

**D. Dietrich
P. Neumann
H. Schweinzer (eds.)**

Fieldbus Technology

**Systems Integration,
Networking,
and Engineering**



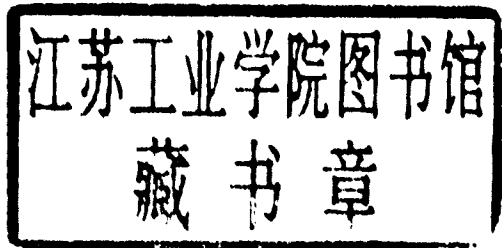
SpringerWienNewYork

D. Dietrich
P. Neumann
H. Schweinzer (eds.)

Fieldbus Technology

Systems Integration, Networking,
and Engineering

Proceedings of the Fieldbus Conference FeT '99
in Magdeburg, Federal Republic of Germany,
September 23–24, 1999



SpringerWienNewYork

Univ.-Prof. Dipl.-Ing. Dr. Dietmar Dietrich

Institut für Computertechnik

Ass.-Prof. Dipl.-Ing. Dr. Herbert Schweinzer

Institut für Elektrische Meßtechnik und Schaltungstechnik

Technische Universität Wien, Vienna, Austria

Prof. Dr.-Ing. habil. Peter Neumann

Institut für Automation und Kommunikation e.V.

Otto-von-Guericke-Universität Magdeburg

Magdeburg, Federal Republic of Germany

This work is subject to copyright.

All rights are reserved, whether the whole or part of the material is concerned, specifically those of translation, reprinting, re-use of illustrations, broadcasting, reproduction by photocopying machines or similar means, and storage in data banks.

© 1999 Springer-Verlag/Wien

Printed in Austria

Printed by Novographic, Ing. Wolfgang Schmid, A-1230 Wien

Graphic design: Ecke Bonk

Printed on acid-free and chlorine-free bleached paper

SPIN 10744232

With 235 Figures

ISBN 3-211-83394-3 Springer-Verlag Wien New York

Preface

Although being a matter of course in science and industry, in the public opinion fieldbus technology is not always seen in its real importance. Terms like “home automation”, “industry automation”, etc. are not always perceived in a positive way: they sound ultramodern, mysterious, unreliable. Often conventional but well-known solutions instead of fieldbus technology are used. On the other hand, fieldbus technology saves money, systems are offering more services and test integration increases reliability.

Fieldbus technology is not an argument for marketing. However, its potential is enormous and unlimited although some believe realization will be a matter of the far future.

For several years, fieldbus systems have been seen as local installations of small interest in comparison with LANs, Internet, or mobile phones. This situation has changed: in automobiles, a fieldbus has to manage the communication of about one hundred nodes. Fieldbus systems are monitored via classical LANs, fieldbus systems in airplanes are used not only for control, but also for online testing, and in some building automation systems more than 10.000 nodes are connected by fieldbus systems. Great demands are arising with consequences in system complexity, reliability, availability and security, all being aspects relevant for scientific work. Activities in this field are numerous and mostly combined with other areas of scientific or engineering work. This is challenging and important because of the connection to different engineering disciplines.

There are slogans as “IT revolution in industry”¹, “the transparent factory”², or “concert of intelligent chips”³. In any way, our age is stamped by information technology. All spheres of our living are being influenced and changed by innovations of information technology. Mobile phones, teleworking, electronic commerce are revolutions in daily life. Similar to the industrial revolution which brought dramatic modifications, collecting, storing, transporting and computing of information leads to radical changes in human society.

In nature which is an important model for technical systems, primitive micro-organisms bear the information in their system structure. Animals being “more intelligent” are based on internal information systems, neuronal networks in the most complex form. Reception and communication with the external world is performed by use of highly sophisticated and adaptable sensor systems, but also internally a great number of sensors is used for process control of life functions.

¹ Die IT-Revolution in der Industrie, MegaLink 11/99

² Die transparente Fabrik; Messe Wien viet; Presse-Info, 18.6.1999

³ Drössler, Ch.: Konzert der schlauen Chips, DIE ZEIT Nr. 24; 10.6.1999

Also fieldbus technology allows more intelligent systems. Smart sensors and complex sensor systems increase the functionality and the effectiveness of the system. In a weekly newspaper⁴ a prognosis of the household of tomorrow is given where cooking, controlling of goods in stock and so on are performed by integrated transponders and neuronal algorithms. This leads to the following scenario:

- more and more smart sensors will be integrated in things of every day life and will be part of the fieldbus system,
- demand of controllers and software will increase dramatically to compute, filter and apply all of these data,
- various aspects of this new technology demand extensive analysis because numerous arising questions have to be answered by scientists,
- average life will change completely, a process which cannot be stopped.

Fieldbus technology carries an enormous part of this development without appearing in public like the Internet or the use of mobile phones. Moreover, this part will increase in the years to come. A clear example for this is the continuous change of mechanical systems by the use of fieldbus technology: when for the first time in Airbus A320, mechanical control of an airplane was replaced by “fly by wire”, the public did not take notice of this, moreover passengers should not be informed about this fact. Nowadays, automobiles are in a similar situation. “Steer by wire” replaces the mechanical steering-gear by electronic control of every wheel, a technique more efficient and flexible, but also cheaper.

In industry and in the private sphere a similar development can be assumed. More and more, decisions for product development are influenced by the total costs which includes service and maintenance. Moreover, the competition of producers leads to increased features of the products. These are all arguments for an integration of fieldbus technology.

Large organizations like factories, hospitals, laboratories need transparency gained by automatic data acquisition. These data are not only directly related to the costs, but also to the personnel and to logistic parameters such as location, functionality, and status of maintenance of the equipment. Dynamic management of the facilities combined with data from processes and the personnel enables a more efficient and reliable operation of this complex system.

In the technical realization of such systems, problems are arising from the inter-connection of different types of networks, especially fieldbus systems with LANs and the Internet. Furthermore, security is an important aspect. These all are subjects reflected in this book.

⁴ Drössler, Ch.: Konzert der schlaunen Chips, DIE ZEIT Nr. 24; 10.6.1999

Network interconnection is a technical and financial problem. Solutions are normally based on compromises and can be optimized by technical efforts. Security is a complex problem because of various aspects, especially the anxiety of the users. Intranet used in companies and banks is an expensive technique which shields against the Internet. On the other hand, an increasing number of systems can be read out and manipulated by remote control and remote service over networks which allow system access needing strict security provision methods. Several principles are known which have to prove their values.

Communication networks connect different spheres and in so far they help to overcome barriers⁵. They create new products, new markets and also new professions. Fieldbus technology is not at the front end of this trend because it acts in the background and in critical domains. Equipped with sensitive sensors, fieldbus technology becomes the backbone of many processes of our life.

This book is a collection of articles dealing with the matter of fieldbus technology. The articles were submitted to the fieldbus conference FeT'99 taking place in Magdeburg, Germany. Two very successful conferences before, the FeT'95 and the FeT'97, were held in Vienna, Austria. The articles were reviewed by the international program committee which decided to also include some high quality articles not presented at the conference.

The book comprises eleven chapters dealing with important aspects of fieldbus technology and reflecting areas of main activity in science and industry. These chapters also coincide with the sessions at the conference.

A number of people were strongly involved in the preparation and completion of this book: M. Wollschlaeger, Magdeburg, managed a main part of the communication with the authors to ensure the preparation of the articles in time. W. Kandler, Vienna, made the final check of the layout of the book which entailed a lot of corrections. We like to thank them very much. We also thank Springer-Verlag Wien for printing and binding the book in its well known high quality.

We would like to thank all those who helped in the organization of the conference: H. Mueller and H. Rosenzweig, VDI/VDE-GMA, who were responsible for the organization, Th. Sauter, W. Kandler and M. Wollschlaeger, who made preparations for the program committee meetings, and the program committee itself. We thank our authors and speakers who provided the valuable contributions for our stimulating discussions. We also thank our four invited speakers who followed our invitation.

⁵ Dietrich, D.; Posta, R.; Schmalek, R.: Feldbussysteme - Synthese statt Konflikt; etz 1-2- 96, Jahrbuch elektrotechnik; VDE

VIII

Our aim is to reach a broad audience. Therefore the conference fees were kept moderate. This became possible only with the support of sponsoring organizations whose financial support we appreciate very much.

Magdeburg, September 1999

Dietmar Dietrich

Herbert Schweinzer

Peter Neumann

Supported by: ABB Automation Products, D-30179 Hannover
 Endress + Hauser GmbH + Co, D-79689 Maulburg
 Kist Europe, D-66123 Saarbruecken
 Phoenix Contract GmbH & Co, D-32825 Blomberg
 Siemens AG, D-90327 Nürnberg
 Weidmueller Connex GmbH & Co, D-32760 Detmold

Conference Chairman

Prof. Dr. P. Neumann, ifak, D

Chairman of the Program Committee

Prof. Dr. D. Dietrich, TU Vienna / ICT, A

Program Committee

Dr. M. Adams, Dr.Seufert GmbH, D
Prof. Dr. K. Bender, TU Munich / ITM, D
Dipl.-Ing. R. Bent, Phoenix Contact GmbH & Co., D
Prof. Dr. J. Böttcher, Univ. der Bundeswehr Munich, D
Prof. Dr. J.-D. Decotignie, CSEM Neuchatel, CH
Dipl.-Ing. A. De Decker, Siemens NV, B
Dr. Keith Dimond, University of Kent, GB
Prof. Dr. D. Dietrich, TU Vienna / ICT, A
Prof. Dr. K. Etschberger, stzp, IXXAT Automation GmbH, D
Josef F. Faller, Carinthian Tech Research, A
Prof. P. Fischer, FH Dortmund, D
Prof. Dr. W.A. Halang, Fernuniversität Hagen, D
G. Hodgkinson, PROFIBUS International, GB
Dipl.-Ing. J. Johansen, PROCES-DATA A/S, DK
Prof. Dr. K. Kabitzsch, TU Dresden, D
Prof. Dr. W. Kriesel, GMA, D
L. Liljegren, ABB, S
Dr. M. Merx, Weidmüller ConneXt GmbH&Co., D
Ing. W. Morrenth, Siemens AG, A
Dipl.-Ing. H. Müller, VDI/VDE-GMA, D
K. A. Myrvang, AD Elektronikk AS, N
Prof. Dr. P. Neumann, ifak Magdeburg, D
Prof. Dr. O. Nisamutdinov, TU Perm, RU
Dipl.-Ing. P. Noury, CEGELEC, F
Dr. T. Sauter, TU Vienna / ICT, A
Ass.Prof. Dr. H. Schweinzer, TU Vienna / EMST, A
Dipl.-Ing. H.-J. Schweinzer, TU Vienna / ICT, A
Dipl.-Ing. H. K. Tronnier, EIBA, B
Dr. K. Watson, Fraunhofer-IITB, D
Dr.-Ing. M. Wollschlaeger, IPE, University Magdeburg, D
Dipl.-Ing. H. Zeltwanger, CAN-in-Automation e. V., D

Steering Committee

Prof. Dr. D. Dietrich, TU Vienna / ICT, A
Prof. Dr. P. Neumann, ifak, D
Ass. Prof. Dr. H. Schweinzer, TU Vienna / EMST, A
Dipl.-Ing. W. Kandler, TU Vienna / EMST, A
Dr. Th. Sauter, TU Vienna / ICT, A
Dr.-Ing. M. Wollschlaeger, IPE, University Magdeburg

Organisation

Dipl.-Ing. H. Mueller, VDI/VDE-GMA
Mrs. H. Rosenzweig, VDI/VDE-GMA

Index of Authors

Almeida, L.	342	Goossens, M.	188
Arroz, G.	375	Gordeev, M.	69
Ayal, M.	76	Groppe, A.	247
Bachmann, R.	276	Hadlich, T.	256
Bangemann, T.	180	Hähnliche, J.	48
Bäuerle, D.	334	Haidvogel, R.	195
Beikirch, H.	368, 381	Heimbold, T.	215
Blevins, T.	112	Hempfen, U.	230
Blum, I.	128	Hoang, M. S.	276
Borodino, C.	423	Hörger, J.	223, 423
Bregulla, T.	423	Iosif, R.	437
Bruns, H.	230	Jasperneite, J.	351
Cavalieri, S.	30	Juanole, G.	128
Consoli, A.	30	Kabitzsch, K.	209
Decotignie, J.-D.	308	Kandler, W.	22, 326
Demartini, C.	429, 437	Kastner, W.	203
Diedrich, C.	90, 423	Klugmann, H.	240
Döbrich, U.	414, 423	Knizak, M.	76, 195
Domínguez, M. A.	157	Kriesel, W.	215
Dübner, R.	180	Laîné, T.	61
Erdner, T.	387	Langmann, R.	247
Felser, M.	299	Leon Chavez, M.	2
Fetzer, U.	408	Lobachov, M.	400
Fischer, P.	105	Mariño, P.	157
Fonseca, J. A.	342	Mataix Oltra, J.	136
Fonseca, P.	342	Mella, A.	445
Gemici, A.	146	Meyer-Gräfe, K.	394
Gerdes, K.-H.	240	Minner, T.	215

XVI

Mirabella, O.	30	Schweinzer, H.	22, 326
Mirbach, S.	240	Schweinzer, H.-J.	291
Neumann, A.	180	Sempere Payá, V. M.	136
Niemann, K.-H.	230	Siltala, N.	164
Nogueira, J.	157	Simon, R.	223, 429
Noury, P.	414	Soucek, S.	291
Ossipov, V.	247	Stampfl, N.	313
Ott, W.	230	Stuhrmann, N.	247
Otto, H.-P.	423	Szczepanski, T.	256
Palensky, P.	319	Szymanski, J.	423
Paliza, F. A.	83	Thiele, D.	112
Partanen, P.	164	Thomesse, J.-P.	2, 437
Perez, A. A.	83	Tovar, E.	359
Peter, M.	55	Tuokko, R.	164
Plagemann, B.	400	Unger, E.	118
Popp, W.	334	Utrilla Ginés, E.	136
Poza, F.	157	Vahldieck, R.	230
Prüßner, M.	146	Vasques, F.	359
Raibulet, C.	437	Vasyutynskyy, V.	209
Rauchhaupt, L.	48	Veríssimo, P.	375
Reguera, V. A.	83	Verney, C.	423
Reiter, H.	188	Vihinen, J.	164
Rieger, P.	276	Vonnahme, E.	351
Rufino, J.	375	Voß, M.	381
Rüping, S.	240, 351	Wagner, U.	98
Russo, F.	445	Witte, H.	118
Saarimäki, V.	164	Wojsznis, W.	112
Sauter, T.	76, 195, 299, 400	Wollschlaeger, M.	118, 172
Schumann, T.	152	Zeltwanger, H.	16
Schwarz, K.	38, 268	Ziegler, A.	284

SpringerTechnik

Gerhard-Helge Schildt,

Wolfgang Kastner

Prozeßautomatisierung

1998. XV, 270 Seiten. 229 Abbildungen.

Broschiert DM 39,-, öS 275,-

ISBN 3-211-82999-7

Schwerpunkte dieses Buches sind: Automatisierungstechnik, vernetzte Rechnersysteme, Computer Integrated Manufacturing, Regelungstechnik (sowohl die klassische Form der Regelungstechnik als auch Fuzzy-Control) sowie Software-Entwicklung für Automatisierungssysteme.

Der Leser bekommt eine leicht verständliche Übersicht über den derzeitigen technologischen Stand der Automatisierungstechnik.

„... Man darf überrascht sein, dass trotz der inhaltlichen Vielfalt und des doch eng begrenzten Gesamtumfangs eine große Fülle an Einzelfaktoren, Zusammenhängen und an Hintergrundinformation geboten wird, wie es insbesondere für Informatik-Studenten an Technischen Universitäten erforderlich ist; in leicht fasslicher Form und unter ansprechender Bebilderung.“

e&i



SpringerWienNewYork

Sachsenplatz 4-6, P.O.Box 89, A-1201 Wien, Fax +43-1-330 24 26, e-mail: books@springer.at, Internet: <http://www.springer.at>
New York, NY 10010, 175 Fifth Avenue • D-14197 Berlin, Heidelberger Platz 3 • Tokyo 113, 3-13, Hongo 3-chome, Bunkyo-ku

SpringerTechnik

Dietmar Dietrich,
Herbert Schweinzer (Hrsg.)

Feldbustechnik in Forschung, Entwicklung und Anwendung

Beiträge zur Feldbustagung FeT '97, Wien, Österreich,
13.–14. Oktober 1997

1997. XVI, 443 Seiten. 233 Abbildungen.

Broschiert DM 128,-, öS 896,-

ISBN 3-211-83062-6

Feldbussysteme sind im Zusammenwirken mit LANs (Large Area Network) und WANs (Wide Area Network) als Nervensystem anzusehen, das in Systeme aller Bereiche unseres Lebens eingebettet wird. Die Automatisierung erlebt dadurch zur Zeit eine revolutionäre Weiterentwicklung. Die Tagung FeT '97 in Wien hat sich zum Ziel gesetzt, aktuelle Fragen zu diskutieren.

Das Buch beinhaltet Aufsätze, die anlässlich dieser Tagung eingereicht und vom Programmkomitee bestbewertet wurden. Damit ist ein guter Überblick geboten, welche Schwerpunkte in der Feldbustechnik gegenwärtig bearbeitet werden. Der Aufbau des Buches erfolgt in zwei Teilen: der erste Teil beinhaltet Beiträge aus Forschung und Entwicklung, der zweite Teil Beiträge mit Produkt- und Anwendungsorientierung. Innerhalb dieser Teile gibt es eine Gliederung nach den Anwendungsschwerpunkten Industrietechnik, Gebäudeautomation und bereichsübergreifende Beiträge.



SpringerWienNewYork

Sachsenplatz 4-6, P.O.Box 89, A-1201 Wien, Fax +43-1-330 24 26, e-mail: books@springer.at, Internet: <http://www.springer.at>
New York, NY 10010, 175 Fifth Avenue • D-14197 Berlin, Heidelberger Platz 3 • Tokyo 113, 3-13, Hongo 3-chome, Bunkyo-ku

Contents

Program Committee	XIV
Index of Authors	XV
1 Protocol Specifications	1
Main Paradigms as a Basis for Current Fieldbus Concepts <i>Thomesse, J.-P.; Leon Chavez, M.</i>	2
Communication Profile for Embedded Networks <i>Zeltwanger, H.</i>	16
Shared Data on InterBus <i>Schweinzer, H.; Kandler, W.</i>	22
Adding Multi-Master Capabilities to Interbus-S <i>Cavalieri, S.; Consoli, A.; Mirabella, O.</i>	30
Telecontrol Standard IEC 60870-6 TASE.2 Globally Adopted <i>Schwarz, K.</i>	38
2 Network Interconnections	47
Opportunities and Problems of Wireless Fieldbus Extensions <i>Rauchhaupt, L.; Hähnliche, J.</i>	48
The Use of Radio Technologies in the Fieldbus Area – Using Interbus as an Example <i>Peter, M.</i>	55
Internet Technologies and Fieldbuses <i>Lainé, T.</i>	61
Security Architecture for Field Area Networks Connected to Internet <i>Gordeev, M.</i>	69
P-NET-Management über das Internet <i>Ayal, M.; Knizak, M.; Sauter, Th.</i>	76
Wireless Data Transfer System for Oil Drawing Plants <i>Perez, A. A.; Reguera, V. A.; Paliza, F. A.</i>	83

3 Profiles	89
Profiles for Fieldbuses – Scope and Description Technologies <i>Diedrich, C.</i>	90
A Functional Profile for Laboratory Measurement Equipment Based on Measurement Bus and Profibus-DP/PA <i>Wagner, U.</i>	98
Mapping of Fieldbus Protocols to Standardised Field Level Objects <i>Fischer, P.</i>	105
Device Based Process Control in Foundation Fieldbus <i>Thiele, D.; Blevins, T.; Wojsznis, W.</i>	112
CANopen Device Profile for Hydraulic Proportional Valves <i>Wollschlaeger, M.; Unger, E.; Witte, H.</i>	118
4 Validation	127
Comparing the Networks CAN and ARINC 629 CP with Respect to the Quality of the Service Provided to an Automatic Control Application <i>Blum, I.; Juanole, G.</i>	128
Modelling and Evaluation of Systems for the Interconnection of Industrial Communications Networks <i>Sempere Payá, V. M.; Mataix Oltra, J.; Utrilla Ginés, E.</i>	136
Use of Formal Specification and Design Language for Protocol Description – Field Report <i>Prüßner, M.; Gemici, A.</i>	146
CANopen Conformance Test <i>Schumann, T.</i>	152
Formal Description Software for WorldFIP Industrial Fieldbus <i>Mariño, P.; Domínguez, M. A.; Poza, F.; Nogueira, J.</i>	157
Experiences in Different Fieldbuses Used together with PC-Based Control Systems <i>Saarimäki, V.; Siltala, N.; Partanen, P.; Vihinen, J.; Tuokko, R.</i>	164
5 Management	171
Mapping of Fieldbus Components to WWW-Based Management Solutions <i>Wollschlaeger, M.</i>	172
Integration of Fieldbus Objects into Computer-Aided Network Facility Management Systems <i>Bangemann, T.; Dübner, R.; Neumann, A.</i>	180
Enabling e-Services through Resource Management API's on Multi-Vendor EIB Building Networks <i>Goossens, M.; Reiter, H.</i>	188

Modulares Agent-Design für Feldbusmanagement <i>Haidvogel, R.; Knizak, M.; Sauter, T.</i>	195
Linux-Gateway zur Fernwartung von Profibus-DP-Geräten <i>Kastner, W.</i>	203
Tele-Diagnosis at Networked Automation Systems <i>Kabitzsch, K.; Vasyutynskyy, V.</i>	209
Diagnose von Feldbussen im Systemverbund <i>Kriesel, W.; Heimbold, T.; Minner, T.</i>	215
Engineering of Distributed Automation Systems Based on Novel Information Technologies and Methods <i>Simon, R.; Hörger, J.</i>	223
PROFIBUS goes Microsoft – Herstellerunabhängige Integration von Feldgeräten in Engineeringsysteme <i>Bruns, H.; Hempen, U.; Ott, W.; Vahldieck, R.; Niemann, K.-H.</i>	230
6 OLE for Process Control OPC	239
A Modular OPC-Server Connecting Different Fieldbussystems and Internet Java Applets <i>Rüping, S.; Klugmann, H.; Gerdes, K.-H.; Mirbach, S.</i>	240
OPC-Schnittstellen in einer offenen Systemumgebung – Praxis und Erfahrungen <i>Langmann, R.; Groppe, A.; Ossipov, V.; Stuhmann, N.</i>	247
OPC – Making the Fieldbus Interface Transparent <i>Hadlich, T.; Szczepanski, T.</i>	256
7 System Aspects	267
IEEE Utility Communications Architecture (UCA) applies mainstream standard Ethernet <i>Schwarz, K.</i>	268
A Component-Based Architecture for Integrating Fieldbus Systems into Distributed Control Applications <i>Bachmann, R.; Hoang, M. S.; Rieger, P.</i>	276
Decentralized automation concepts based on Ethernet-TCP/IP and CANopen <i>Ziegler, A.</i>	284
Considerations on a LonWorks/IP Gateway Implementation <i>Soucek, S.; Schweinzer, H.-J.</i>	291
The Importance of Being Competent: the Role of Competence Centres in the Fieldbus World <i>Sauter, T.; Felser, M.</i>	299

8 Research	307
Some Future Directions in Fieldbus Research and Development <i>Decotignie, J.-D.</i>	308
IEEE1394 in Comparison with Other Bus Systems <i>Stampfl, N.</i>	313
On Interoperability and Intelligent Software Agents for Field Area Networks <i>Palensky, P.</i>	319
Transmitting Voice on InterBus <i>Kandler, W.; Schweinzer, H.</i>	326
9 Real-Time Aspects	333
Simulation of Communication Systems in Industrial Area <i>Bäuerle, D.; Popp, W.</i>	334
A Flexible Time-Triggered Communication System Based on the Controller Area Network: Experimental Results <i>Almeida, L.; Fonseca, J. A.; Fonseca, P.</i>	342
Analysis of Switched Ethernet Networks with Different Topologies Used in Automation Systems <i>Rüping, S.; Vonnahme, E.; Jasperneite, J.</i>	351
Analysis of the Worst-Case Real Token Rotation Time in PROFIBUS Networks <i>Tovar, E.; Vasques, F.</i>	359
10 Realisations	367
Powerline Communication in der Feldebene <i>Beikirch, H.</i>	368
Design of Bus Media Redundancy in CAN <i>Rufino, J.; Veríssimo, P.; Arroz, G.</i>	375
Programmable Process Interfaces for Smart Bus Nodes <i>Beikirch, H.; Voß, M.</i>	381
Eine Feldbusarchitektur mit realzeitfähiger Fehlerkorrektur <i>Erdner, T.</i>	387
Safety-Oriented INTERBUS – INTERBUS Safety <i>Meyer-Gräfe, K.</i>	394
MultiPort RAM: a PC-Based Implementation of the Fieldbus Concept <i>Lobachov, M.; Sauter, T.; Plagemann, B.</i>	400
Fieldbus Physical Layer in the Application <i>Fetzer, U.</i>	408

11 NOAH Esprit 26951 Project	413
ESPRIT Project NOAH – Introduction	414
<i>Döbrich, U.; Noury, P.</i>	
Fieldbus Profile Harmonization – Approach of NOAH ESPRIT 26951 Project	423
<i>Otto, H.-P.; Borodino, C.; Bregulla, T.; Diedrich, C.; Döbrich, U.; Hörger, J.; Szymanski, J.; Verney, C.;</i>	
Electronic Device Description	429
<i>Simon, R.; Demartini, C.</i>	
A DBR-Based Approach for System Management	437
<i>Demartini, C.; Iosif, R.; Raibulet, C.; Thomesse, J.P.</i>	
NOAH Project: an Example of Application	445
<i>Mella, A.; Russo, F.</i>	