

## **CURRICULUM VITAE**

**NAME: PETER WALKER, MA, C.Eng, FIEE**

**PROFESSION: SENIOR TELECOMMUNICATIONS ENGINEER & MANAGER**

### **EDUCATION:**

- BA (Hons) Electrical Sciences, Queens' College, Cambridge University 1971
- MA (Cambridge University) 1975

### **PROFESSIONAL QUALIFICATIONS**

Institution of Electrical Engineers (now the Institution of Engineering & Technology)

- Associate Member 1974
- Member 1978
- Fellow 1986
- Achievement Medal for outstanding contribution to communications 2002

Council of Engineering Institutions

- Chartered Engineer 1978

### **KEY QUALIFICATIONS:**

Mr Walker has had over 42 years experience in the telecommunications industry and is widely recognised as a key expert in regulation. He spent 22 years at British Telecom in a range of senior management posts involved in network engineering during the key period when the networks were transitioning from analogue to digital technology. He then moved to become the Director of Technology at OfTel (1993-2003). This has given him unique experience within the regulatory environment during the period when much of today's regulatory system was developed, as well as insight into the way that regulators think. As part of OfTel's senior team, he worked on all the key policy developments, gaining valuable experience of the economic, legal and accounting aspects of regulation in addition to his core engineering skills. He is now an independent consultant, specialising in telecommunications technology, regulation and public policy. His expertise covers not only the regulatory framework as a whole, but also detailed knowledge of specialist issues such as interconnection, numbering (including portability), carrier pre-selection, broadband access (including Local Loop Unbundling), network resilience, and how regulation impacts new technologies such as Next Generation Networks and Voice over IP.

## **WORK EXPERIENCE:**

### **2004-date: Hollyer Associates**

Director & Principal Consultant, specialising in telecommunications technology, regulation and public policy. Since becoming a consultant, has been sought after to contribute to projects from clients in both the public and private sector, in the UK and abroad.

Recent work includes:

#### *Saudi Arabian Regulator (2006)*

Assessment of incumbent's proposals for local loop unbundling and other wholesale broadband access products and preparation of a public consultation on these products.

#### *Saudi Arabian Regulator (2008 to 2010)*

Review of incumbent's Reference Interconnection Offer and Reference Offer for Data Access, including providing advice on the impact of Next Generation Networks.

#### *Irish Regulator (2007-date)*

Appointed as Chairman of industry group to review the impact of Next Generation Networks in Ireland. Also appointed to the Comreg Electronic Communications Expert Advisory Panel.

#### *Bahamas Regulator (2010)*

Assessment of incumbent's proposed Reference Access and Interconnection Offer and also advice on the technical aspects of proposals for the 'untying' of the Cable Network.

#### *Jersey Regulator (2009)*

Advice on the impact of Next Generation Networks on wholesale products.

#### *Oman Regulator (2009)*

Advice on technology trends, including impact of Next Generation Networks.

#### *Oman (2008)*

Produced consultation responses for the 2<sup>nd</sup> mobile operator on the subjects of International Infrastructure, Local Loop Unbundling and Next Generation Networks.

#### *Jordanian Ministry of Information and Communications Technology (2006-2007)*

Consultancy project to update the Ministry's 2003 policy statement on IT and Telecommunications.

#### *Peruvian Ministry of Transport and Communications (2006-2007)*

Consultancy project to provide advice and support to the Ministry and Regulator on the implementation of Number Portability.

*European Union support to MEDA country regulators (2005-2011)*

Developed and delivered 4 day training workshop on numbering for Middle East/Mediterranean countries. Produced Reference Guidelines on Numbering and Number Portability and provided specific advice to Turkey, Morocco, Tunisia, Lebanon, Palestine and Israel on a range of topics including the development of Broadband/Local loop unbundling, Voice over IP, Number Portability and numbering for new services. Contributed to and assisted organisation of, training workshops on ICT/Broadband Regulation and Infrastructure Sharing & Rights of Way.

*Bahrain Regulator (2006-2007)*

Member of Appeal Panel for Fixed Wireless Spectrum Auction. Advice on the licensing of extra-territorial providers of Voice over IP services. Technical contribution to Strategic Market Review.

*Regulatory Advisor to Sapphire Networks, Gibraltar (2006-date)*

Providing ongoing regulatory advice to Gibraltar's second network, in particular with responses to regulatory consultations. These have included interconnection, market reviews, local loop unbundling, universal service, number portability and liberalisation of building wiring.

*Negotiations Support Unit for Palestinian Authority (2006)*

Consultancy report on proposals for setting up a discrete Palestinian International Gateway and the separation of the network from that of Israel.

*British Virgin Islands Government (2005-2006)*

Appointed to negotiating team to oversee the liberalisation of telecommunications in the British Virgin Islands.

*South East Europe Regulatory authorities (2009)*

Provided training to regulators in Broadband, Local Loop Unbundling, Numbering, Number Portability, Voice over IP and Next Generation Networks.

*Botswana Regulator (2006)*

Advice on licensing of Voice over IP services.

*Greece (2008)*

Provided advice to a network operator on MVNO network architectures and business models.

*South African Regulator (2007)*

Advice on the structure and content of new licences required by the recent Electronic Communications Act.

*UK based Global MVNO (2010-2012)*

General regulatory support to small MVNO, including assistance with novation of telephone number ranges from a company acquired from Administrators; arranged for membership of the UK Mobile Number Portability Operator Steering Group and provided advice on relationship with the GSM Association.

*UK and Irish Operator (2010)*

Advice on regulation of GSM Gateway systems.

*Ghana (2011)*

Expert witness on matters concerning interception of telecommunications.

*Harlow District Council, UK (2011)*

Advice on technical and contractual aspects of agreements with a cable operator.

*UK Competition Appeals Tribunal (2012)*

Expert witness on practical aspects of copper line-plant.

*UK Valuation Office Agency (2004-2005)*

Expert witness for Lands Tribunal Appeal on business rating of fibre cables, supporting successful appeal by government against UK operator.

*Anguillan regulator (2004)*

Advice on interconnection dispute between fixed and mobile networks.

*A UK calling card operator (2006)*

Advice on patent dispute concerning calling card platforms.

*A US/UK equipment vendor (2005)*

Advice on UK regulation of Voice over IP and GSM guard bands.

*UK Home Office (2004/5)*

Advice on approaches to validation of data retention proposals by telecom operators.

*A UK Service Provider (2005, 2010)*

Advice and support on dispute with telecom operator concerning Number Portability obligations and policy. Further support concerning customer contracts and interaction with numbering regulations.

*UK Regulator Ofcom (2006)*

Consultancy report on the scope to expand the UK stock of GSM Mobile Network Codes.

*UK Regulator Ofcom (2005)*

Consultancy report on the technical implications of finer digit analysis to accommodate numbering developments caused by Voice by IP. Follow on work included a cost assessment of operators' costs when migrating services between number ranges.

*Developer of Business Park (2005)*

Advice and expert witness submission on dispute with telecom operator concerning repair and installation of telecom facilities.

*UK Government Security Agencies (2005)*

Produced guidance for the industry on telecommunications resilience to support the UK Critical National Infrastructure and developed analytical approach to categorization of physical assets.

*UK Government Departments (2005)*

Produced explanatory guide to telecommunications resilience for ministers and senior officials.

*Irish telecom operator (2005)*

Expert advice on legal dispute with another operator on wholesale service features.

*UK Regulator Ofcom (2005)*

Consultancy report on likely development scenarios for broadband services over the BT network.

*Major UK consulting company (2011)*

Delivered training sessions to their regulatory consultants to improve their appreciation of network and technological aspects of regulation.

*Interconnect Communications Ltd (2004-date)*

Lecturer on their Telecommunications Regulatory Master Classes. (Bath, UK; Hong Kong, Bahrain, Oman, Ireland and UAE)

## **2004: Office of Communications (OFCOM)**

As Senior Adviser, Technology Strategy, assisted the creation of the Technology Strategy Group within the newly-created 'converged' regulator. Contributed to the Strategic Telecommunications Review, by advising on the cost modelling of networks and setting the framework of current technology trends within which the review would take place. Seconded to team which gave launch presentations in the UK 'nations & regions'. Provided briefings to the Chinese government and the Nigerian regulator about experiences of UK regulation and approaches they might follow. In addition, continued to perform several of the roles described below.

## **1998-2003: Office of Telecommunications (OFTEL)**

Director, Technology, a new role created to exploit his capabilities across a range of functions. A member of Oftel's senior management team, he contributed to Oftel's policy development and compliance activities as well as providing strategic technological advice to the Director General. He provided a focus for Oftel's external relations with the engineering community in industry, government and academia. Provided briefings on UK regulatory experience to many foreign visitors. He also advised other government departments on network resilience, national security and civil emergency issues. Accountable for the delivery of technical advice within Oftel, the operation of the Numbering Unit and acted as senior 'champion' for 15 of Oftel's projects and programmes.

## **1993-1997: Office of Telecommunications (OFTEL)**

Head-hunted for the post of Technical Director, leading Oftel's Technical Branch (15 staff), reformed the approach to technical advice and expanded the job to embrace a wider policy role, contributing key principles to the 1998 reform of Oftel.

Major activities during the 10 years with Oftel included:

### *Revision of the UK regulatory framework*

In 1998 and again in 2003, responsible for several key aspects of the transposition of the new EU regulatory framework into the UK, notably on access and interconnection. In particular, made a significant contribution to the Communications Act 2003, on key definitions, numbering, premium rate services and the introduction of the new concept of persistent network misuse. In 1996, introduced the concept of technology neutrality into the regulation of BT's data services, in order to remove anomalies produced by BT's use of Asynchronous Transfer Mode technology.

### *Poland Twinning Project*

As one of Oftel's senior directors, contributed to the project to create a new telecommunications regulator in Poland in preparation for their accession to the European Union. Personally advised on aspects of interconnection and consumer protection.

### *Introduction of Wholesale Line Rental*

Led joint Oftel/industry team to deliver definition of new Wholesale Line Rental product in challenging timescales. This was the first use by Oftel of facilitated introduction of incentive-based regulation.

### *Introduction of Carrier Pre-selection (CPS)*

Defined the regulatory framework for implementation of CPS, including creating the Functional Specification. As Project Director, oversaw the industry working groups that implemented CPS to meet EU regulatory timescales. Expert Witness for Oftel when BT mounted judicial review of Oftel's decisions on CPS.

### *Local Loop Unbundling (LLU)*

Working with consultants, advised Oftel concerning the technical and practical aspects of the introduction of LLU into the UK regulatory environment. This included detailed agreements on co-location and the creation of the Access Network Frequency Plan to ensure no mutual interference between broadband users.

### *Liberalisation of Directory Enquiries (DQ)*

Project Director for DQ liberalisation, oversaw the programme to introduce new DQ service providers into the market, including, technical, numbering, commercial, interconnect and consumer protection aspects.

### *Internet access*

As Technical Director and working with Oftel's economists, set the initial interconnection framework for non-geographic telephone calls, which produced a major stimulation to cost-effective Internet access to the mass-market and subsequently led to the concept of 'subscription-free' access, which provided a further jump in Internet penetration. In 1997, working with government and industry, set the basis on which BT and others might provide a flat rate Internet access for schools. Later, in 1999, in response to public, political and media campaigning, persuaded BT to introduce flat-rate Internet access for all, which led to a further 10% increase in Internet penetration in the following year. As Project Director, commissioned consultants to validate personal conclusions on the extent to which BT's trunk network could support flat rate Internet access traffic. Set the framework of technical options for considering how to promote the growth of broadband Internet access and what role local loop unbundling should have. Chaired Oftel's Internet Forum to provide debate with stakeholders in the Internet community.

### *Universal Service*

Project Director for Universal Service, providing significant input on the new concept of 'Functional Internet Access' and how it should be interpreted for the UK. Project

also reviewed the need for a Universal Service fund, provision of services to the disabled, control of expenditure and low-user schemes.

### *National Emergency Plan*

In the wake of '9/11' and on behalf of the UK government, personally created the National Emergency Plan for the UK telecommunications sector, so that both government, regulator and industry understood their roles and responsibilities in the event of a major civil emergency. Chaired the UK Emergency Planning Forum. This activity followed other involvement in emergency planning issues, such as leading the telecoms industry preparation for the Millennium date change ("Y2K") and handling other unplanned events such as the Fuel Crisis and Foot & Mouth epidemic, both of which brought risks to the continuity of telecoms services.

### *Liberalisation of terminal equipment regulation*

Appointed by the European Commission to chair a committee to produce guidance on the telecom operator aspects of the 3rd phase of terminal equipment liberalisation in Europe (The Radio & Telecommunications Terminal Equipment Directive). This required negotiating amongst a large group of regulators, incumbent operators and equipment vendors across a wide range of European Member States.

### *Corporate Governance*

As one of Oftel's senior directors, created a Project Management Manual to ensure that all regulatory work was performed in a disciplined way. Similarly produced important guidance on the process of consultation with stakeholders and the production of consultation documents. A member of Oftel's Audit Committee responsible for introducing risk management processes into Oftel and other 'Post-Turnbull' reforms, including Annual Statements of Internal Control. As Budget Manager for the Policy Directorate, jointly responsible for signing off Oftel's last set of published accounts. Chaired the Information Systems Group, to oversee Oftel's own internal use of IS/IT.

### *Numbering and Number Portability*

Project Director responsible for Oftel's Numbering Unit, overseeing the major numbering changes in the UK in 1995 and 2000. Produced the initial Functional Specification describing how number portability would work in the UK and was an Expert Witness in the subsequent referral appeal to the Monopolies and Mergers Commission. Chaired Oftel's Numbering Forum and Numbering Advisory Group.

### *Accountability to Parliament*

Appeared in Parliament on several occasions to account for Oftel's policies, including the Trade & Industry Select Committee's enquiry into (1) fibre grids, (2) changes to freephone numbering, (3) e-commerce, (4) internet access; the Welsh

Affairs committee enquiry into Broadband in Wales and the House of Lords Science and Technology Committee's enquiry into Multimedia.

### *Interconnection and Interoperability*

Set up the Network Interoperability Consultative Committee, as both an industry consensus group and advisory committee to Oftel to decide the technical basis and detailed specifications for inter-operator interconnection and interoperability. This was one of Oftel's most successful examples of co-regulation in practice. Following the resolution of a series of interconnection disputes, produced the Interconnection and Interoperability Guidelines to provide non-binding advice on how Oftel would treat disputes over interconnection and wholesale obligations. Produced the industry Code of Practice allowing the rapid introduction of Calling Line Identification (CLI) services and chaired the CLI Interest Group 1994-2003. Provided advice to the Monopolies and Mergers Commission into the functioning of mobile telephone networks as part of their investigation into mobile call termination interconnect charges. Similarly was an Expert Witness to the Competition Appeals Tribunal in their review of charges for mobile radio station backhaul circuits.

### *Network Efficiency Study*

Investigated the efficiency and network planning aspects of BT's core telephone network and made recommendations to avoid recurrence of congestion.

### *National Security*

Advisor to the Home Office, Cabinet Office, law enforcement bodies and the intelligence agencies on lawful interception, data retention, fraud and related security activities.

### *Training and Education*

As Director, Technology, responsible for the technical training of all Oftel staff and provided frequent lectures and briefings on technology to senior staff. Responsible for Oftel's panel of Technical Expert Advisors that provided independent advice to support decision making and to understand major advances in technology. Also provided personal briefings to Ed Richards, during the time he was the Prime Minister's Media Policy Adviser at 10 Downing Street.

### **1991-1993: British Telecommunications (BT)**

As Head of Planning, London Networks, accountable to Director, London for 400 strong Planning Department with budget of over £20M, responsible for planning the BT network in Greater London, serving 6M customers. Created a novel cost reduction strategy for the evolution of BT's London network. Redesigned BT London's planning team, reducing costs by 27%. Initiated major review of operational accommodation and started programme to concentrate exchange areas and dispose of surplus buildings.

### **1991: British Telecommunications (BT)**

As Manager, Customer Networks, created a design team to integrate BT's customer network design activities and support outsourcing bids to major UK companies, including one to a major UK bank. Responsible for the launch of BT's Flexible Bandwidth Service, used as a platform for outsourcing bids.

### **1990-1991: British Telecommunications (BT)**

Seconded to special project as Manager, Network Operations to assist the launch of Syncordia, BT's global outsourcing unit based in Atlanta, USA. Headed a small team of chosen experts to design their initial global network and operational systems. Negotiated with their initial customer prospect (a major multinational computer company) for the technical arrangements for the outsourcing of their network in challenging timescales. Led negotiations for equipment tendering with two major vendors. Agreed transition arrangements for the permanent Syncordia organisation.

### **1986-1990: British Telecommunications International (BTI)**

Promoted to Director, Planning to lead BTI's planning division of 480 staff with budget of over £14M. Responsible for the planning, provisioning, development and utilisation of BTI's networks, exchanges, private circuit systems, operational centres and supporting information systems. Accountable to the Director, Networks for the growth and digitalisation of the international network. This was delivered through multi-national relationships with many other international carriers. Negotiated international consensus allowing early deployment of International ISDN, through negotiations with two alliances, one European and one intercontinental. Reformed provision of both direct dial and private services through bulk pre-provisioning. Introduced new services including Virtual Private Networks and International Freephone.

### **1982-1986: British Telecommunications International (BTI)**

As Head of Planning & Development led the planning and development of BTI's international telephone network, delivering cost and quality improvements with a team of 115 staff. Negotiated several major contracts with vendors to deliver digital international exchanges. Created a world first by deploying CCITT7 signalling between different vendors' equipment. Deployed managers into operational roles to maintain services during 12 week technician strike.

### **1982: British Telecommunications International (BT)**

Promoted to BT's senior management team as Head of Maintenance Practices and Computer Development Division responsible for maintenance support to operations staff and the development of exchanges and computer systems with a staff of 126. Initiated plans to create paperless operational centres and the automation of provision processes.

### **1981-1982: British Telecommunications International (BTI)**

Promoted to Project Manager, International Systems and led BTI's major projects section. Delivered £45M projects for international exchanges to cost and time. Also responsible for the whole of the capital budget for exchange systems (~£12M per annum). Introduced BT's first digital international exchange on time.

### **1975-1981: Post Office Telecommunications**

As Head of Group in the New Exchange Development Division, responsible for the development of international exchanges and their signalling systems. Achieved the successful development and appraisal of software and hardware for BT's first large Stored Program Controlled exchange. Contributed to the specification of the CCITT6 signalling system, which was the world's first common channel signalling system, forerunner of the CCITT7 system now deployed worldwide. Carried out independent teletraffic analysis of the design of the international exchanges, saving significant capital expenditure.

In 1978, coordinated from London, the Post Office's technical consultancy input to the evaluation of tenders for international exchanges in Libya.

### **1971-1975: Post Office Telecommunications**

Held 3 posts as Executive Engineer in the development department, working on national and international crossbar exchanges and international signalling systems. Work included the type approval of software for the processor used at London's Sector Switching Centres, system appraisal of the Ericsson crossbar international exchange, and the introduction of the R2 international signalling system. Developed a model for predicting post-dialling delay in international networks. In 1972, seconded as team leader to investigate operational experience with local crossbar exchanges, including cross-examination of senior staff in 9 telephone areas.

## OTHER PROFESSIONAL ACTIVITIES

### Activities with Institution of Engineering & Technology (formerly the IEE):

- 1994-2000:** Member of Professional Group E7 on Telecoms Networks & Services.
- 1998-2000:** Member of the Electronics and Communications Board.
- 2001-2008:** Member of Communications Networks & Services 'Professional Network' Executive Team, delivering knowledge services.
- 1996-2005:** Member of organizing committee for course "Telecom Networks: the Next Generation".
- 2001-date:** Member of the Communications Policy Panel, advising on public policy issues.
- 2002-date:** Member of Interview Panel, assessing candidates for Chartered Engineer status.

### Other:

- 1975-1978:** Visiting lecturer Aston University on switching systems.
- 1994-2000:** Member of the Communications Panel of the Office of Science & Technology's "Foresight" Programme.
- 1993-2003:** Member of the Joint Committee on Networking, funded by the Higher Education Funding Councils, providing advice to the Universities and the 6 Research Councils on their networking arrangements.
- 1977-1984:** **International Telecommunications Union (ITU)** Represented the UK on Study Group XI of the CCITT in Geneva. Appointed as Rapporteur during 1980-84, for recommendations on signalling interworking and private signalling systems for international use.
- 1980-1984:** **ITU** UK coordinator for Study Group II on international telephone operations.
- 1994-2004:** Member of the Home Office Standing Committee on Interception and its successor the Interception Steering Group
- 1997-date:** Visiting lecturer University College, London on regulation.
- 2001-2008:** President of the UK Branch of the Federation of Telecommunications Engineers of the European Community (FITCE)
- 2002-2008:** Member of the Internet Crime Forum, a joint law enforcement & industry group to encourage closer cooperation on network crime issues.
- 2003-date:** External Adviser to British Telecom on their heritage policy.
- 2004-date:** Appointed Chair of the Technical Advisory Board, which advises the UK Home Secretary on resolution of disputes between government and telecommunications operators on matters relating to required lawful interception facilities.
- 2005-date:** Appointed to Nominet's Advisory Panel for Second Level Domain applications.
- 2009-date:** Appointed member of the Strategy Board of the Communications Management Association (CMA).

## SELECTED PRESENTATIONS

A frequent public speaker throughout his career. The following lists presentations made in recent years:

2009

Telecommunications Regulatory Master Class (UAE)  
Lectures on Broadband, Numbering and NGNs (Balkan Regulators)

2008

Telecommunications Regulatory Master Class (Oman)  
Telecommunications Regulatory Master Class (NGNs; Ireland)

2007

The Regulatory Scene (University College, London)  
Telecommunications Regulatory Master Class (Regulation, Interconnect and NGN)  
Telecommunications Regulatory Master Class (Bahrain)  
Broadband regulation (The Hague, for MEDA country regulators)

2006

Telecommunications Regulatory Master Class (Hong Kong)  
Numbering: a 4 day workshop for MEDA country regulators  
The Regulatory Scene (University College, London)

2005

Network Resilience: an independent view (Survive ICT SIG)  
Interconnection: the role of the regulator (Telecommunications Regulatory Master Class)  
The Regulatory Scene (University College, London)  
Technology Trends – update (IEE)  
Voice over IP – Issues and implications for numbering and number portability (IIR portability conference, Budapest)  
Why Regulate? (Queens' College, Cambridge)

2004

Technology Trends – key insights into the latest developments (IEE)  
The legislative framework (UCISA/UKERNA conference)  
Licensing and Interconnection (Telecommunications Regulatory Master Class)  
Lessons from regulatory experience (ECC TRIS conference, Bulgaria)  
Telecoms resilience – a partnership (Financial Services Round Table)  
Approach to Next Generation Networks and VoIP (Intellect conference)  
Network Architecture (Ofcom)  
New regulator – new regulation (the communications network)  
Why regulate? (IEE West London branch)  
Ofcom's first annual plan (Joint Committee on Networking)

2003

E-Resilience and Sustainability (Kent emergency planners' conference)  
Recognising the responsibilities (The Continuity Forum)

Can a converged regulator deliver? (ISPA legal forum)  
Introduction to Ofcom (NICC Open Forum)  
Ofcom's contribution to UK resilience (Treasury workshop)  
Mobile & Disruptive Technologies (FITCE, Newport)  
Network Misuse – a non-criminal approach (Government Industry Forum)  
Regulation and Quality of Service – the UK approach (IEE QoS conference)  
Some thoughts on regulation (UCL lawyers seminar)  
Impact on academic networks of the new regulatory framework (JCN)

2002

Update on new technologies (Ofcom)  
Why does the industry look the way it does? (Telecoms Executive Network)  
Business Continuity – Ofcom's approach (CMA conference)  
UK government resilience work in the aftermath of '9/11' (NICC Open Forum)  
From circuit switched to IP based networks – risks and opportunities (Keynote speech, FITCE conference, Genoa)  
Welcome Speech (launch of The Communications Network)

2001

Regulation in a changing world (IEE)  
From Fire Beacons to the Internet (Ofcom Christmas lecture)  
IP interconnection – a necessary part of unmetered Internet access? (Denton, Wilde Sapte conference)  
www.regulation – the why, what and whither of communications regulation (IEE Keynote Speech)  
Telecoms Markets and Players (IEE TNG residential course)  
Local Loop Unbundling – UK progress (Beyond Networks conference)  
Regulating in an IP environment (Commonwealth Telecoms Organisation)

## **SELECTED PUBLICATIONS**

Regulatory Milestones (Ofcom News 2003)

www.regulation: the why, what and whither of communications regulation (IEE Electronics and Communication Engineering Journal December 2001)

International Telephony - making the right connections (IEE News October 1987)

The CCITT6 Common Channel Signalling System (IPEE Journal January 1981)

The TXK5 Switching System at Mollison and Thames International Exchanges (IPEE Journal October 1977)