

Mobile VCE

A Review of the first 5 years of the
Virtual Centre of Excellence

97-02

“To say that mobile communications is a fast-moving industry would be an understatement...”



purpose of review

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“When Mobile VCE was founded just 5 years ago, UMTS was not yet standardized and the wireless Internet was being conceived. Today 3G services are in commercial service and ‘All-IP’ is acknowledged as an emerging practical reality - in Japan NTT recently announced cessation of investment in other wired infrastructure.



The value of developing shared long-term future visions as a tool to grow the overall market for us all, a key feature of Mobile VCE's approach, is today widely acknowledged and, in the present climate, all the more necessary. Industry-led vision can direct research to stimulate new concepts and enabling technology.

Such an approach, coupled with the world-class competencies of our researchers, has been an important factor in the development of Mobile VCE from its early origins as a UK-based national initiative to its role today, acknowledged on the international stage as a pioneer of future mobile communications.

The 21st century has begun with difficult times for the industry. The reality is, however, that basic technology advances will result in wireless technologies becoming embedded in all aspects of everyday life, creating multiplied opportunities for new lifestyle services, products and revenue streams far beyond traditional mobile communications. The vision and technologies being created by Mobile VCE will support our members in accelerating such new offerings.

Mobile VCE has not stood still in its first five years. The challenges of the future will be no less than those of the past - as we look forward it is clear that Mobile VCE has the potential to play an increasingly significant role.”

Dr Keith Baughan
Nokia
Chairman

“Many of you will have heard me say over the past 2 years that one of the best aspects of my role as Chief Executive of Mobile VCE is the privilege of working alongside such highly capable people - talented and mature individuals, from both industry and academia, who are not content to live within today's constraints but who strive to create the world of tomorrow. The significant value that Mobile VCE brings to our industrial members is a reflection not only of the high financial gearing that arises from shared funding but also derives from the willingness of these members to collaborate and share ideas, skills and experience, within the context of long term research, to pioneer new technology to grow future markets from which the whole industry will benefit.



In this review we have sought to present to our members a concise overview of the contribution and development of Mobile VCE over its first five years and to give some preliminary views of the way ahead.

One of the keys to maximizing the benefits of membership is to identify relevant outcomes from Mobile VCE research and to secure exploitation by connecting internal company R&D staff to the activity and researchers within Mobile VCE. Such linkages enable ‘seeding and feeding’ of in-house research. My hope is that the material presented in this review will stimulate our members in this respect and help them to better understand the appreciating value of their investment in Mobile VCE”.

Dr Walter Tuttlebee
on behalf of the
Executive Committee

context

Origins of Mobile VCE

The Virtual Centre of Excellence originated as a joint initiative of industry, university and the UK government, through its 'Foresight Exercise' in the mid-1990's, which aimed to encourage long-term industry growth and sustainability through improved planning and exploitation of research. It was intended that Mobile VCE should be industry-led, should fully benefit from the research expertise of the universities, and should retain strong relationships with government. Mobile VCE was thus constituted as a not-for-profit company with a Board of Directors comprising 5 industrials, 3 academics, 1 executive director and 2 observer members from government.

Objectives

- To harness the research efforts of a selected group of UK universities into a cohesive world-class virtual research Centre of Excellence, focused on mobile radio and personal communications technologies and applications
- To influence the direction of long-term research through dialogue between industry and the academic community
- To carry out programmes of research with a particular emphasis on encouraging a cross-disciplinary approach and well managed programmes
- To provide a mechanism for industry to work collectively with key universities to ensure it has the necessary flow of the most skilled experts in the new technologies
- To project internationally the work and reputation of the Virtual Centre of Excellence

executive committee 2002



Dr Keith Baughan
Nokia
Chairman



Dr Walter Tuttlebee
Mobile VCE
Executive Director



Dr Mike Barnard
Phillips



Dr Peter Keevill
Lucent



Prof Mike Walker
Vodafone



Dr Sen Lin Zhang
O2



Prof Hamid Aghvami
Kings College London



Prof Peter Grant
Edinburgh University



Prof Joe McGeehan
Bristol University

Observer Members

Graham Worsley
Dept of Trade & Industry

Pilar Sepulvida
Engineering & Physical
Sciences Research Council

achievements

The original objectives have been and continue to be achieved. Mobile VCE's unique model and successful modus operandi has become widely valued. By the end of 2001, Industrial membership had grown around 50%, from 20 founder members to 29, with a significant involvement from elsewhere in Europe, and beyond, reflecting the increasing reputation of Mobile VCE's research across Europe, America and Asia.

Together with success in securing additional government funding, this increased membership has enabled the research activities undertaken for our industrial members to grow from 1998 levels of £1m pa to an anticipated £1.8m pa in 2002, representing a significant increase in the research leverage available to our industry members, the training of more high quality researchers with experience of working closely with industry, subsequently available for recruitment, and a reorientation of the university research capability towards the needs of industry, without any compromise of its academic integrity.

Core Research

The first core research programme of some 50 man years ran from 1997-2000. Its scope was comprehensively summarized in a dedicated special issue of the IEE's Electronics & Communications Engineering Journal (December 2000).

The plan for the second core research programme of 100 man-years, was reviewed by a panel of international experts from Europe and North America, and received many positive comments. This programme, now over half way through, is yielding important results in a number of key areas, such as software defined radio, wireless capacity enhancement techniques and traffic modelling and network dimensioning. Further important outputs are anticipated over the coming 12 months.

The third core programme, defined by our members during 2001, is now ramping up, and will overlap with the second core programme during 2002 and 2003. Recognising the increasing impact of short range wireless communications, the Internet and digital broadcasting the new programme seeks to create a solutions toolbox that individual member companies can use in different ways to support new commercial opportunities emerging from network interworking.

Industrial Steering

Research is overseen by Steering Groups, headed up and staffed by our Industrial members, supported by an academic co-ordinator. Their role includes the assessment of the research and identification of potential patents. A very substantial number of publications have been approved by the Steering Groups, including contributions to major international conferences and journals.

Each industrial steering group organises seminars each year designed to allow senior managers from our member companies to receive an overview of our latest research. Tutorials and seminars with presentations from our industrial members are a more recent innovation, designed to encourage cross-pollination of knowledge and ideas across the industry value chain.



Individual member companies collaborate closely with different research teams, reflecting their own company's specific interests, pulling through results and research approaches to 'seed and feed' their own in-house research programmes.

Elective Research

Within a core research programme strategic innovations may emerge, worthy of commercialisation but of prime interest to a sub set of our members - eg handset manufacturers, mobile operators. Such companies may individually or jointly commission an elective research programme to bring the technology closer to market. A current example is a programme to incorporate an adaptive directional antenna into a handset; based on patented techniques developed in the core 1 programme this work has already resulted in a further patent filing.

Specific examples of research outputs are available as Research Briefs enclosed in the back pocket of this brochure or from the Mobile VCE office.

International Recognition

The creation of Mobile VCE was only possible because of the strong mobile research infrastructure that has developed since the 1970s within the UK. Mobile VCE has helped to consolidate and deepen this infrastructure and industry relationships and has become a very tangible demonstration of this national asset. As such it serves a valuable role in communicating the availability of this resource to the global mobile industry and attracting inward investment to the UK.

Mobile VCE has developed however into a truly international organisation, today having industrial members from most parts of the world and undertaking research which is having increasing international impact. Mobile VCE meetings and seminars are attended by staff not only from European countries but also further afield. We also receive frequent requests to contribute to international industry fora. Relationships with the Software Defined Radio Forum and the Wireless World Research Forum are strong and links with ITU WP8F and with activities in Asia are strengthening.

During this transition, our relationships with national government have prospered, one recent example being the financial and organisational support received from the Department of Trade & Industry's International Technology Service for a technology mission to Japan. This explored future evolution of mobile communications through meetings with mobile operators, manufacturers, the mITF, ARIB and MPHPT, the Japanese government ministry responsible for mobile communications.



A symposium held at Yokosuka Research Park, YRP, was organised through the British Embassy in Tokyo, with speakers from both Mobile VCE and leading Japanese operators, manufacturers and universities. The event attracted almost 250 invited industry attendees, including some from the USA, Australia and other Asian countries.

Over the past two years Mobile VCE has participated, by invitation, in the annual UK- Japan and UK-Korea High Technology Industry Fora. The latter resulted in an invitation during 2002 to meet with several Korean manufacturers and operators interested in learning about our activities. Korea's strength in mobile communications is well known, but it also leads the world in broadband Internet rollout.

2001 saw the establishment of the Wireless World Research Forum, WWRF, an outcome of the earlier Wireless Strategic Initiative, WSI. Mobile VCE's original Core 2 vision - 'Scenario 2010' - was presented to the WSI group during 2000 by Prof Barry Evans, chair of the Mobile VCE Visions Group. Mobile VCE has chosen to be an active contributor to WWRF, which is seen as a useful forum for communicating overviews of significant research achievements to a wider audience.

Mobile VCE has also become a valued contributor to the work of the SDR Forum, following an initial invitation to their Seattle, June 2001, meeting. The relevance and importance of our research was quickly recognised and the ongoing dialogue which resulted has seen Mobile VCE input playing an important role in the Forum's response to the current FCC notice of inquiry on security aspects of software radio. Ongoing dialogue with the UK, Japanese and other national regulators may result in further initiatives relating to software radio over the coming year.

the way ahead

Several members have encouraged Mobile VCE to explore the possibility of training provision. To this end a one week residential course in Mobile Cellular Communication Systems is being developed for first delivery around Easter 2003. Further plans will depend upon the perceived value and success of this first event.

Mobile VCE has also received encouragement, within the national context, to seek Faraday Partnership funding, which could allow Mobile VCE to provide additional services to our industrial members aimed at improving technology pull-through and at developing new linkages between existing members and smaller companies, perhaps in the applications development space. In considering such an option the Board of Mobile VCE is determined not to jeopardize the existing highly successful activity.

Within the wider European context, the 6th Framework Programme is at an advanced stage of preparation at the time of writing. Some of our industrial members have encouraged Mobile VCE to act as a catalyst for members with common interests to form consortia. The European Commission, and other non-members, have expressed a desire to see Mobile VCE participation in the new Programme. Clearly Mobile VCE has the expertise to build upon its existing base to develop a much more extensive Network of Excellence, or potentially to facilitate Integrated Projects; other approaches also exist.

The development of international relationships with similar collaborative research organizations outside Europe is also under consideration. Again, the Board will not take any steps which would weaken existing strengths or competences, but rather wishes to develop options that will add value for our members.

Publications

Publication of research overviews is encouraged, as one way of increasing awareness of the results within our member companies and increasing the likelihood of the research being taken forward by members and others into standards activities (although Mobile VCE leaves this activity to its members). During the first five years of activity some 150 publications and conference presentations have resulted from our research.

Patent Filings

Decisions on patent filings are made by our industrial members through the mechanism of the Industrial Steering Groups and to date include over 30 active cases. The majority of these have proceeded to international (PCT) filing and 8 to specific national filings, generally in Europe, the USA and Japan. Further details are available on the members' website.

- **Communications Terminal & Operating Method**
- **Adaptive Multifilar Antenna**
- **Dual Direction Channel Estimator**
- **Media Access Control for Wireless Systems**
- **Telecommunications Receiver (Fast Adaptive Algorithms)**
- **Mobile Communications - Virtual Bus**
- **New ATM Protocol Stack for Wireless Communications**
- **Communication Networks (Internet Protocols)**
- **Dynamic Selection of Radio Communication Network Operator or Service Provider (Digital Marketplace)**
- **Generic Framework for Resource Management in Mobile Communication Networks**
- **Adaptive Multifilar Antenna II**
- **Pre-emptive Bandwidth Allocation by Dynamic Positioning**
- **Adaptive Hybrid Interference Cancellation, Multi-User Detection for Multi-rate System**
- **Dynamic Threshold Soft Handover**
- **Open Protocol Programming Interface Model & Architecture for Re-configuration in Software Radios (Optima)**
- **Antenna Combiners: Summed Taps**
- **Channel Allocation & Assignment Methods & Systems**
- **Reconfiguration Management Architecture & Reconfiguration Protocol for SDR Terminals**
- **Mobile Positioning using Integrated Ad-hoc Network**
- **Location Update & Selective Paging Strategy in a Wireless IP Network for Fast Moving Users**
- **Cooperative Diversity - Virtual Antenna Array**
- **Cooperative Diversity - Forced Synchronisation**
- **Cooperative Diversity - Frequency Relaying**
- **A Novel Active Queue Management Technique**
- **Remote User Authentication**
- **Generic Framework for Distributed Mobile Entity and Service Management in Wireless Communications Systems**
- **Routing Update Procedure**
- **Generic Call Admission Control and Scheduling**
- **Mechanism for Diverse Services**
- **Beamforming & Intelligent Scheduling for Layer Separation in Hierarchical Cell Structures**
- **Improvements Relating to Multifilar Helix Antennas**

***available from the
mobile vce office***

A range of Information Sheets and Research Briefs are available from the Mobile VCE office on request.

Information Sheets provide detail of how Mobile VCE is structured and operates.

Research Briefs provide succinct summaries of potentially strategic research, available for commercial exploitation by our industry member companies.

Details of information available may be found at:
www.mobilevce.com/information.htm

Industrial Members

BBC
Crown Castle
Degree2 Innovations
Fujitsu
Hutchinson 3G
Inmarsat
ITC
Lucent
Matsushita (Panasonic)
Motorola
NEC
Nokia
Nortel Networks
ntl
O2
Orange
Philips
Radiocommunications
Agency
Samsung
Siemens
SK Telecom
Sony
Tality
Texas Instruments
Thales
T-Mobile (One2One)
Toshiba
Vodafone

Academic Members

University of Bradford
University of Bristol
University of Edinburgh
King's College, London
Royal Holloway College
University of Southampton
University of Strathclyde
University of Surrey

Mobile VCE
Grove House
Lutyens Close
Chineham Court
Basingstoke
Hampshire
RG24 8AG
United Kingdom

Tel: +44 (0) 1256 338604

Fax: +44 (0) 1256 316589

E-mail: postroom@mobilevce.com

Website: <http://www.mobilevce.com>

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Mobile VCE: the convergence of industry and academia

by W. H. W. Tuttlebee

Virtual Centre of Excellence in Mobile and Personal Communications—Mobile VCE—is a not-for-profit company established as a joint initiative of the mobile communications industry and leading research universities, with support from the UK Government. It is an acknowledged success of the Government's Foresight exercise. Its innovative approach provides companies with a highly cost-leveraged means of accessing the best of the academic base to undertake international-level, industry-led research to underpin the future development of wireless communications as it converges with the Internet and broadcast industries.

1 Origins

The apparent dichotomy between the long-term academic culture and the short-term development-focused research mentality of industry is well recognised. It was from this background that representatives of the UK's mobile phone industry began to explore alternative models as part of the UK Government's Foresight exercise in late 1995. Many companies were placing research contracts with universities, but such work was often uncoordinated and disconnected from mainstream industry development. From this came the concept that something more effective and substantial could be done together—but what?

By late 1996 ideas had clarified and a nucleus of industry players had coalesced around the idea that has since developed into the Virtual Centre of Excellence in Mobile and Personal Communications—Mobile VCE—albeit the name had still to be decided at that stage. The emerging concept was for a virtual company, funded by industry and pioneering an industry-steered programme of research undertaken by research teams drawn from the country's top universities specialising in mobile communications. Mobile VCE was thus proposed as part of the Government's Foresight Challenge competition. Clear industry support and the evident benefits of the proposed approach were key factors in the subsequent decision of the Office of Science and Technology to support Mobile VCE with Foresight funding, leading to the formal establishment of the company in November 1996.

2 Objectives

The company's prime objective is to undertake long-term research and, within this framework, to create for its members commercially valuable intellectual property rights (IPR) relevant to mobile/wireless communications and, most importantly, with their active involvement. The motivation and quality of the research staff, matched by the commitment of the major industry players, have created a momentum that encourages the participation of senior technical staff from the mobile telecommunications companies—perhaps one of the key factors in anchoring the research into industry developments.

3 Membership

Industrial Members join Mobile VCE on payment of an annual membership fee and acceptance of the Memorandum and Articles of Association of the company, and upon signing a Deed of Adherence to the company's IPR Agreement. Currently Mobile VCE has 24 full Industrial Members, leading international players in the wireless industry (see Table 1) who each pay an annual subscription of £32k or £64k, depending on whether they opt for a Class 1 or Class 2 membership. Membership is viewed as a long-term commitment, for at least the duration of a Core Research Programme (3–4 years), rather than simply as a one-year decision. The financial costs, even taken over a 4 year period, are remarkably low compared to the benefits.

Table 1: Full Industrial Members of Mobile VCE, as at autumn 2000

BT Cellnet	NTL
Dolphin	One-2-One
Ericsson	Orange
Fujitsu	Panasonic
Hutchison 3G	Philips
Inmarsat	Racal Thomson
ITC—the Independent Television Commission	Radiocommunications Agency
Lucent	Simoco
Motorola	Tality
NEC	Texas Instruments
Nokia	Toshiba
Nortel	Vodafone

Table 2: Academic Members of Mobile VCE

University of Bradford	Royal Holloway College
University of Bristol	University of Strathclyde
University of Edinburgh	University of Southampton
King's College London	University of Surrey

To encourage involvement by small- and medium-sized enterprises a category of Industrial Associate Membership exists that offers a reduced set of member privileges in return for a smaller annual subscription, based on a sliding scale according to the size of the organisation.

Mobile VCE delivers value to its Industrial Members in many different ways, the main ones being summarised in the Panel opposite. As noted earlier, the *modus operandi* of Mobile VCE ties its research into industrial reality—the contribution of the industry staff, although relatively low in terms of effort per company per year, is crucial in shaping the direction of the research.

Different benefits are seen as being of varying importance by different Members, reflecting their size, position and role in the industry. For example, for some companies their membership provides a cost-effective means to monitor new research directions across a wide field, without the need to fund large in-house research activities. For others, the converse is true—the programme of Mobile VCE is used to inform a larger internal programme, helping to shape its strategic direction. For yet others, royalty-free access to the growing pool of IPR generated by the research programme is seen as a key factor, whilst for others the interaction with the academic researchers is seen as a way of keeping their staff sharp and aware of new research trends.

By contrast, Academic Members (see Table 2) have a harder life! Universities may join Mobile VCE *by invitation only*, on the basis of assessment and selection by the Industrial Members, the key criteria being a *proven and clearly demonstrable track record*—not just potential—*of excellence in relevant research*. When Mobile VCE was formed, some 23 universities applied for membership, of which just 5 were chosen; a further 3 universities have subsequently been admitted. Ongoing performance,

assessed through formal procedures and by review by the Industrial Members, determines the level and areas of participation in future research programmes, thereby ensuring that Mobile VCE maintains the highest quality, as befits a true Centre of Excellence. Whilst such a procedure means that membership of Mobile VCE is not a 'cosy club' for academics—far from it—the universities clearly secure substantial benefits from their participation, not least the implicit recognition of quality that accompanies membership and which thus helps them to attract both high-quality staff and other sources of research funding. Perhaps one of the most strategically important benefits for the universities, however, is the input regarding research directions that they receive from the Industrial Members through Mobile VCE's Steering Groups.

4 Steering Groups

Industrial Members have full access to the Mobile VCE Core Research Programme, technical reports and research teams, as well as the opportunity to participate in the Steering Groups, established for each of the Core Programme work areas. Steering Groups typically comprise some 6–8 Industrial Members who meet at least quarterly to monitor, review and direct the research activities. Each Steering Group is chaired by a senior Industrial Member, supported by an Academic Co-ordinator, who oversees the research teams.

The appointment of senior industry technologists, from the operational as well as the research parts of their companies, to chair and participate in these groups allows for a very strong input to the academics. It secures a higher degree of industrial relevance than is achieved in most other models of collaborative research. And yet, the structure and ownership of Mobile VCE ensures that such industrial relevance is achieved without compromising either the long-term nature of the research or its academic integrity.

Whilst such involvement demands a high degree of commitment, experience has shown that those Industrial Members who participate actively in this way reap significant benefits. Steering Group membership provides an avenue to direct the research, to secure early access to its results, and to network with other members of the mobile industry on a regular basis and, from time to time, the opportunity to recruit good research staff.

5 Pan-university teams

The research within each work area is undertaken by collaborative teams, usually comprising personnel from more than one university. Co-ordination of these pan-university teams is managed by an Academic Co-ordinator, a senior staff member—lecturer or professor—from one of the member universities. Innovative 'carrot and stick' mechanisms have been established within Mobile VCE that have proved to be very effective in encouraging the universities to deploy high-quality creative staff within the Mobile VCE teams,

to collaborate closely across traditional boundaries and to identify valuable IPR. Joint pan-university publications have begun to appear, as have complex software simulation tools, created in a composite manner across multiple research institutions. When Mobile VCE was first established such collaborative achievements were just hopes, but they have now become reality.

6 Research programmes

Two types of research activities are undertaken by Mobile VCE: so-called 'Core' Research and Elective Research. Both types of programme (described below) are defined jointly by Industrial Members and lead academics, are monitored and steered by Steering Groups and are undertaken at member university premises, usually by combined teams from more than one university, selected to match expertise to requirement. The research is based on formal contracts placed by Mobile VCE with its Academic Members, and is overseen by the Mobile VCE office, which provides a central hub for management, communication and information dissemination

Core Research Programmes represent substantial integrated programmes of research, funded by pooling members' subscriptions, usually also augmented by Government grants (see Fig. 1). The first Core Research Programme, over 50 man-years of focused research,

Benefits of Industrial Membership

- Industrially relevant, long-term research defined and steered by the Members
- Highly cost effective due to the significant financial gearing of Members' subscriptions (See Fig. 1). A typical Industrial Member pays less than 2 man-years to gain full access to the 100 man-year Core 2 programme
- Intellectual property. The existing, already significant, IPR portfolio will increase substantially in future years with royalty-free licences available to full Industrial Members.
- Short-term technology spin-offs—structures in place for commercial exploitation
- Elective Research, funded by a single company or by a small group of Members on a shared-cost, shared-benefit, basis, to address shorter term R&D needs
- Members' technical seminars
- Training of own staff through working alongside highly competent researchers
- Recruitment—development of new research staff for the industry and access to the leading research talent available today in the UK
- Networking to identify and shape, with industry colleagues, the trends which will influence the short- as well as the long-term

commenced in March 1997 and concluded in early 2000. The programme addressed four areas:

- services
- networks
- terminals, and
- radio environment.

The Core 1 programme delivered over 20 patent filings, of which 12 have progressed to the PCT (international) stage and 3 to national filings. A large number of detailed research reports, provided on CD-ROM to members, are complemented by Members' Technical Seminars. Such seminars, typically 2–4 per year, provide opportunities for a much broader base of technical staff from Member companies to become aware of the

results, tools and resources available to them through Mobile VCE. Raw data and processed results from advanced propagation research campaigns are also available to Members, as are software tools relating to multimedia traffic planning and other topics.

Overlapping Core 1, the Core 2 Research Programme commenced with a soft launch in October 1999. Its objectives relate to a long-term, year 2010, scenario. In all probability there will be shorter term spin-offs, as there were from Core 1, where research contributed to and influenced companies' in-house programmes and thereby fed indirectly into standardisation.

The Core 2 programme, whose vision is described in

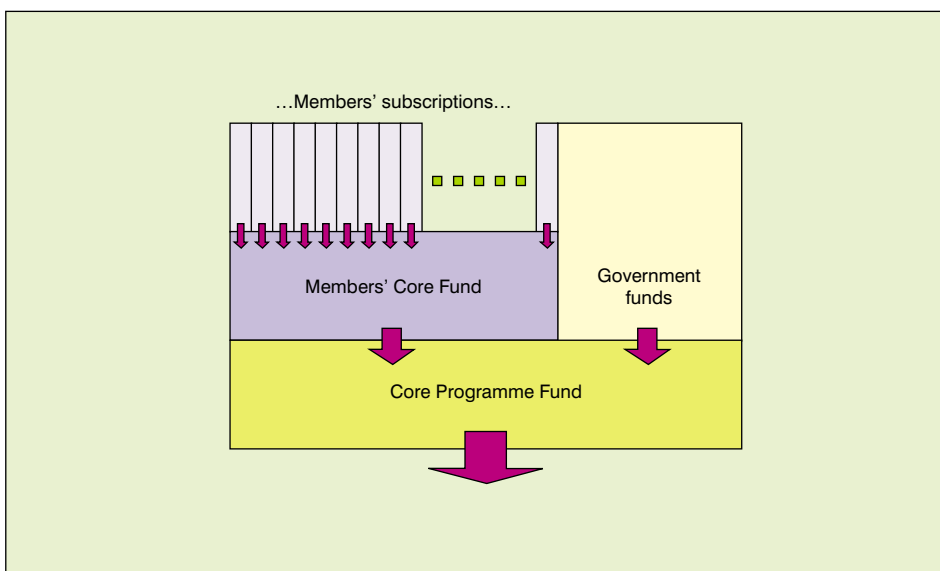


Fig. 1 High financial gearing. The Core Research Programme is funded by the aggregation of all the Members' annual subscriptions, further augmented by Government funds. This approach provides excellent financial gearing of members and public funds.

this issue by Evans and Baughan, received a favourable evaluation from a panel of international experts, from both industry and academia, who critically reviewed it as part of the EPSRC* decision-making process to support it with grant funding. This major research programme, of over 100 man-years, is structured into three areas:

- software based systems
- networks and services, and
- wireless access.

The enlargement of the staffing, compared to Core 1, has enabled Mobile VCE to widen its academic base, embracing an increased emphasis on mobile computing, middleware, agent technology and security aspects, complementing and building upon existing strengths in wireless access, software radio, networks and services.

Elective Programmes are research programmes of interest to a subset of the industrial membership and in which Members may choose ('elect') or decline to participate. Such programmes are funded by either a single company or jointly by a group of companies with common interest. For such programmes, access to results and any consequent IPR is restricted to those who elect to fund the work. Such programmes may build, for example, on prior Core Research, providing Members with an easy route for cost-effective predevelopment of emerging technology, bridging the gap between research and product development and ensuring that the companies have direct access to the relevant researchers, thus easing the transition from research to product.

The elective mechanism also allows Industrial Members to outsource research work for which they lack sufficient specialist internal staff, using Mobile VCE as a flexible extension resource to their company. Such work is obviously undertaken on terms of strict commercial confidentiality.

7 Conclusion

The Virtual Centre of Excellence in Mobile and Personal Communications—Mobile VCE—is now some 4 years old. Initially trading on promise and the goodwill of the industry, the company has now delivered tangible benefits to its Members. Effective structures and mechanisms have resulted in a high and sustained degree of commitment from its Academic Members. The value and effectiveness of the Steering Groups has encouraged Industrial Members to resource these with high-quality staff, enabling a very effective industry input to the work and enabling the companies to derive greater direct benefits themselves. The international endorsement of the enlarged Core 2 Research Programme promises a strengthening of Mobile VCE's resources and member benefits, which is already being evidenced by fresh patent proposals, and is reflected in new Industrial Members.

*EPSRC—the Engineering and Physical Sciences Research Council—funds university research and is the route by which Government funding has been made available to Mobile VCE to support its research programmes.

Walter Tuttlebee joined Mobile VCE as Executive Director in December 1999, bringing with him a background in R&D management and business development in personal communications. With his previous company he was a key player in the initiation of major research programmes—including the collaborative FRAMES and ATDMA programmes—that have significantly shaped 3G standards. His activities in short-range wireless communications—editing two books and creating a global Web community (www.dectweb.com)—involve him in chairing and speaking at industry conferences on DECT, Bluetooth and related technologies, the evolution of which will significantly influence the wireless world of 2010 addressed by Mobile VCE's Core 2 programme. Walter has BSc and PhD degrees from Southampton University and an MBA from Cranfield. He is a Fellow of the IEE.



Address: Mobile VCE, Ringway House, Bell Road, Basingstoke, RG24 8FB, UK.

Email: walter.tuttlebee@mobilevce.com

Web: <http://www.mobilevce.com>

Further developments are anticipated over the coming year as the Members consider how Mobile VCE should build upon the success to date.

The other papers in this issue provide a window on the breadth of technical innovation emerging from Mobile VCE and an insight into Vision 2010—the wireless world a decade from now—and the contribution that Mobile VCE aims to make towards this. With the pace of progress in mobile and personal communications as rapid as it is, Mobile VCE's innovative approach is making an important contribution to global industry developments.

Acknowledgments

Mobile VCE wishes to acknowledge the financial support that it receives from the UK Government via the EPSRC and the public endorsement it receives from the Department of Trade and Industry. The author would also like to acknowledge the contribution of his predecessor as Mobile VCE Executive Director, Dr. Tony Warwick, who was responsible for establishing the many excellent mechanisms that have formed a firm foundation for the effective functioning of the organisation. In addition, the exceptional quality and commitment of the many participants from both industry and academia is gratefully acknowledged, in particular that of the Industrial Chairmen of the Steering Groups and their Academic Coordinators. The technical and managerial contributions of these individuals on an ongoing basis have proven to be fundamental to the success of Mobile VCE.

©IEE:2000

Received 26th June 2000

This article is a development of the author's plenary presentation at the IEE Third Generation Mobile Communications Technologies Conference, 3G2000, held in London in March 2000.