

## MICROWAVE AND mm-WAVE ENGINEERING CHALLENGES IN PAN-EUROPEAN COMMUNICATIONS RESEARCH

Professor John G Gardiner

University of Bradford and Department of Trade and Industry, UK



### ABSTRACT

The pan-European research programmes under the 3rd and 4th Frameworks have identified, and are now researching radio-based personal communications systems operating at frequencies from UHF to 60GHz. The performance targets for these systems are set out by reference to particular projects recently launched and also those proposed for projects offered under the 2nd call for the current programme.

### BACKGROUND

The rapidly evolving telecommunications environment World-wide has been reflected in the support which the European Commission has given to communications research in successive programmes co-ordinated across the European Union Member States. Within the 3rd Framework programme, fundamental research was undertaken in the RACE Programmes (Research in Advanced Communications for Europe) and this has been the basis for subsequent work under the 4th Framework umbrella in a programme known as ACTS (Advanced Communications Technologies and Services). The European Commission

identified six major areas of research in the ACTS workplan:

- \* Interactive digital multimedia services
- \* Photonic technologies
- \* High-performance networking
- \* Mobility and personal communications networks
- \* Intelligence in networks and service engineering
- \* Quality, security and safety of communications services and systems

These are supported by a further tranche of projects under the heading 'Horizontal Actions'. A total of 333 projects were offered in response to the first call for proposals which closed in January this year and the evaluation process subsequently retained 119 of them for funding. Given the diverse nature of the research areas listed above it is hardly surprising that not all have implications for the microwave engineering community, but equally, the trends towards providing access to increasingly wide-band services and applications has continually pushed system engineers to examine higher and higher frequencies in order to satisfy capacity demands. Added to this, the increasing pressure to free user terminals

from fixed wire connections has resulted in a substantial migration of research effort towards microwave and mm-wave radio systems for a range of application environments from wireless-LANs to satellite-mobile services.

### **RACE AND ACTS OBJECTIVES**

The RACE Programme took as a starting point the 2nd generation systems now familiar as GSM operating at 900 MHz and 1.8 GHz, the DECT cordless system allocated to the 1.9 GHz band and anticipating standardisation of the HIPERLAN wireless-LAN system operating in the ISM bands at 2.5 and 5 GHz. From this basis RACE developed a target specification for UMTS (Universal Mobile Telecommunications System) for which spectrum is now allocated at around 2.5 GHz. It was envisaged that UMTS would support all the service types associated with the cellular, cordless and W-LAN functionalities, and that a maximum bit rate of 2 Mbit/s on the air-interface would suffice. With the passage of time, however, it has become clear that the convergence of computing, broadcasting and telecommunications is creating a wider range of requirements than those originally envisaged and a new view has emerged. This sees a steady evolution based on the GSM platform and developing the potential of the 2nd generation air-interfaces, while a new, backwards compatible system capable of supporting higher bit rates in an adaptive radio and terminal environment takes on the mantle of the original UMTS but with substantially enhanced capability. However, once the emphasis moved away from the radio air-interface as the major focus for research, the requirements scenario shifted to reflect the aspirations of the fixed network community who increasingly sought to regard wire-connected and radio-

connected terminals as indistinguishable. This meant the need for transparent delivery of ATM traffic into radio air-interfaces, bit-rate capabilities of SDH 155 Mbit/s and support for full multimedia services. It was in this context that the first call for proposals for ACTS was generated.

### **STATUS OF THE ACTS PROGRAMME**

The first call for proposals resulted in submissions embracing 3,842 participants from 33 countries in Europe and elsewhere. The proposals represented some 3.7 billion ECU, about four times the fund allocated by the Commission. Ultimately of the projects which were retained many were scaled down to match the funding available. Central to the ACTS orientation has been the concept of service and applications trials using 'National Hosts' and this practical emphasis has been reinforced by defining 'domains' and 'chains' by which project are linked together to maximise the benefit from synergy among the research groups.

### **PROJECTS WITH MICROWAVE AND MM-WAVE IMPLICATIONS**

#### **Research into Sub-systems**

FIRST - Flexible Integrated Radio Systems Technology

MEDIAN - Wireless Broadband CPN/LAN for Professional and Residential Multimedia Applications (60 GHz)

TSUNAMI II - Technologies in Smart Antennas for Universal Advanced Mobile Infrastructure

#### **Systems Research**

COBUCO - Cordless Business Communication System

MEMO - Multimedia Environment for Mobiles (1.7 Mbit/s on digital audio

broadcast bearer

DIGISAT - Advanced Digital Satellite Broadcasting and Interactive Services

ATLANTIC - Advanced Television at Low Bit Rates and Networked Transmission over Integrated Communications Systems

FRANS - Fibre Radio ATM Networks and Services

WAND - Wireless ATM Network Demonstrator (17 GHz)

MICC - Mobile Integrated Communication in Construction

FRAMES - Future Radio Wideband Multiple Access Systems

MOMUSYS - Mobile Multimedia Systems

ISIS - Interactive Satellite Multimedia Information System

MOSTRAIN - Mobile Services for High Speed Trains

### **Satellite Mobile/Personal Systems Research**

SECOMS - Satellite EHF Communications for Mobile Multimedia Services (20/30 GHz and 40/50 GHz)

VANTAGE - VSAT ATM Network Trials for Applications Groups across Europe

ISIS - Interactive Satellite Multimedia Information System

### **TARGETS FOR THE SECOND CALL FOR ACTS**

After the first call projects had been let, it was concluded that there was a need to fill specific gaps in the research cover. Five issues in particular were singled out for attention:

- \* cellular television and interactive multimedia environments
- \* harmonised control and management in photonic networks
- \* optimisation of integrated and scalable

high-speed networks

\* satellite components for 3rd generation mobile and broadband wireless systems

\* service creation process and experimental service development

The first and fourth of these topics have particular significance in the context of hardware engineering. The target of the cellular television issue is the spectrum allocation at 40.5 - 42.5 GHz. Whilst the perception is that initially applications will be in interactive television and therefore highly asymmetrical, the Commission are also aware that there is potential in this spectrum allocation for other high capacity telecommunications services.

The ACTS programme has prompted recognition within the European Commission that telecommunications is now a global rather than a regional industry and for the first time has welcomed involvement by participants from outside the EU. Taking advantage of this, a collaborative project has been defined involving a European team led by Alenia Spazio, collaborating with JPL/NASA in USA. The project capitalises on experience on both sides of the Atlantic in satellite-mobile systems operating at 20 & 30 GHz.

### **THE CHALLENGE**

As the next millennium approaches there can be no doubt that the general perception in the telecommunications industry is of a personal communications environment in which a substantial proportion, if not the majority of users will be accessing services via radio-connected terminals. Given the capacity demands which this will create coupled with the variety of services which users will expect to have available point strongly towards three engineering goals -

utilisation of spectrum opportunities from 1 - 60 GHz, terminal adaptivity to access different services at different frequencies and at different bit-rates, in some cases as high as 155 Mbit/s and, above all, at equipment cost levels comparable with other domestic electronic appliances.

## **REFERENCES**

- 1 European Commission, 'ACTS 1995 - An Overview of the Programme and Projects', Directorate General DG XIII-B, Document reference AC950968.
- 2 European Commission, '2nd ACTS Call, General Information', Directorate General DGXIII-B, Document reference A561-GI.