Digital processing of control command & connected functions in EHV substations - an analysis of the operating requirements and technical constraints;
M Pavard, C Corroyer, P Bornard, T Lefebure, J M Tesson, France.
- Paper **C83_2.3:**
The impact of bus-oriented telecontrol equipment on the lay-out of the data acquisition and control system of ENEL H.V. stations;
A. Schiavi, Italy.

The paper describes the objectives and the major requirements to be met by the next generation of telecontrol equipments that will be installed in the Enel EHV stations. The telecontrol equipment will become a distributed system consisting of "units" which are spread in the station and are interconnected by means of high speed lines (e.g. fibre optics) between kiosks and the station main building. The function that will be supported by the new system and the planned impact on the lay-out of the traditional data acquisition and control system in the station are described.
- Paper **C83_2.4:**
Integrated computer system for protection and control of high voltage substations;
A Phadke, WG34.02 Convener, S H Horowitz, J S Thorp, United States.
- Paper **C83_2.5:**
EPRI Project: E A Udren, United States;
F. Bardiaux, Belgium..



Papers from the 1985 Munich Colloquium

- Paper **C85_00:**
Special Report: Digitalization of power system communication networks
R Koskinen
- Paper **C85_A00:**
Special Report: Optical communication systems.
J W Dillow
- Paper **C85_1.1:**
An economic approach to fibre optics for corporate communications of a power utility;
J R Martin, United kingdom

This paper reviews the approach that the CEGB is making with its implementation of a corporate communications network based largely on the use of composite optical fibre earth wires on the 400 kV Primary System. Provision of the composite earth wires only becomes economic if they are made available when the natural refurbishment of the overhead lines is taking place. The initial optical fibre routes are to be extended to the centres of communications activity by the use of microwave links but further consideration is being given to the use of post fitted optical fibre cables to the lower voltage lines which pass closer to these centres.

- Paper **C85_1.2:**
Optical cables for existing transmission lines;
W Keress, R J T Claburn, United Kingdom

The recent installation of optical cables on phase-conductors of 132kV transmission line in SWaEB is described together with results of supporting R & D and field- trials at lower voltages. Consideration is given to the economic aspects of optical systems which can be retro-fitted in this way and the implications, for systems-operation, of the availability of telecommunication and telecontrol channels having large information capacity and fast response-time are discussed. The paper will be supported by films of the actual installation and data on its commissioning and operation to date.

- Paper **C85_1.3:**
Technical and economic analysis of various solutions for optical fibre telecommunications system on EHV power lines;
R Cortina, P Nicolini, A Schiavi, G Bianchi, P Calzolari, G Gavardi, Italy

The telecommunication systems presently used at ENEL (Italian State Power Board) grids are essentially based on radio links and power line carriers. These systems are expected to cover growing telecommunication needs for the medium and partly the long term. Looking even further into the future, however, when a substantial increase in these requirements is foreseen (telecontrol of systems, telephony, data and message transmission for teleprocessing), together with the introduction of new techniques seems to be necessary. Bearing in mind the great

progress in fiber optic technology, coupled with its well known intrinsic transmission advantages, a research project to study the feasibility and reliability of a telecommunication system based on the use of optical fibers associated with power lines was undertaken by ENEL a few years ago.

- Paper **C85_1.4:**

Fibre optic aerial cables in high voltage lines;

U Oestreich, West Germany

- Paper **C85_1.5:**

The state of application of optical fibre communication systems in Japanese electric power companies;

T Yamazaki, N Ohtsuka, M Kajitani, K Shimoi, Japan

With the development of optical-fiber communication technology, various outstanding features of optical-fiber cable have attracted the attention of Japanese electric power companies, and they started research into optical-fiber communication systems in 1974. This was followed by successful introduction of practical systems in 1978. Since then, such systems have come into wide use, and as of March, 1985, 227 systems were in operation, covering the total system length of approximately 2,600 km. At the 1982 Paris Conference, we reported on optical fiber communication systems in practical use at that time. This paper outline the subsequent installation of additional fiber communication systems for electric power companies in Japan, and the trends of related standarization, research, and developments

- Paper **C85_1.6:**

Application of optical fibres in very high voltage substations;

B Fernández Roldan, A Llobet, Spain

The increasing automation of very high voltage electrical centres requires abundant transmission of information between various points in the plant. The transmission of information in these centres presents special problems owing to the strong electrical fields, large ground voltage differences between terminals and radioelectric interferences caused by the corona effect and arcing; all these are difficult to solve using conventional means. Optical fibre transmissions are the ideal solution for this type of installation. This paper describes the optical fibre isntallation made in a 400kV substation and the experiences obtained during two years' operation

- Paper **C85_2.1:**

Digital radio links and digital branching in the power company telecommunication networks;

J Komulainen, E Salo, Finland

- Paper **C85_2.2:**

Starting DNS of the Tokyo electric power company INC (TEPCO);

Muneyuki Tsukiyama, Toyoji Nakazawa, Toshiyuki Taguchi, Japan

The Tokyo Electric Power Co., Inc. (TEPCO) succeeded in developing and introduced the Digital Network System (DNS) for electric power utilities in the Tokyo Metropolitan area. The DNS connecting mutually a Local Area Network (LAN), Time-Division (TD) exchanges through a communication system is a synchronous network where complete synchronism is established. Since the DNS utilized form the telephone system or Office Automation (OA) has been proved to be excellent. The TEPCO has a plan that it will be extended throughout the company.

- Paper **C85_2.3:**
Communication network management system of electric power industry;
S Yoshida, M Monma, N Narisawa, C Fujiya, T Tohma, Japan

Recently the importance of communication system has increased in stable power supply, relaying system and telecontrol systems. In this situation, Communication Network Management System (CNMS) has been developed to improve reliability and quality of communication system. This CNMS has the functions such as line quality monitoring, supervision of communication equipments and management of work on communication system. This paper presents features of CNMS and the results obtained in the field.

- Paper **C85_2.4:**
Introduction of digital communications at ENEL: 18 GHz radio links;
E Pace, A Schiavi, Italy

The growing requirements of data transmission for telecontrol and the trend to system integration require to convert the telecommunications network from analog into digital. The main objective is the economy and the flexibility that can be provided by a single telecommunications network that will be able to handle both voice and nonvoice services. At ENEL the first step towards a digital network is the introduction of 18 GHz low capacity digital radio links in the peripheral telecommunication network. This paper describes the main characteristics of such systems and a study of their propagation behaviour. The interfacing solution with other non-digital carriers is also mentioned as well as some installation solutions.

- Paper **C85_2.5:**
Installation of a digital radio link at ELSAM;
Erik Andersen, Denmark
- Paper **C85_3.1:**
Summary of discussion: Digitalization of power system communication networks;
Assembled by G F Vincent
- Paper **C85_3.2:**
Summary of discussion: Optical communication systems;
Assembled by G F Vincent



Papers from the 1997 Beijing Colloquium (C35-97)

- Paper **C97_A11:**

New Philosophies in the development of Sevillana's mobile services, A Gutierrez et al, Spain

As in many other power utilities, Sevillana has several PMR networks for the use of operation people, Nevertheless, the disadvantages of these old systems (cost, size, poor management) and the difficulties to maintain and expand them, impose a new approach to the mobile services Sevillana need.

As a previous step, the Telecommunication Business Unit, met the Distribution people at all levels (from the Department Director to the lineman) in order to know directly which aspects of the service was more significant for the users.

With this information, a technical and economical debate was maintained between both Distribution and Telecommunication personnel and a final agreement was sent to the Management.

In this Report the reasons, constraints and conclusions about the final agreement are given.

- Paper **C97_A12:**

Improving frequency spectrum utilisation; Z Enbao, China

- Paper **C97_A13:**

New mobile radio communication system for electric utilities; H Hosokama, et al, Japan

- Paper **C97_A14:**

Planning and implementation of an 800Mhz trunked radio network; D Haoming, China

- Paper **C97_A15:**

A discussion on digital trunked standard in Chinese power private network; G Ning, et al., China

In China the construction of private mobile communications has had over 40 years history since it started in the 50s. The first trunked radio system in China was introduced by telecommunications departments of Shanghai from Motorola in 1990. At present, more than 100 units have approved by the department-in-charge of the

MPT for the operation of 800MHz trunking radio services. There were totally above 10 thousand channels of trunked radio system, with 500 thousand subscribers. A variety of systems exist. The signalling standard specification was MPT1327, APCO16 and LTR, etc.

The Trunked Radio Networks in Electric Power, at present, have covered Beijing, Shanghai, Shenyang, Harbin, and other cities, and prepared to realise 800MHz trunked radio network roaming the whole nation. This system uses Ericsson's EDACS

- Paper **C97_A21:**

Assessments made by Danish power utilities concerning the application of TETRA for operational purposes;

K Jensen, et al., Denmark

Like companies in other countries, the Danish power utilities have used private mobile radios (PMRs) for many years. Today, many Danish utilities have only one radio channel at their disposal. This limits the possibilities of simultaneous calls. It is doubtful whether the frequency ranges and the technology used today may satisfy the need for more channels without resulting in mutual interferences. In the years to come, the utilities will need to transmit data to and from mobile radios.

Recently, international non-proprietary standards were published for private digital trunked networks, called TETRA networks. TETRA networks are suitable for both telecommunication as well as data communication. One of the advantages of TETRA networks is short dial-up times.

In Denmark, a TETRA company has been established which will acquire theoretical as well as practical knowledge of TETRA in order to promote the establishment of an operational company in Denmark.

- Paper **C97_A22:**

Voice and Data services over MPT13xx and TETRA trunking systems;

L Muñoz, et al., Spain

- Paper **C97_B11:**

SWOT analysis for entering the telecommunication market under deregulation process in China,

H Cao, China

Nation-wide digital telecommunication network for electric power industry in China was established since late 70's. This was to provide internal telecommunication services including operational telephony, teleprotection, telecontrol, administrative telephony, and data communication. It has now become one of the largest telecommunication networks in China.

Reviewing the current status and trend, in terms of capabilities from an internal viewpoint and of possibilities from an external environmental point of view, this paper exams the strengths, weaknesses, opportunities and threats (S.W.O.T.) for Chinese PST network operators to enter the telecommunication market under deregulation process in China.

- Paper **C97_B12:**

Telecommunications deregulation - a window on Africa;

A Busse, South Africa

This paper focuses on telecommunications deregulation in Southern Africa with special emphasis on the South African context. Policy issues influencing deregulation such as network development, regulatory reforms, market liberalisation, progressive introduction of competition and opportunities for

regional co-operation are presented in this paper. The effect of telecommunications deregulation on regional power network players is also discussed

- Paper **C97_B13:**
Opportunities and threats in power utilities' telecommunications business - ESB's initial experience,
P Lynch, et al., Ireland

Liberalization of telecommunications in Ireland is proceeding in line with European Directives and as barriers to trade are removed, a more open competitive business environment is being created. In this new environment, there are both opportunities and threats for providers of telecommunication facilities and services. For power utilities, there are opportunities to provide facilities and services to new 'external' customers. However, there are also threats of losing some 'internal' customers to external service providers

- Paper **C97_B21:**
Measuring system for the Spanish liberalised electricity market;
F Gonzalo, et al., Spain

In the way to the liberalisation of the Spanish electricity market, the Regulatory Office (CSEN) has defined a nation-wide measuring system as a base for bidding and settlement activities. This system, that must be in operation before 1st of January 1999, for every installation (producer or consumer) in excess of 12 MVA or 5Gwh/year respectively, implies not only new devices (current and voltage transformers, energy meters...) but a telecommunication's framework and a Control System able to guarantee the fair play and the transparency. In the Report, a detailed information about the system, the alternatives to the telecommunication network to support it and the total costs are given.

- Paper **C97_C11:**
Considerations in planning a DDN for power system control;
H Cao, China

In the late 70's, the public telecommunications infrastructure in China was extremely deficient in both quantity and quality. This has stimulated the emergence of many private communication networks for specific applications. The Chinese Ministry of Electric Power made an important decision in 1979 to build its own telecommunication network. Now the Chinese PST covers all the provinces in the mainland.

With the fast development of power industry in China, the traffic pattern in the PST network has been changed because of fast growing applications of computers for both administration and operational control.

A project to construct a network platform for power system control in China was initiated and its first-phase trial with 3 nodes was implemented in 1993. The second-phase of the project involving 15 nodes installed in about ten provinces is now under construction.

- Paper **C97_C12:**
Plan to build an integrated business network in North China Power Network;
L Shantian, China

- Paper **C97_C13**:
The challenge of managing new communications technologies;
J Escudero,, et al., Spain

The power utilities are incorporating in their communication networks some equipment and systems based on new technologies such as SDH or ATM but, simultaneously, they continue operating devices with more traditional technologies. The aim of this article is to explain the characteristics of the NOMOS telecommunications management network run by Compania Sevillana de Electricidad (Seville Electric Company) related to quality of service. Many of these characteristics only support the ISO and ITU-T recommendations in this area. However, beyond that, different special parameters not listed in the current standards are defined.

- Paper **C97_C21**:
The role of SDH now and in the future in power system telecommunications;
V Jääskeläinen, et al., Finland

It is now two - three years since the SDH was first introduced to power system telecommunications. Even though it has already proved it's technical superiority compared to PDH (8, 34 and 140 Mbit/s systems), there has been still some concerns on it's ability to transport teleprotection signaling and on the network synchronization. Also an emerging issue is the role of SDH in the future broadband network, especially now when the benefits of ATM technology is widely discussed on all forums. In this article the usability and limitations of SDH technology to transport teleprotection signaling are covered. Simple guidelines on SDH network synchronization will be given and how the synchronization of primary rate equipment (2Mbit/s systems) should be linked to SDH network. Finally the roles of SDH and ATM in a broadband network are discussed.

- Paper **C97_C22**:

This paper was withdrawn

- Paper **C97_C23**:
A method of disturbance data transmission and conversion networks;
J Xin, et al., China

Disturbance data is a basis for fault analysis. With the development of Communication Network, Computer Network and Software Technology, the requirement of remote analysis and transmission of disturbance data is increasing. Therefore, it is becoming a more and more important question that how to transmit disturbance data in network and how they to be accepted by devices based on different protocols. A method of disturbance data transmission and conversion on networks is presented in this paper. The disturbance data is saved to PC used for disturbance data analysis in local network after conversion into the format IEC 870-5-103 protocol from other protocols.

- Paper **C97_C31**:
Self healing mechanisms for ATM power utility networks;
J Viaplana et al., Spain

One of the most stringent factors in the design of a communications network that must support the typical services of the power utility companies is the provision of the needed level of survivability. Currently, this level is 99.95% for critical communication nodes, defined as class A3 in IEC 870-4 standard. On the other hand, ATM based networks are being increasingly deployed in the utility environment as a backbone, supporting integrated services over a common network infrastructure. This leads to an even higher design objective for the survivability level due to the interactions between different services. Both factors in conjunction lead to a need for a rigorous approach in the design and implementation issues that must be taken into account in the design of ATM based utility networks. This paper describes such a rigorous approach and proposes a specific implementation of it for the power utilities environment.

- Paper **C97_C32:**
Experiences with the development of an ATM switch oriented to power utility needs;
J Selga et al., Spain

ATM is a switching and multiplexing technique that uses fixed length data messages called cells as basic data units for transmission. Each cell is 53 bytes long from which 5 are the header and the remaining 48 are the information. Cells were first standardised by ITU-T in year 1988. ATM is a connection oriented technology that uses fixed routes through the network to route cells. There are two types of routes, Paths and Channels, and they correspond to two header fields, VPI (Virtual Path identifier) and VCI (Virtual Channel identifier).

In ATM the connection is established by means of a traffic contract in which the operating parameters of the network and the user are specified, which determine the Quality of Service (QoS) of the connection. The connections in the network can be established permanently from the Management Center or in a switched way by means of call establishment on user request.

The design of the RAV (in Spanish: Red de Alta Velocidad) High-Speed Network incorporates, for all aspects of the network, the recommendations of the ATM Forum, which is in fact an international standard for private networks and which is in tune with those of the ITU-T.

- Paper **C97_C33:**
Digital teleprotection over ATM networks;
C Samitier et al., Spain

New Broadband networks, which are mainly based on ATM technology, introduce a great flexibility of operation allowing different types of services to be integrated. The natural evolution of a network towards the Broadband is the introduction of an ATM Backbone. This will give the support for the integration of different services increasing at the same time the overall capacity of the network.

When Digital Teleprotection was introduced, both Teleprotection terminals were connected by means of a dedicated digital channel. Nowadays, it is gaining ground the interconnection through cross-connect system so that the physical link is shared among different services. In the near term, Broadband Backbones will include ATM technology. It is important then to study the capability of this new technology to communicate TP equipment, the effect over the Teleprotection service and over its working parameters.

Studying the potential interest of a native ATM Teleprotection interface is also important. It is expected that the gradual deployment of ATM will make the availability of a pure ATM TP interface very interesting, as it will allow the direct connection of TP terminal to the ATM switch.

- Paper **C97_C34:**
Telecontrol over ATM; ;
C. Samitier, et al., WG35.07

Asynchronous Transmission Mode (ATM) has become an accepted network technology. It provides service integration, Quality of Service (QoS) options, routing and switching and can be implemented for virtually any service type provided the transmission speed between the network nodes are above a practical minimum level. The wide acceptance of ATM and its flexibility makes it an interesting candidate for Telecontrol Networks.

This paper presents some the interfacing methods (layering approach) between Telecontrol applications and ATM networks. The paper gives a description of how IEC 870-5 and ATM may inter-operate and a brief overview of inter-operation between IEC 870-6 and ATM.

The paper gives a brief definition of the relevant Types of service, Bearer Service and QoS

- Paper **C97_C35:**
Developing b-ISDN in power private communications network (PPCN);
S Yuan, China

It is determined that the developing policy of power private communication network (PPCN) of China is to make full use of power private communication resources in order to serve the power network safe production and social public telecommunications.

It is recognised that the upcoming user applications will demand higher throughput and less delay from PPCN. However the present PPCN can not support a considerable variety of requirements of new telecommunications services. Obviously, the PPCN of China requires a unique network infrastructure which can be deployed flexibly to support all the present and future services. The design goal of broadband integrated services digital network (B-ISDN) is to provide the capacity to support these applications. Consequently, developing B-ISDN would be demanded from PPCN of China.

ATM cells are responsible for carrying various user payload, while SDH/SONET acts as the physical carrier transport system with great bit rate, traffic capacity and powerful OAM functions.

- Paper **C97_C41:**
Prospects for the deployment of optical fibre ring access network for power system application;
F Ding, et al., China

- Paper **C97_C42:**
TDMA point-to-multipoint approach to power system protection and supervision;
C Naidoo, et al., South Africa

This paper presents the TDMA Point-to-Multipoint (P-MP) digital microwave

communication equipment as a Bearer of Power Utility type applications. A description of the equipment is given with an account of its current and future application. Protection field trials performed on the system are presented. Known frequency problems are highlighted and solutions proposed.

- Paper **C97_C43:**

CDMA used in power scheduling system;

Z Yang, et al., China

- Paper **C97_C44:**

Radio vs Fibre;

T Jordan, Norway

The development of new communication technologies, and in particular, new transmission concepts has led to increasingly cheaper and more reliable transmission mediums. At the same time the development of improved network technologies ensures that the transmission mediums may be optimised both in regards to capacity and in regards to the resilience required to give a desired service quality.

Line-of-sight radio relay systems and fibre transmission systems are the main alternatives in transmission networks today. Both transmission systems are capable of delivering good transmission quality. This is widely accepted for fibre solutions. It is also true for modern radio-relay systems when the transmission links are properly engineered. However, as some attitudes to radio-relay systems are still influenced by early radio-relay design and lack of accurate engineering methods, it may be useful to highlight the potentials of modern radio-relay systems when compared to fibre solutions.

This paper describes briefly one way of defining the performance of a transmission path, looks at some of the transmission constraints that have to be overcome in a radio-relay system, gives a brief summary of the constraints on a fibre-channel and makes an overall comparison between the two mediums.

- Paper **C97_C51:**

Digital PLC - a reliable transmission scheme;

T Jordan, et al., Norway

Power Line Carrier (PLC) has been established as a reliable and inexpensive means of transmitting operational services. The theory for PLC-transmission was founded in the 1920's, while PLC came into common development in the 1930's. Since the PLC concept was transformed from Double Side Band to Single Side Band in the late 1940's no major conceptual change has occurred until the latest digital evolution.

With the onset of digital technology, a whole new range of applications is envisaged - from solving the bottlenecks in existing PLC-networks or providing increased resilience/availability to providing digital access and new services. This paper gives a set of guidelines in how to plan PLC-links in general, considers a method of assessing the quality of a PLC link, looks at some of the critical design parameters of Digital PLC equipment and shares some of the experience that has been gained with the first digital PLC products. Only with Digital PLC is it possible to utilise the full potential of the power line medium.

- Paper **C97_C52:**

A new Coupling Mode for 500kV PLC;

X Feng Xiang, et al., China

- Paper **C97_C61:**

Time process of multipoint network access relay;

X Bingzhen, et al., China

The point-to-multipoint network access is often encountered in SCADA (Supervisory Control And Data Acquisition) system of power system. If the devices of point-to-multipoint network use different protocols, protocol conversion has to be carried first. To complete the general polling for each outstation and selection of master station, the time interval of multipoint access must be reasonably distributed and processed. The relationship between network access time and running speed of outstations, data transmission baud rate, processing time of protocol conversion software, and method on reducing network access time is given in this paper. An example is demonstrated on how to process the network access time and multipoint memory assignment corresponding, and how to set start time and meter time internal in protocol conversion software.

- Paper **C97_C71:**

Wireless ATM for power system communication;

P Kewu, et al., China

- Paper **C97_C72:**

Technical and economic analysis of WLLAN feasibility in substations and generation facilities; ;

J Zaminillo Peral et al., Spain

- *Substation control and measurement cabling has traditionally been resolved with copper shielded cables in a star and branch topology from control and measurement apparatus located in the switchyard to the presentation and control devices inside building. Buildings can be dispersed close to the line equipment or centralised as classical.*

New substations are being implemented with integrated control and protection electronics that uses fibre cables as transmission mean. This is a drastic way of copper reduction and a electromagnetic and telecomm performance increase. Multiuser radio technology has substantially evolved in last decade for local area network (LAN) purposes inside buildings in order to drastically reduce cables constraints and change flexibility. The IEEE 802.11 working group is standardising a medium access control (MAC) for wireless LAN (WLLAN). The present work has studied theoretical and practically a commercial product of wireless LAN in an Electra de Viesgo's substation.

This paper presents the technical and economical aspects of applying WLLAN in substations for internal communications services and the results of the practical study.

- Paper

A micro wireless transmitter - functions and testing;

Zhanghan, China

- Paper **C97_C81:**

New technology for keeping microwave towers of electric power communications free from lightning strokes;

L Houqun, et al., China

- Paper **C97_C82:**

Study of anti-lightning protection methods for microwave stations located on areas of frequent lightning activity plus high earth resistivity; ;

X Wenqi, China

- Paper **C97_C83:**

New technology for lightning protection for power communications facilities;

Z Dian, China

- Paper **C97_C84:**

Study of influence and protective methods from electromagnetic influence on communication equipment;

X Wenqi, China

This paper mainly introduces electromagnetic interference influence caused by lightning on communication equipment through some scientific researches and tests, which have been executed during design process on Tianshengqiao Hydro Power Station---Guangzhou station Digital Microwave Communication Project (TGDMCP) in China.

This paper also presents recommending criterion values about malfunction and damage of communication equipment caused by lightning electromagnetic interference based on results of tests, and offers some protective methods after calculation to ease adverse influence.

It is suggested for comprehensive anti-lightning protection methods to be adopted by using Semiconductor Lightning Eliminators plus Hexahedron Shielding to cover the whole communication equipment room.

- Paper **C97_C91:**

Applications of WDM in power system telecommunications;

J Wang, et al., China

- Paper **C97_C92:**

Microphase! V-wave phasor transducer for Sevillana de Electricidad state estimator;

J Benavente, et al., Spain



Papers from the 1999 Krakow Colloquium

- Paper **C99_GR:**

General Report

Erik Sandström, Tony Watson, Sweden/Canada

Post-event General Report for the Colloquium including summaries of discussions held at the Colloquium.

- Paper **C99_00:**

Special Report

Erik Sandström, Tony Watson, Sweden/Canada

Special Report for the Colloquium including summaries of papers and questions to be posed during the discussions.

- Paper **C99_A11:**

Digital private mobile radio system:

M Mankel, Germany

The energy supplier's mobile radio of course is involved in this business. 'Make' or 'buy' is often an important question in this context. And for the answer of this question: the decision maker has to know the advantages and disadvantages of different systems and, of course, the total costs of the different solutions. Due to the growth rate of the public radio systems according to the GSM-Standard the non-public radio systems moved to second place by number. However, the private radio system still has its full right of existence.

- Paper **C99- A12:**

The next generation mobile system - will it support more than mobile services;

P D Moray, United Kingdom

In many countries the increasing demand for mobile services produces intense pressure on the use of radio spectrum and, as a result, there is continual progression to narrower bandwidth systems. Technological developments aim to keep pace with such demands. Sometimes, technology can facilitate the changes by providing a product which offers significant gains in spectrum utilisation and provides much greater functionality. This paper and the accompanying slides describes one such system, TERrestrial Trunked Radio System (TETRA) and argues that technology has developed a system which can support far more than the traditional voice services.

- Paper **C99_A13:**

Withdrawn

- Paper **C99_A14:**

Mobile Communications in Energie Noord West NV;
A H Toet, et al, Netherlands

At this moment Energie Noord West investigates the usability of a new GSM / Iridium hand held mobile telephone. When the test results of the Iridium terminal are positive, the present Inmarsat terminals will be replaced by the combination of an Iridium/GSM handset in pocket size.

Under the pressure of the Millennium problems ENW decided not to dismantle the old mobile radio systems, but to revise and to preserve them for mobile communications during the critical dates. A limited number of about 30 mobile sets will be available for operational purposes during these critical dates.

- Paper **C99_A15:**

New TETRA-System for power companies in Sweden;
L. Wennerberg, Sweden

In 1996 Vattenfall took the initiative to a conference on mobile radiosystems for the Swedish power companies. The purpose was to find the operative demands on future mobile communications for the energy sector in Sweden and to recommend a system solution. Different technical system solutions were then examined by a working group such as GSM2, GSM2+, GSM-R, TETRAPOL and TETRA 25.

- Paper **C99_A16:**

Use of radio for transmission of data;
E Chauet, France

SCLE has been developing over the last ten years control-command applications in the power sector. Traditionally, the data transmission support used for such applications is the conventional telephone network. The growth in the use of mobile telephones has encouraged SCLE to propose the use of the GSM network for carrying data of strategic importance for EDF, such as information relating to power meter readings.

- Paper **C99_B11:**

Implementation of operational services like telecontrol using QoS IP networks;
Working Group 35.07, International

The Quality of Service guarantee required by SCADA etc applications is not a native characteristic of this technology but the current state of these

technologies allows operational services provision over IP networks to be considered. The proposed method of QoS specification for the Internet is to specify a service class and a set of parameters, depending on the service class. To ensure the correct operation of QoS Architecture, the network must dynamically check the behaviour of different applications. Its function is to guarantee the QoS of the well-behaved users by controlling the misbehaved ones. This is not the case for Telecontrol applications since they cannot generate more traffic than expected.

- Paper **C99_B12:**
A new generation of packet switch designed for the integration of operational services; R Cabezas, et al, Spain

New advances in Datagram technology, chips capacity and the tremendous success of the Internet has made ENDESA Group reconsider the original TRAME concept in order to obtain a new system that integrates all these new advances brought about by the Internet. The new system, the TRAME+, has been designed to be a cost-effective solution for the integration of Operational Services in a common Packet Switching network. The paper covers architectural and operational network aspects giving a review of the different considerations that have been taken into account in the system specification.

- Paper **C99_B13:**
Application of TCP/IP to achieve mutual connection to power system monitoring and control systems by electric power companies;
F Ogasawara, et al, Japan

In the interest of more efficient power system operation, electric power companies (EPC) have a need for more integrated information interchange through mutual internal and external connection to power system monitoring and control systems. Such mutual system connection, however, is quite difficult due to the problems associated with special redundancy configuration and vendor-related differences. In an effort to resolve these problems, we have therefore an RNA (Real-time computer Network Architecture) communication protocol in which certain functions specific to power system monitoring and control systems have been added to the standard communication protocol TCP/IP. These added specific functions have been developed as a UNIX compatible package software product in order to achieve greater convenience, reliability and low-cost affordability of connection. This paper gives a general outline of the RNA communication protocol and introduces some examples of how this protocol has been applied for communication among EPCs and within EPC organisations.

- Paper **C99_B14:**
An NMS strategy for deployment of FEPs in high voltage substations;
M Lonsdale, United Kingdom

Historically, Centralised Front End Processors (FEPs) allowed control rooms to lever the benefits of centralised communications processing; however, a number of major electricity companies have recognised the limitations of this approach and are now deriving operational benefits through devolving FEPs into High Voltage Substations. Electricity Companies have seized the opportunity to remove single points of failure and, at the same time, structurally modify the communications architecture to minimise multi-drop configurations. More interestingly, FEP platforms can be upgraded in tandem with this change in topology to support open, standardised SCADA protocols that offer enhanced features and enable the support of large numbers of remote outstations. Distributing intelligence will enable the Electricity Companies to reduce the processing overhead on centralised control room resources and move confidently into the next millennium with a platform that supports existing and emerging telemetry applications.

- Paper **C99_B15:**
Telecontrol network design issues using IP technology;
G Fahlén, et al, Sweden-Spain

Datagram technology is not a new invention; in fact, Vattenfall has almost 25 years of experience in the use of this technology in its Telecontrol network. However, it has only been after the great success of Internet that a common widespread standard protocol, the IP suite, has been adopted. This paper presents the project under development in Vattenfall for the implementation of a Data network that will support the Telecontrol service using IP technology. The use of IP technology will allow a flexible and scalable network, able to integrate any other requested service, to be implemented.

- Paper **C99_B16:**
SCADA systems design alternatives based on TCP/IP;
F Pérez, et al, Spain

For protocols included in the SCADA systems, international standardization arose when there already were a large number of established protocols. The IEC (International Electrical Commission), has been developing standards, and EPA (Enhanced Protocol Architecture), OSI (Open System Interconnection). Although these architectural models respect to a greater or lesser extent the OSI model, it's also true that in the last years we have noticed a loss of influence of OSI architecture, and on the contrary, a resurgence of the TCP/IP architecture. In this article we will expose the advantages of using the TCP/IP architecture instead of OSI in the SCADA systems.

- Paper C99_B21:
Applying Estelle to improve telecontrol protocol performances;
V Medina, et al, Spain

Communication protocols, that are applied to control Power Networks, have to be studied thoroughly, because the expense of setting up such systems can be reduced just by optimizing them. Our research group works on the improvement of these communication protocols. Some results of our research are the application of Formal Description Techniques to convert telecontrol protocols or improvements in telecontrol medium access protocol, gaining in efficiency. A Formal Description Technique (FDT) is chosen when a protocol has to be specified in a formal way. Although there are many FDTs, just three of them are the most popular. These are ESTELLE (Extended State-Transition Language) and SDL (Specification and Description Language), based on extended finite state machines, and LOTOS (Language for Temporal Ordering Specification), based on process algebra.

- Paper C99_B31:
The SGRT project of Union Fenosa;
J L Teja, et al, Spain

For the companies with an own telecommunications infrastructure, the corporate telecommunications network has achieved a very important role in the last years. The different operations involved in the daily job and the systems supporting the company business goals are continuously more linked to a proper and efficient work of the corporate telecommunications network. The TMN standard of ITU appears to perform a suitable management of these networks. This paper exposes the real experience of design and development of SGRT (Sistema de Gestión de Red de Telecomunicaciones, Telecommunications Network Management System) project, which accomplishes the TMN standards and the application in the Union Fenosa telecommunications network.

- Paper C99_B32:
TMN versus SNMP based network management systems;
J Luque, et al, Spain

The OSI (Open System Interconnection) model has been a successful framework for protocol architecture in some environments. When network management arose as a major problem, the natural official answer was to build the Telecommunication Management Network (TMN), an architecture based on the existing OSI model. To cope with the OSI drawbacks, the TCP-IP and related protocols have become a de facto standard for many applications. Most computer networks, both in academic or industrial environments are based on TCP-IP. Internet is also a TCP-IP based network. This model uses quite simple but useful protocols to communicate computers. Its kernel is the SNMP (Simple Network Management Protocol) which is widely supported and allows for the easy management of multivendor networks.

- Paper **C99_B33:**
application of the Web Browser for Management of Virtual Networks;
M. Garstka, et al, Poland

Virtual networks become more and more common in both local area computer networks and in wide area networks of telecommunication operators. The idea of virtual networks is that a group of user use only a part of the bandwidth which is available in the physical network and the part is logically separated from the traffic of other users. In many cases users of a virtual network (or maybe the administrator who is responsible for the virtual network) should have access to the devices which support the virtual network. We suggest that web browser may be used as a user interface to managed devices. In the article we present a software system which allows users to manage selected parameters of networking devices via a web browser.

- Paper **C99_C11:**
Window of opportunities to Powergrid in the liberalised telecom scenario in India;
A K Bhatnagar, India

POWERGRID is the largest electric power transmission company in India and is one among six largest electric power transmission companies in the world. POWERGRID is investing massive amount in SCADA based Energy Management Systems (EMS). The EMS is supported by a wideband communication system comprising Digital Microwave Radio & Fibre Optic transmission systems. However, the wideband communication system being established will have capacity much higher than that required for the intended purpose. Thus there are new possibilities for implementing sustainable network in a competitive environment. This paper is aimed at bringing out those issues.

- Paper **C99_C21:**
A radio network architecture for automatic meter reading;
J Molina, et al, Spain

Electrical power supply is currently being deregulated and liberalized. This situation will create many problems in the distribution phase, in the separate reading and billing of the electrical consumption of each company's client, and consequently also in the sharing of the costs of generating that electrical power. Within this context, on-site readings taken manually by an operator are not a practical or economical solution since it is difficult to perform these readings without problems or errors.

- Paper **C99_C22:**
The communications options for support of remote control of a high voltage network - a case study;
P D Moray, United Kingdom

This paper examines the communication options available to an United Kingdom electricity company when seeking to implement remote control of a Distribution High Voltage (DHV) power network. In the majority of developed countries, electricity companies have for a number of years, been examining the benefits of remotely/automatically controlling some of the switch points on DHV networks. In the UK, there are benefits for customers in rural areas but there has been no real driver for the capital investment.

- Paper **C99_C31:**
TASE.2 and grid security calculation;
W Kaib, et al, Germany



Up to the end of 1996 the Energie-Versorgung Schwaben AG (EVS) and the Badenwerk AG (BW) had been independent companies and merged at the beginning of 1997 to the Energie Baden-Württemberg AG, which now is the fourth-largest energy supply company in Germany. In 1997 the electricity supply of EnBW amounted to 49000 GWh. The structure of the EnBW is geared towards the requirements of the deregulated energy market. Separate companies for generation, transmission and distribution were founded. The EnBW Transportnetze AG operates the 380 kV and 220 kV lines of the transmission networks. For the future the competence to operate the 110 kV / 20 kV / 0,4 kV distribution networks will be at EnBW Regional AG.

- Paper **C99_C32:**
Platforms and solutions for process and market communication;
W Maerz, Germany

Deregulated markets heavily depend on electronically means and applications for process and market communication to allow high customer driven market dynamics by reasonable low transaction cost. All existing deregulated energy markets have developed communication de-facto solutions to archive this goal. Before starting with communication platforms and solutions the market model (transactions and objects) should be described taking into account power exchanges, bilateral trade, ISO's (independent system operator) or system operators, transaction management of energy delivery schedules, meter readings collection and accounting and billing including change of customer. The most promising modeling language for this is UML (Universal Modeling Language).

- Paper **C99_C33:**
French deregulated market: Publishing system between EDF and other power utilities about production planning;
J-B Chauvin, et al, France

This synthesis document is intended to give a general presentation of the

new Publication system which has been put in place between the TNMS and all producers. The purpose of the Publication tool is, in the short term, to manage the dispatch of data regarding schedules and statements to producers. The documents involved in this will be T-I schedules (T like « Today »), instructions and redeclarations, T-schedules and producers' overall differentials as calculated by the Décomptes programme. This information will provide the producers with the necessary explanations of their invoicing and will enable them, if the case should arise, to query this. The Publication tool is therefore designed to be deployed at the producer end, and also on future TNMS sites so that they have access to the same information base as the producers for inspection purposes.

- Paper **C99_C34:**
DEIEL - for electronic information exchange on a deregulated power market in the Nordic countries;
M Nilsson, et al, Sweden

In the Swedish power market a customer who wishes to buy electricity on the free market must install an hourly-registering meter. Each network company is responsible within its own area for all measurement and reports the data to other actors such as electricity retailers, balance responsible companies, called balance centres, and to Svenska Kraftnät. All the Nordic countries have now begun deregulating their power markets. Because of the development towards a deregulated and common power market in the Nordic area it was necessary and natural to establish a common standard for communication. In this environment we developed a standard called Ediel, designed for non-real time data exchange.

- Paper **C99_C35:**
A telecontrol gateway to meet UCPTE requirements regarding the technical data to be exchanged between European Utilities;
J-P Bourbigot, et al, France

To meet data exchange requirements between UCPTE partners, the latter have been setting up data links for 20 years to transmit information such as: breaker status and power measurements at borders as well as energy counter values. At first, the volume of information to be exchanged between UCPTE Control Centres was low and no effort was done to promote interoperability. The growth of power exchange on the UCPTE power network as well as the deregulation of electricity market justify to increase the data exchange between the telecontrol systems. The upcoming of protocol gateway between the different telecontrol systems seems to be a solution that provides performance and flexibility. From the final TASE.2 interface specification drafted by UCPTE experts, it's up to each country to develop the gateway between the TASE.2 European network (URTICA) and its own telecontrol network.

- Paper **C99_C36:**
Q1000, an advanced communicating meter;
M Sadouni, USA

The new ways of the deregulation and privatisation has obliged energy suppliers to propose to their customers systems which offer new services such as real time meter reading. The largest customers are usually directly connected to the HV network, which makes them more volatile, as they can be supplied more easily by other providers on the network. Competition is born. Due to their ability to choose their provider, the significant customers will be more demanding on information related to their electricity consumption. The required information is no more limited to basic quantitative metering or billing data; it is becoming qualitative too as real time communication.

- Paper **C99_C37:**
French deregulated market: Communication System settled by French System Operator to calculate settlement;
J L Bergerot, et al, France

The European Directive on the opening of the energy market came into effect in France on 19 February 1999. One of the consequences is the creation of a System Operator one of the missions of whom was to establish the deviations between forecasts and actual generation and consumption and to deal with their payment. It has been necessary, for this purpose, to design and deploy a new communication system. One of the elements of this system is made up of power exchange meters installed at all the incoming and outgoing points on the transmission network and of remote metering servers installed in the 7 regional control centres. The data collected at this level are then forwarded to a central server where the deviations are calculated.

- Paper **C99_C38:**
Evolutions of the management system of the T90 equipments for the GRT needs,
T Jacquemin, et al, France

The T90 application is developed and maintained by company UNILOG. This is a communications server that allows the configuration and the remote control of EDF equipments installed in the consumers and the producers.

- Paper **C99_C39:**
Building the telecommunication infrastructure for the energy market in Poland;
B. Rudnicki, Poland
- Paper **C99_C40:**
CENTREL-NET concept to exchange the real-time data and energy metering data as well as other electronic data between CENTREL utilities and UCPTE neighbours;
H. Baranowski, Poland

- Paper **C99_D11:**
Operational video systems at power utilities in Japan;
Y Yamanda, et al, Japan

This paper discusses future video transmission systems, looking at the present level of introduction of operational video systems such as ITV systems and Video-conferencing systems, network technology including video-related technology and ATM, and mobile video transmission using mobile communication technology.

- Paper **C99_D12:**
IDOLO: The use of multimedia technology in the operation and maintenance of large industrial networks;
J I Escudero, et al, Spain

The use of multimedia technology is becoming even more important for the automatisisation of processes in which there is human involvement. So far, the application of these technologies has been limited to industrial processes realized in small spaces. However, SCADA systems such as electrical power networks have not taken advantage of these new forms - electronic documentation and videoconferencing.

- Paper **C99_D13:**
The use of new ITU-T multimedia communications standards for operational video;
J Zamanillo Peral, Spain

TV networks for substation and power plants operation and surveillance have been traditionally implemented as local due to high prices involved in every network element because of the process and bandwidth demand of the video and audio sources. In 1989 telecommunication analysts foresee very low use of videoconference due to a lack of standards, very high market prices and organization habits. At that time, they could not predict the explosive driving force of the pair Internet-PC in society. The advent in 1994 of the modem V.34, and the subsequent popularization of the multimedia techniques for domestic PC have achieved a set of hardware and software elements. That put in hands the possibilities of establish videoconference sessions over POTS using the recent (1995) H.324 ITU's Rec.

- Paper **C99_D14:**
Experiences in the provision of video-surveillance service using IP networks;
L Mota, et al, Portugal-Spain.

The transmission of video signals, primarily developed for security applications, has now found a wide variety of usage. Some of them fall into

the field of the Operational Services as they are becoming a necessary component in the proper and efficient operation of Power Control Networks. The Video-Surveillance service has been integrated in the Control Network that also supports the Telecontrol service. This integration is a straightforward solution since the Video Surveillance service could be considered to be a complement of the Telecontrol.

- Paper **C99_D15:**
Professional Video Services in Broadband Corporate Networks - opportunities and experiences;
M. Rzanek, Poland

There are three fundamental elements necessary for the successful implementation of contemporary professional video services: technology, infrastructure and know how. The paper demonstrates that all are available now in Poland.