Wireless Communications: An Area of Opportunity for Ireland

A report by Forfás to the Minister for Enterprise,Trade and Employment

April 2004

Functions

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- encourage the development of industry, technology, marketing and human resources in the State;
- encourage the establishment and development in the State of industrial undertakings from outside the State; and
- advise and co-ordinate Enterprise Ireland, IDA Ireland and Science Foundation Ireland in relation to their functions.

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- forbairt na tionsclaíochta, na teicneolaíochta, na margaíochta agus acmhainní daonna a spreagadh sa Stát;
- bunú agus forbairt gnóthas tionsclaíoch ón iasacht a spreagadh sa Stát; agus
- Fiontraíocht Éireann, GFT Éireann agus Fondúireacht Eolaíochta Éireann a chomhairliú agus a chomhordú ó thaobh a gcuid feidhmeanna.

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Executive Summary

I. Introduction

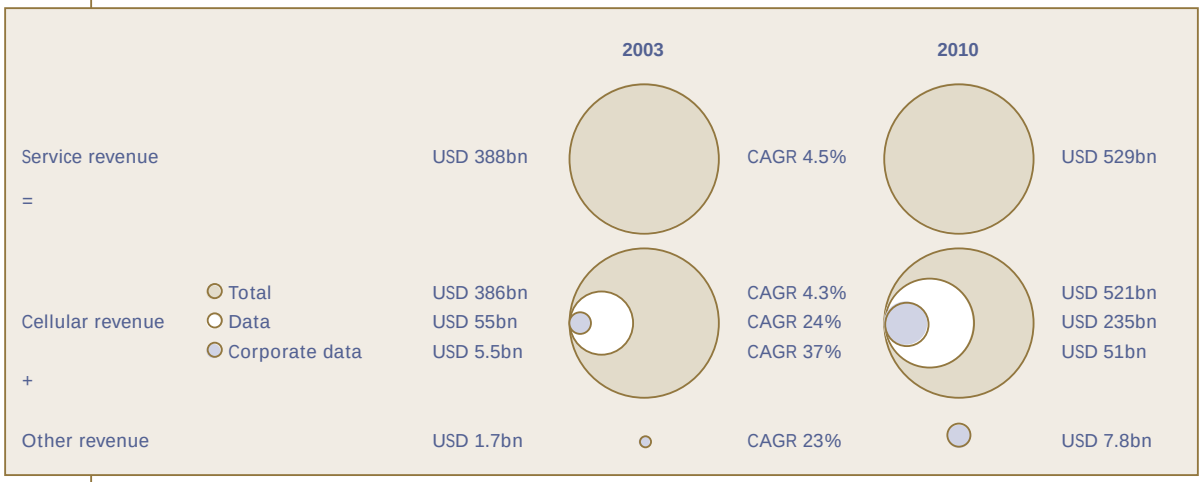
Wireless communications has been identified by a number of studies as an area of high potential growth. In 2003, Forfás worked with representatives of industry, the development agencies, academia and UK-based telecommunications consultancy Analysys to investigate these opportunities in greater detail and to recommend actions to promote the development of wireless as a sustainable internationally traded sector from Ireland.

II. The Wireless Sector

The wireless industry internationally is defined as encompassing mobile networks (2G, 3G, 4G, WLAN, etc.), fixed and broadcasting networks, hardware devices, middleware, software (e.g., security, etc.), satellite services, and market applications and services for delivery to final customers.

Internationally, the wireless sector will continue to show strong growth rates. Fuelled by a cellular subscriber growth rate of 7 per cent per annum over the next seven years, and the emergence of a wider range of data applications, the sector is expected to grow faster than GDP in all regions globally. Cellular revenue is expected to remain the largest contributor to a $529 billion market in 2010. (see Figure A).

Figure A: *Trends in Global Service Revenue*



The underlying growth in data applications offers a unique opportunity for Ireland to establish a robust wireless cluster based on its existing strengths in the sector. The value of the data services market is estimated at $55 billion today and is set to grow to $235 billion by 2010.

Ireland is recognised internationally as having one of the most dynamic mobile markets in Western Europe:

- Ireland enjoys a mobile penetration rate of 81%, slightly above the European average of 78%.
- Irish consumers are early adopters of new mobile services. Data services already account for close to 20 per cent of total average revenue per user, almost double the Western European average.

The wireless sector in Ireland comprises around 60 enterprises involved in wireless activities. The sector employs over 4,300 people, with employment split evenly between foreign and indigenous firms[1]. Employment is concentrated in Dublin (58%), with some activities in Cork (18%), Westmeath (Ericsson), Limerick/Shannon (Intel and Analog Devices) and Kildare (Intel). The Irish wireless sector, funded by a resilient venture capital sector has built a strong knowledge base in key growth areas, as shown in Figure B.

Figure B: *Irish Strengths in the Wireless Sector*

Established players	Emerging players	Niche players
• OSS • Billing systems • Transaction management • Security	• Middleware • Messaging • Location-based services • Vertical applications • Interface management	• Embedded devices and cores • Customer Premises Equipment • Smart antennae

III. Key Recommendations

This report outlines the key challenges facing the Irish wireless industry today and recommends a series of focused actions that need to be taken going forward, including:

1. **Focused development of the sector:** *Analysys* recommend that Ireland should focus its future development on its existing established strengths in OSS[2], security and the billing and transaction management area of the wireless sector. These are sustainable activities with high barriers to entry due to the complexity of the solution required, and Irish companies have the potential to exploit the current standardisation process. The importance of building strong relationships with the customer base (operators and large corporate) also weakens competition from more distant low cost countries.

   Analysys also recommend that Ireland has the potential to expand its core strengths into certification and hosting activities, exploiting current activities in middleware to create a European hub for the emerging mobile application hosting industry.

2. **Research and Development:** This study highlighted a lack of collaboration between industry and academia in the wireless area, and identified a disconnection between wireless research and current industry strengths. Section 4.2 sets out a range of recommendations to improve the alignment between research and industry interests and to improve industry - research collaboration.

3. **Accelerated Liberalisation of Spectrum Management:** Compared to leading international clusters, there is a lack of a clear central institution to lead the industry in Ireland, such as Ericsson in Kista (Sweden) or the universities in North Jutland (Denmark) and Cambridge (UK). One method of stimulating the trial and deployment of new wireless technology in Ireland, and making Ireland known internationally as a market for advanced wireless activities, is by encouraging the liberalisation of spectrum management. Specific actions required are set out in section 4.3 of this report.

[1] This excludes employment in the telecommunications companies (e.g. Vodafone, O2, Meteor etc.)

[2] Operations Systems Support

4. **Leading a Process to Establish a Wireless Community Based Network:** As in the broader ICT sector, there appears to be a relatively low level of interaction between many of the players in the Irish wireless sector. The development agencies should build on the work to date in this area (e.g., Communications Software Forum and website - www.commsoftireland.com, IBEC's Cellular Association, Enterprise Ireland's CEO forum, etc.) to establish a community-based network that would be supported by a web interface to disseminate information among members.

5. **Industry Standards:** It is recommended that Enterprise Ireland (and IDA Ireland where appropriate) support their client companies in identifying appropriate standardisation bodies and assist them in actively participating in standardisation processes.

6. **International Wireless Event in Ireland:** While Ireland has established internationally recognised competencies in areas such as messaging and mediation, the perception of Ireland as a developed wireless cluster is not strongly recognised outside of Ireland. While Ireland has a strong presence at international wireless events, hosting a high-profile event in this country could serve to elevate Ireland onto the global wireless map. Having reviewed the worldwide wireless conference schedule, and observing Ireland's strengths and strategy going forward, *Analysys* recommend the development agencies should promote and support the establishment of an international wireless event, focusing on Ireland as an *application hosting and certification hub*.

7. It is recommended that a **Wireless Implementation Group** be established by the Development Agencies to oversee the implementation of the recommendations in this report.

1 Introduction and Background

Advances in wireless communications are projected to be a significant driver of business growth, international investment, new enterprise creation, and research and development activity within the broader ICT sector going forward. Ireland already has a significant number of companies (both indigenous and overseas owned) operating in the sector and is currently one of the most dynamic mobile markets in Western Europe.

In 2003, Forfás developed a baseline assessment of the current state of the wireless sector in Ireland which provided profiles of key overseas and indigenous wireless companies currently operating in Ireland and examined Irish wireless related research and development. Building on this baseline assessment, Forfás commissioned UK-based consultants *Analysys* to undertake a more detailed study of the Irish wireless sector. The study had four objectives:

1. To map the development of the wireless sector, and to identify opportunities and threats internationally;
2. Relative to competitor countries, to identify and assess the strengths and weaknesses of the sector in Ireland;
3. To identify actions required to develop the sector in Ireland;
4. To identify and assess sector specific business environment conditions, necessary for the further promotion and development of the evolving wireless sector in Ireland.

Forfás established a Steering Group to oversee and drive the study (see Appendix I). This Group comprised of a mix of representatives from the wireless industry, as well as representatives from IDA Ireland, Enterprise Ireland, SFI, Shannon Development, ComReg and academia. During the study, Forfás and *Analysys* undertook a number of consultations with key wireless industry players (both nationally and internationally), with Irish 3rd level institutions and other stakeholders.

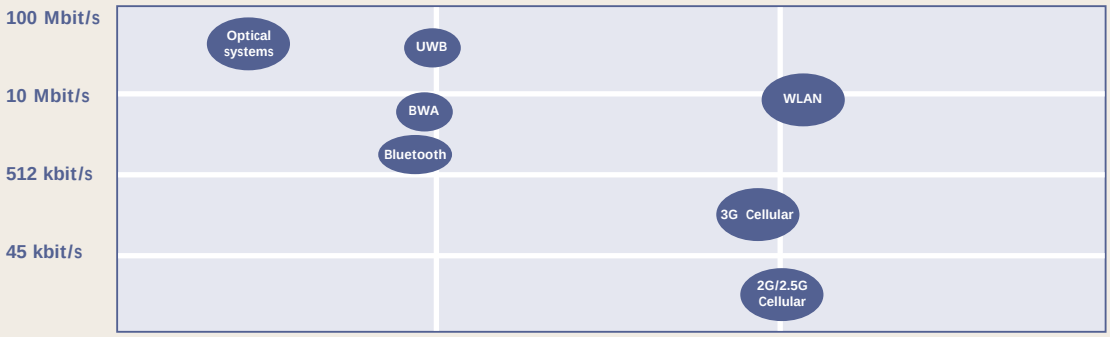
This report outlines key findings and recommendations. Section 2 examines the global wireless landscape and analyses the future growth potential of the industry. Section 3 provides an overview of the Irish wireless sector and specifically outlines the current strengths and weaknesses of the sector. Section 4 focuses on the recommendations required to progress wireless communications as a sustainable, internationally traded sector in Ireland.

2 The Global Wireless Industry

2.1 Introduction

The wireless industry internationally is defined as encompassing mobile networks (2G, 3G, 4G, WLAN, etc.), fixed and broadcasting networks, hardware devices, middleware, software (e.g., security, etc.), satellite services, and market applications and services for delivery to final customers.

Figure 1: *Competing Wireless Technologies*



While cellular (2G, 3G) will remain the dominant wireless access model, uncertainty remains over the most appropriate technologies to deliver this. Three broad technology categories can be defined;

1. Legacy technologies including analogue, GSM, TDMA, PHS, and PDC systems;
2. Evolutionary technologies, already widely developed, including GPRS and EDGE, and cdma2000 1xRTT;
3. Revolutionary technologies, including WCDMA (3G), cdma2000 1x EV-DO.

At present, almost 90 per cent of subscribers access wireless services and applications through legacy systems. This is forecast to fall to 60 per cent by 2005 as evolutionary (35%) and revolutionary (5%) systems achieve market adoption. By 2010, it is anticipated that 55 per cent of subscribers will access wireless services through evolutionary systems, while 30 per cent will have adopted revolutionary systems. Legacy systems are expected to become marginal.

2.2 Growing Wireless Markets

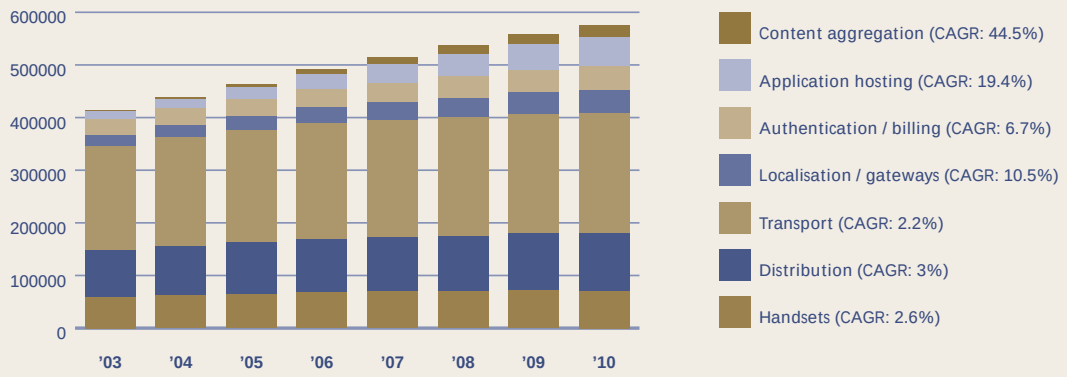
The wireless sector continues to show strong growth rates globally. Fuelled by an annual global cellular (2G/ 2.5G/3G) growth rate of 7 per cent over the next decade, the sector is expected to grow faster than GDP in all regions globally. The cellular mobile market is forecast to generate over $529 billion in service revenues by 2010 and $80 billion in device revenues. In 2003 alone, the cellular mobile market generated over $388 billion in service revenues and $62 billion in device revenues. Alternative technologies outlined in Figure 1 (e.g., Bluetooth, BWA, WLAN, etc.) will generate revenues of $7.8 billion by 2010, a substantial increase from the $1.7 billion generated in 2003.

In 2002, the number of mobile cellular subscribers worldwide grew by more than 20 per cent to 1,148 million. The growth rate for 2003 was expected to fall to 15 per cent as major western markets saturate. Western Europe, which accounts for 24 per cent of the worldwide subscriber base, was expected to have 316 million subscribers by the end of 2003. Population penetration will then reach 68%, close to the estimated saturation level of 70%. The focus on subscriber growth is expected to shift from the major western markets to China and the Asia Pacific regions over the next 7 years. China is expected to account for 21 per cent of the total global subscriber base by 2010, taking over from Europe as the number one mobile market in 2005. This has implications for the relative importance of emerging technologies used in Western Europe (GSM/ GPRS/ 3G) and China (CDMA)[3].

2.3 The Changing Wireless Value Chain

The high growth rates experienced in the wireless industry have led to the emergence of a number of new global brands (e.g. Nokia, Ericsson, Vodafone, etc.) and have attracted a range of established companies to enter the wireless sector (e.g. traditional fixed line telephone companies, Microsoft, etc.). It remains unclear which firms and technologies will dominate in the future. However, as can be seen in Figure 2, the key growth areas will be centred around the provision of wireless services and content (where Ireland's strengths are based), rather than in equipment and devices which are being increasingly commoditised.

Figure 2: *Worldwide revenue by value chain element*

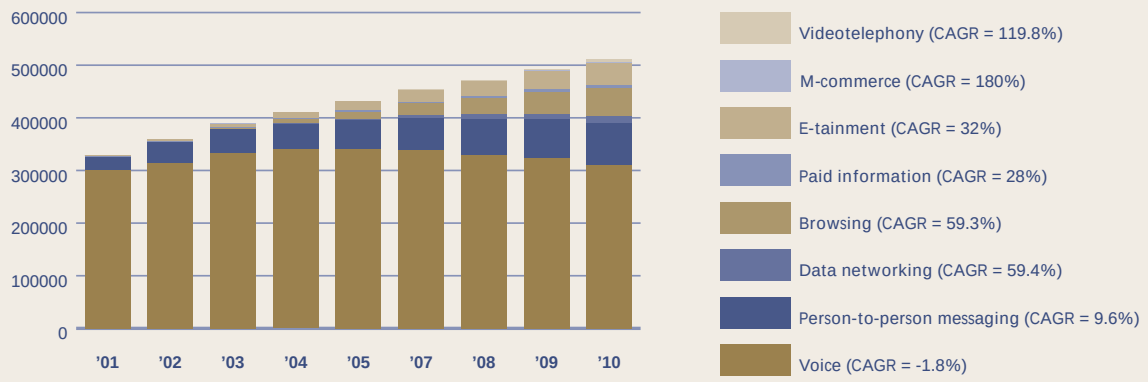


2.4 Opportunities in the Provision of Data Services and Support Platforms

The wireless industry has been characterised by falling average revenue per user (ARPU), as mobile voice services become pervasive among the population. Growth in the mobile subscriber base has, however, largely compensated for the decrease in revenue per user. Although this trend is likely to remain significant in developing markets, mature markets have begun to focus on generating higher revenue per user to foster growth. Revenues per user are starting to grow in Western Europe and Japan due to improved customer management, with a shift from low revenue generating prepaid users to post-paid users, continuing fixed line to mobile substitution, and most importantly the development and introduction of new data services.

[3] In China, 95 per cent of subscribers are using GSM/GPRS networks today; depending on the forthcoming decision of the Chinese government on the TDScdma standard (a variant of the CDMA standard), one could expect a more even split between GSM and CDMA families of standards to be deployed in China. A lack of standardisation will segment the global market, resulting in the emergence of competing technologies and the need for bridging technologies.

Figure 3: *Worldwide Revenue by Application*



2.4.1 Opportunities in Data Services

While voice services are expected to continue to generate the largest percentage of revenue up to 2010 (see Figure 3), mobile operators are currently deploying a range of data applications to sustain and grow revenues. Those services can be grouped into seven broad categories:

1. **Person-to-person** messaging - via email, text, chat facilities, unified messaging, instant messaging and multi-media messaging.
2. **Data networking** - the use of shared applications such as Microsoft NetMeeting, as well as access to corporate intranets database applications such as customer relationship management, etc.
3. **Browsing** - content that is made available over cellular networks without charge, other than those charges that apply for standard network access, including mobile-specific content and general Web browsing.
4. **Paid information** - push or pull electronic content, delivered over cellular networks, for which a premium is paid over and above standard network access charges.
5. **e-entertainment** - personalisation services (e.g. ring tones and logos) and downloading or accessing games, cartoons, music, video clips and other forms of entertainment over a cellular network.
6. **m-commerce** - transaction oriented services, including e-pay facilities, mobile shopping portals, mobile banking and share trading, and bookings and ticketing, but excluding games and other forms of content.
7. **Video-telephony** - audio-visual, person-to-person communications.

Table 1: *Data Revenue as a Share of Total Revenue*

	2001	2002	2003	2010
North America	9%	14%	16%	50%
Japan	10%	15%	17%	48%
Western Europe	9%	12%	15%	44%
China	7%	11%	12%	42%
Latin America	6%	10%	11%	42%
Eastern Europe	7%	11%	12%	41%
Rest of the Asia-Pacific	6%	11%	13%	41%
Africa and the Middle East	2%	3%	4%	33%

North America, Japan, and Western Europe will experience strongest growth in data services and will account for three quarters of global data revenue in 2003 (see Table 1). The value of the data services market is estimated at $55 billion today and is set to grow to $235 billion by 2010. *Analysys* forecast that data revenues will comprise 40-50 per cent of revenues by 2010. Analysys also expect cellular to remain the dominant wireless market.

2.4.2 Opportunities in Support Platforms

Anticipated growth in data services will result in significant opportunities internationally for companies to supply content for mobile applications, and to develop the software and systems required to manage these processes.

As described in the previous sections, the diversity of networks and services will require the development of complex software systems that bridge wireless and non-wireless networks and services. While large international network operators stand out due to their ability to capture a higher proportion of the value, they will increasingly rely on complex support platforms (for operating support, billing, authentication, certification, and Quality of Service management), whose value will remain protected. The complexity of the solutions required, and the strong relationships that must be established with increasingly consolidated network operators create high barriers to entry that must be exploited by successful providers.

3 The Irish Wireless Cluster

3.1 Strong Demand for Wireless Services in Ireland

Ireland is recognised internationally as having one of the most dynamic mobile markets in Western Europe:

- With 3.16 million mobile subscribers in mid-2003, Ireland enjoys a penetration rate of 81%, slightly above the European average of 78%.
- The Irish market also enjoys one of the highest levels of revenue per customer. The two main Irish operators have average revenues per customer of around €564 per year, some 50 per cent above the Western European average (only Switzerland and Norway have higher ARPUs in Europe).
- Irish consumers are early adopters of new mobile services. Data services in 2002 accounted for close to 20 per cent of total average revenues per user, almost double the Western European average.

3.2 Growing Irish Wireless Sector

The wireless sector in Ireland comprises around 60 enterprises involved in wireless activities. The sector employs over 4,300 people, with employment split evenly between overseas owned and indigenous firms. Employment is concentrated in Dublin (58%), with some activities in Cork (18%), Westmeath (Ericsson), Limerick/Shannon (Intel and Analog Devices) and Kildare (Intel)[4].

3.2.1 Indigenous

The indigenous wireless sector is primarily focused on the provision of software for wireless devices (see Appendix II). Key areas where Irish firms have established internationally recognised competencies and are competitive include:

- **Mediation** (software products for wireless operators to manage billing and transactions) accounts for approximately 30 per cent of employment in indigenous companies. Some consolidation is still taking place as Openet recently acquired Sepro, and Network 365 (a two-time Tornado 100 winner), recently announced its merger with iPIN (US based) and is now operating under the new brand Valista.
- **Security** software employs 250 people or 12 per cent of the indigenous workforce active in wireless. Ireland has established strong credentials in the area, though less so in the wireless space only.
- **Operational Support Systems** (for mobile networks): The OSS market is rapidly changing. As incumbents modernise their OSS applications, there is more room for new products and brand reputation becomes more important. Ireland has a number of strong firms in this area (e.g. Aran Technologies, Cape Technologies, etc.)
- **Messaging:** Following the sale of Aldiscon (a world leader in the development of text messaging technologies) to Logica, Ireland has retained strong innovative capabilities in the messaging area and a number of smaller companies, totalling 16 per cent of the wireless workforce. These companies are small and at an earlier stage of development.
- **Specialist applications:** Mirroring trends in the broader mobile sector, there is also a noticeable grouping of small firms and start-ups in the content services and aggregation area of the value chain, such as MapFlow and Red Circle.

[4] For large companies with multiple activities only employees involved in wireless areas are counted, employment in telecommunications companies (e.g. Vodafone, O2, Metor etc.) has been excluded.

3.2.2 Foreign Multinational Corporations

There are a small number of large international companies (e.g. Ericsson, Siemens, Motorola, Intel, Microsoft, ADC, Amdocs, etc.) that employ over 2,000 full-time employees in Ireland in wireless related activities. 75 per cent of the workers employed in wireless activities are involved in wireless infrastructure and applications, with the remaining 500 employees involved in the design and development of middleware and end-user devices.

There are a number of overlapping competencies between indigenous firms and MNCs in Ireland. In the mediation area, the presence of ADC and Amdocs complements the strengths of indigenous companies. Similarly, there are potential complementarities in the OSS and middleware sectors, where large, established firms such as Sun and Ericsson are present.

3.2.3 Network Operators

Ireland now has four mobile cellular operators: Vodafone, O2, Meteor and 3 (owned by Hutchinson). Vodafone (formerly Eircell) and O2 (formerly Esat Digifone) hold 55 per cent and 40 per cent of the Irish market respectively. Meteor, a relatively new entrant to the market has a market share of between 4 per cent and 5%. 3 has recently entered the market, and has no market share to date. The launch of commercial 3G services is expected in 2004. Meteor is the only operator not to hold a 3G licence. A number of fixed wireless access providers are also emerging, which will further promote competition in the market. In November 2003, ComReg awarded 59 fixed wireless access licences to eight companies. Companies that won licences include Budget Wireless, Digiweb and Last Mile Wireless.

Irish mobile operators have played a critical role in the development of the sector through the procurement of Irish wireless software services. As the operators are now part of larger international companies, applications development and procurement is being centralised overseas, making access more difficult for Irish companies.

3.3 Summary of Irish Strengths

The Irish wireless sector, funded by a resilient venture capital sector has built a strong knowledge base in key growth areas, as shown in Figure 4 below.

Figure 4: *Irish Strengths in the Wireless Sector*

Established players	Emerging players	Niche players
• OSS • Billing systems • Transaction management • Security	• Middleware • Messaging • Location-based services • Vertical applications • Interface management	• Embedded devices and cores • CPEs • Smart antennae

(CPEs - Customer Premises Equipment)

3.4 Research & Development

Research and development in wireless technologies is widespread in Irish research institutions and the commercial sector. Fourteen of the research institutions[5] and the majority of companies engage in research and development activities in the wireless area. (see Appendix II)

The level of collaboration between the industry and the third level sector in Ireland is relatively low and a cause for concern. *Analysys* have identified two contributory factors, which will need to be addressed:

- The focus of the commercial wireless sector and the research institutions is very different. The business activities of wireless companies in Ireland are strongly focused on the software applications value chain in which the research institutions have relatively little activity. Research institutions are primarily focused on the wireless infrastructure value chain. This divergence of focus greatly reduces opportunities for collaboration between businesses and research institutions conducting wireless R&D.
- As identified elsewhere, there is a low level of interaction (non-commercial and commercial) between the industry and the research base (commercialisation, technology transfer, etc).

3.5 Lessons for Ireland from International Wireless Clusters

While the Irish wireless industry has grown significantly in recent years, it is still developing as a cluster, as there is not a significant level of interconnection between businesses, academia and government, and there is a limited presence of "spill-over benefits". The pre-cluster stage is most commonly characterised by groups of disparate firms that are either unaware of each other or unwilling to actively communicate. The potential exists among these competing institutions to benefit from complementary work, but either supporting infrastructure to facilitate networking is lacking or the incentives are not apparent. However, the analysis of the Irish cluster, supported by a wide range of interviews, has outlined a number of weaknesses that must be addressed:

- although with a stronger presence in Dublin, the Irish wireless cluster is geographically dispersed (industry and research);
- collaboration among firms and links with academic research is weak;
- the cluster lacks strong differentiators internationally.

[5] Comprehensive information on the work of the Research Institutions in Ireland can be found in Research in Third Level Institutions in Ireland in Wireless and Related Technologies - 2003 (http://www.ida.ie/industry/Research%202003%20for%20internet.pdf).

While Government and the Development Agencies in Ireland have been supportive of the wireless industry, analysis from other such clusters abroad has shown how Government can play a key part in catalysing industry forces:

- clusters develop around a strong anchor institution - e.g. a University (Cambridge, North Jutland), or a large company (Ericsson - Kista in Sweden, Nokia - Finland, Qualcomm - San Diego)
- clusters mature around a set of competencies through natural business cycles of success and failure: key is the ability of the cluster to retain the human capital and sustain the innovation process (e.g. the North Jutland cluster that originally centred around equipment manufacturers)
- circulation of labour is often more important than a large pool of graduates
- an availability of VC capital
- clusters' ability to innovate is supported by the presence of a reputable academic network of researchers who are able to cross easily the boundaries between research and commercialisation
- clusters are driven by a small network of individuals: community networking (San Diego, Cambridge) disseminates best practice more rapidly and allows quick identification of innovation with strong potential
- proactive government policy can play a key role in initiating cluster formation and providing momentum to the industry through R&D funding (Kista in Sweden, Finland), networking support (Cambridge, Finland), and funding academic excellence (Kista, North Jutland)
- Government policy alone, however, cannot ensure the success of a cluster (Ottawa).

Appendix III provides a comparison of international wireless clusters based on cluster development criteria.

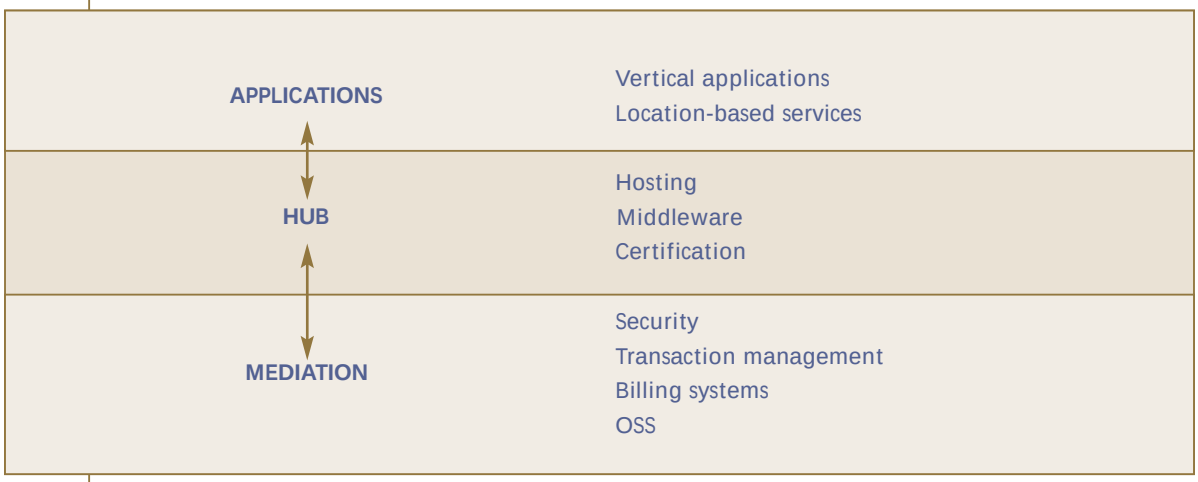
4 Key Issues and Recommendations

Having examined Ireland's strengths and the future growth opportunities in wireless, as well as evidence from internationally-recognised wireless clusters, *Analysys* identified a number of key requirements to promote the development of wireless as a sustainable internationally traded sector from Ireland.

4.1 Focused Development of the Wireless Sector

Analysys recommend that Ireland should focus future development on its existing strengths in the support platforms (**mediation**) that are required to deliver mobile services, such as operations systems support (OSS), security, billing and transaction management. These are sustainable activities with high barriers to entry due to the complexity of the solution required, and companies have the potential to exploit the current standardisation process. The importance of building strong relationships with the customer base (operators and large corporate) also weakens competition from more distant low cost countries.

Figure 5: *Intergrated Wireless Value Chain for Ireland*



Analysys also recommend that Ireland has the potential to expand its core strengths into certification and hosting activities, exploiting current activities in middleware to create a **European hub for the emerging mobile application hosting industry**. Hosting mobile applications is set to become a key constitutive element of the wireless service delivery architecture in the future. Emerging business models (e.g., Brew) will require content aggregators and application certifiers to host applications that need to be delivered across networks. Geographic proximity of core European markets, as in the case of Google when it chose Ireland in 2003, as well as Irish technical and commercial competencies would ideally place the country as a centre for such 'wholesale' hosting activities. The presence of an established certification player and an Irish-based virtual market for applications would strengthen Ireland as a centre of a sustainable wireless growth. Appendix IV provides a framework and rationale for the selection of these segments of the wireless market.

Other emerging activities in Ireland should be supported opportunistically. *Analysys* note that these are more fragile as barriers to entry are often lower. Ireland, however, could exploit the standardisation process to establish critical mass in some areas (such as location-based services) or focus on niche vertical markets where it has established a knowledge base (such as logistics

management or supply-chain management). However, *Analysys* note that specialist mobile applications for businesses are essentially an extension of existing applications in the fixed-line area and that several models will compete to deliver these solutions:

- large companies (such as financial institutions) are likely to prefer in-house managed solutions to comply with high standards of security and reliability until standard solutions are developed;
- companies with weaker IT capabilities may prefer hosted solutions with few upfront or installation costs.

4.2 Cooperation between Research Activities and Industry

This study has highlighted a lack of meaningful collaboration between industry and academia in the wireless area, and identified a disconnection between wireless research and current industry strengths. Successful clusters worldwide have demonstrated that links with academic research and the setting of appropriate incentives for academic research to exploit the commercialisation of Intellectual Property Rights (IPR) are critical to development.

In terms of R&D funding policy, the levels of R&D funding for wireless have been acknowledged as satisfactory. However, the management of this funding has been perceived to be sub-optimal and interviews with industry and academia have emphasised the need for more predictable R&D funding processes. Technology transfer is also acknowledged as critical to the success of any cluster and research institutions need to devote more resources to the commercialisation of research through the provision of advice and support for researchers.

It is recommended that:

- An independent wireless advisory group be established by the development agencies, as part of an overall implementation group for this report (see recommendation 4.7), to inform and advise on R&D funding allocation and long term strategy.
- The timeframe of R&D funding should be structured to encourage and promote academic and industry collaboration; (Government Departments, Development Agencies)
- Researchers need support to pursue EU research funds more vigorously. The initial provision by Enterprise Ireland of €20,000 for academics to lead on major projects should be kept under review;
- The Irish Council for Science, Technology and Innovation should review the IPR controls over commercial exploitation of research to ensure there is a real financial incentive for researchers to commercialise ideas. ICSTI has developed a national code of practice for publicly funded research. There is a need to develop a similar code of practice for public-private funded research and supports need to be provided to encourage commercialisation and greater awareness of industry needs;
- A virtual community of wireless researchers should be promoted in Ireland which would incorporate both the Irish research institutions and industry[6] and links to international clusters. (Development Agencies)

[6] This could potentially build on the work of Inter-Trade Ireland (www.expertiseireland.com)

4.3 Accelerated Liberalisation of Spectrum Management

Compared to leading international clusters, there is a lack of a clear central institution to lead the sector in Ireland, such as Ericsson in Kista (Sweden) or the Universities in North Jutland (Denmark) and Cambridge (UK). Because a central institution, around which the cluster is built, cannot be created overnight, Ireland must look to other means of creating a "wireless friendly" environment. Foreign countries need a reason to locate their wireless activities in Ireland, and domestic companies need as many alternative sources of advantage as possible to compensate for the lack of a strong anchor.

One method of stimulating the trial and deployment of new wireless technology in Ireland, and making Ireland known internationally as a market for advanced wireless activities, is by introducing a more liberal spectrum management regime. The primary objectives of these spectrum recommendations are to promote the development of wireless companies in Ireland (as set out in Section 4.1), by providing them the opportunity to test and develop products and services over existing and emerging (and potentially competing) service bands (e.g. over European, North American or Asian technologies).

Ireland, like all European countries, has traditionally used a thorough and meticulously implemented system of spectrum management, with the assignment of spectrum to individual users under the control of the government. Many countries with spectrum congestion problems have realised that existing spectrum management regimes are not sufficiently responsive or flexible for today's market. In particular, current regimes are seen as too slow at getting spectrum into the hands of new users, inefficient in the way that some parts of the spectrum remain unused and provide insufficient incentives for users to use spectrum efficiently. The process of re-allocating spectrum from one service band to another in response to market changes may take many years and involve complex negotiations at both national and international levels. This may mean that, for long periods of time, spectrum is not efficiently allocated across potential uses, weakening the potential for innovation, the development of new services, and thus competitive advantage. The emergence of new technologies (Wireless LAN, Bluetooth, etc.) has demonstrated that making spectrum available can stimulate innovation and can lead to more efficient usage than if it was assigned to a single user.

Two important, and related, mechanisms are being widely discussed to address the perceived lack of flexibility and responsiveness in traditional spectrum management regimes. These are:

- **Spectrum trading** - allowing users to buy and sell spectrum on a secondary market.
- **Change of use** - allowing users to change the usage of spectrum that they have been assigned, or have bought on the open market.

The new European regulatory framework for electronic communications allows member states to introduce spectrum trading for the first time. As a result, a number of member states are actively considering the introduction of both spectrum trading and change of use. In particular, the UK and the Netherlands are at a reasonably advanced stage of planning the introduction of these measures. Beyond Europe, spectrum trading has already been introduced in Australia, New Zealand, and the USA. It is acknowledged that ComReg have begun preliminary work on these areas and that Ireland has been one of the first European countries to adopt the new regulatory framework. While Ireland does not generally suffer from spectrum congestion issues, as an island economy, Ireland may have more latitude to release spectrum without distorting spectrum use in other countries.

It is recommended that:

- the Department of Communications, Marine, Natural Resources consider accelerating the enabling of a secondary market for spectrum trading;
- ComReg consider promoting the change of use of spectrum by users;
- ComReg to continue to monitor the development of "spectrum commons" models in other markets and consider making bands available for unlicensed use in response to, or ahead of developments in other markets (including important markets beyond Europe such as USA and Japan);
- ComReg monitor progress in Ultra Wideband (UWB) licensing in other markets with the aim of moving more rapidly to license UWB than other European markets;
- ComReg consider establishing zones of relaxed spectrum regulation - for example a UWB zone in an Agency business park;
- ComReg consider extending the regime of test licences to allow R&D and commercial trial licences.[7]

4.4 Leading a Process to Establish a Wireless Community Based Network

The experience overseas, notably in Cambridge and Finland has shown that an effective way of supporting a sense of community across the cluster, and increasing collaboration between parties, is by leading a process to establish a community based network that would be supported by a Web interface to disseminate information among members.

The objective of this network would be to increase awareness within and of the wireless sector in Ireland, to develop a visible community of interest in order to provide an effective way of sharing learning and best practice (e.g. standards, selling in overseas markets, etc.). This portal can make available a range of information provided by members as a means of quickly disseminating community progress and act as a company database allowing third parties interested in the wireless capabilities of Ireland to quickly identify relevant companies and potential partners. Experience abroad has shown that the relatively low costs[8] of maintaining a portal can turn it into a self-financing venture. Table 2 provides some examples of international wireless networks.

Table 2: *Examples of International Wireless Networks*

Cluster	URL
Ottawa	http://www.ottawawirelesscluster.com
Finland	http://www.e-finland.fi
Finland	http://www.vtt.fi/virtual/navi/etusivu
Sweden	http://www.kista.com
North Jutland	http://www.norcom.dk
Cambridge	http://www.cambridgenetwork.co.uk

[7] Granting commercial test licences has the potential to both promote and impede innovation. While it can provide an incentive to develop new products or services, it is also acknowledged that it may be difficult to remove a test licensee once a market has developed, even if that use of that spectrum is sub-optimal. Each case requires to be considered on its merits.

[8] For example, Cambridge Networks, a similar initiative based around the technology clusters in Cambridge, now has 1300 members and is operated at a cost of GBP 350,000 per annum. These costs are recovered through membership fees, external sponsors and the gateway activities that the community offers to overseas visitors.

It is recommended that:

- The development agencies and the wireless sector should build on the work to date (e.g., Communications Software Forum and website - www.commssoftireland.ie, IBEC's[9] Cellular Association, Enterprise Ireland's CEO forum, etc.) to initiate an Irish wireless network linking research, industry and sector interest groups.

4.5 Industry Standards

As described in section 3.3, Ireland has developed a range of competencies around the areas of transaction management, billing, security and OSS. These directly underpin the growing importance of the authentication and billing of future wireless systems, as well as the complex gateway systems that bridge wireless and non-wireless networks. The diversity of networks makes these functions critical for the development of applications. These areas, however, are still in the process of stabilising many of the critical standards that will enable compatibility and inter-operability within the broader wireless systems. It is, therefore, critical that Irish companies are well positioned in the standardisation process in the respective industry groups.

It is recommended that Enterprise Ireland (and IDA Ireland where appropriate):

- support their client companies in identifying appropriate standardisation bodies and help them to actively participate in standardisation processes;
- promote Ireland as a meeting place for standardisation bodies;
- monitor specific standards development and organise seminars targeted at the wireless community.

4.6 International Wireless Event in Ireland

While Ireland has established internationally recognised competencies in areas such as messaging and mediation, the perception of Ireland as developed wireless cluster is something that is not strongly recognised outside of Ireland. While Ireland has a strong presence at international wireless events, hosting a high-profile event in this country could serve to elevate Ireland onto the global wireless map. The wireless world has already established a number of global events that would be difficult to replicate here, including:

- Cannes GSM conference in February;
- ITU Telecoms Fair in Geneva in October (held every four years);
- CTIA Wireless I.T. and Entertainment in March.

[9] *http://www.ibec.ie/sectors/tiff/tiffweb.nsf/LookUpPageLink/home*

There is scope, however, to create a new event around an area that is likely to grow in the coming years and that has not yet attracted sufficient attention. The event must reach high visibility, attracting a wide range of industry representatives and should aim at gathering several hundreds attendants. A potential candidate would draw on the recommendation to expand Ireland's value chain core competencies from existing strengths in OSS, security, billing and transaction management into the *application hosting and certification* areas, and would aim at establishing Dublin as the annual meeting place for mobile application developers and operators centred around:

- a world-class conference on mobile application business models and developments
- a showcase for mobile applications
- an opportunity to create an informal market place for developers and network operators.

This event, which could be organised by a private organisation is envisaged to be self-funded after a few years.

It is recommended that:

- the development agencies should promote and support the establishment of an international wireless event, focusing on the areas outlined above.

4.7 Wireless Implementation Group

It is recommended that a **Wireless Implementation Group** be established by the Development Agencies to oversee the implementation of the recommendations in this report.

Appendix I

Steering Group Members

1. Dr. Richard Horton - *ComReg;*
2. Mr. Brendan McDonagh - *Aran Technologies;*
3. Mr. John O'Hare - *Amocom Technologies;*
4. Mr. Gerry Fahy - *Vodafone Ireland;*
5. Mr. Joe Butler - *Intel;*
6. Mr. Brian Kinane - *Mobile Aware;*
7. Mr Steven Rochefort - *Ericsson Ireland;*
8. Dr. Dirk Pesch - *Cork Institute of Technology;*
9. Prof. Phillip Perry - *Dublin City University;*
10. Prof. Cormac J. Sreenan - *University College Cork;*
11. Mr. Bill Hunt - *Analog Devices;*
12. Ms. Patricia McLister/ Ms. Anne Fitzpatrick/ Mr. Aidan Stack - *Enterprise Ireland;*
13. Mr Jim Whelan/ Mr. Pat Howlin - *IDA Ireland;*
14. Mr Ken Stockil - *Shannon Development;*
15. Dr. Alastair Glass - *Science Foundation Ireland;*
16. Ms. Maria Ginnity - *Forfás;*
17. Mr. Adrian Devitt - *Forfás;*
18. Mr. Shane Quinlan - *Forfás*;
19. Mr. Patrick Gaule - *Forfás.*

Appendix II: Wireless Value Chain

For the purpose of this study, the value chain below has been used to analyse indigenous and overseas firms based in Ireland, and the Irish research and development base.

Figure 6: *Agreed Wireless Value Chain*

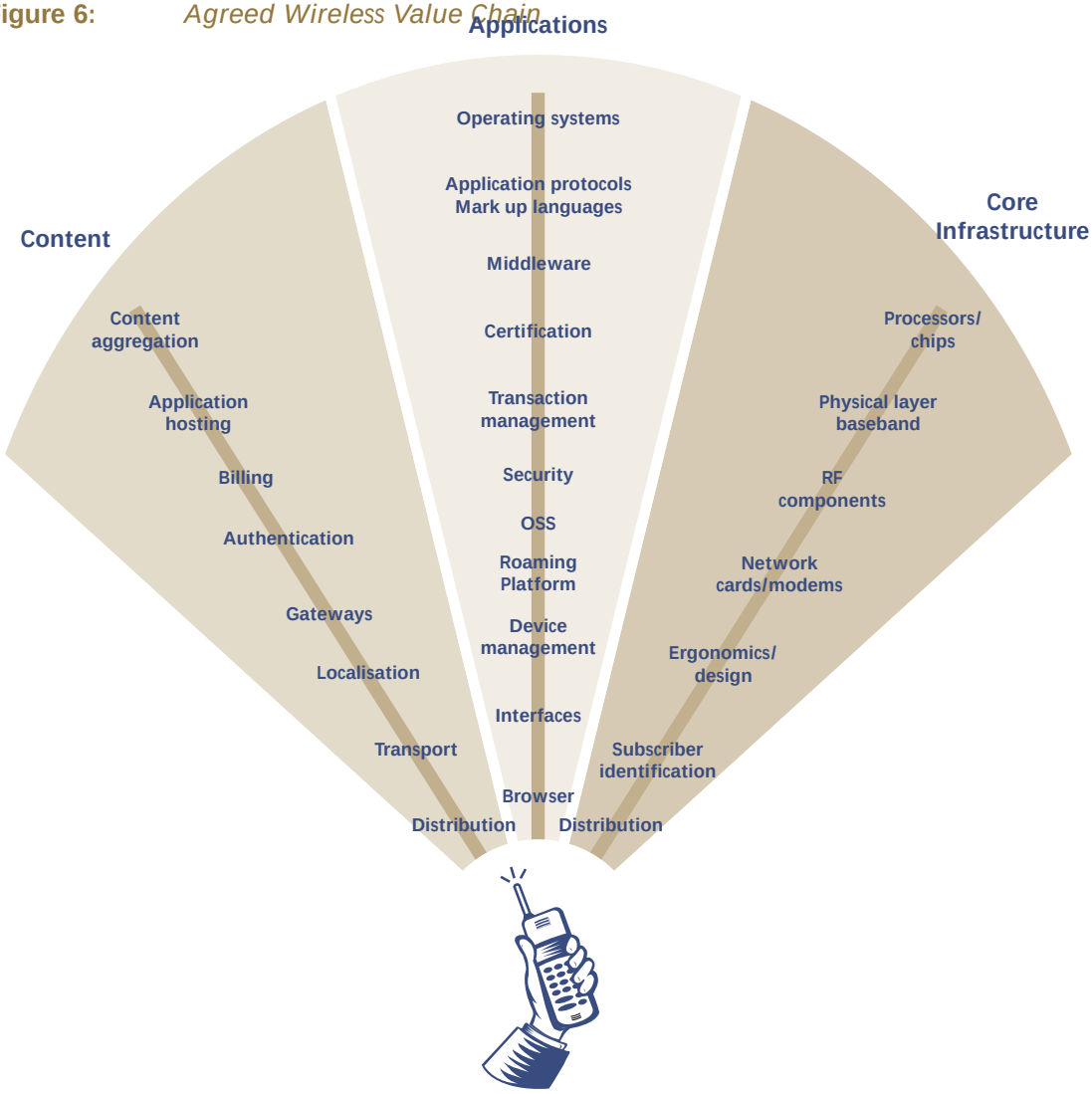


Figure 7: *Sample of Indigenous Wireless Companies across the value chain*

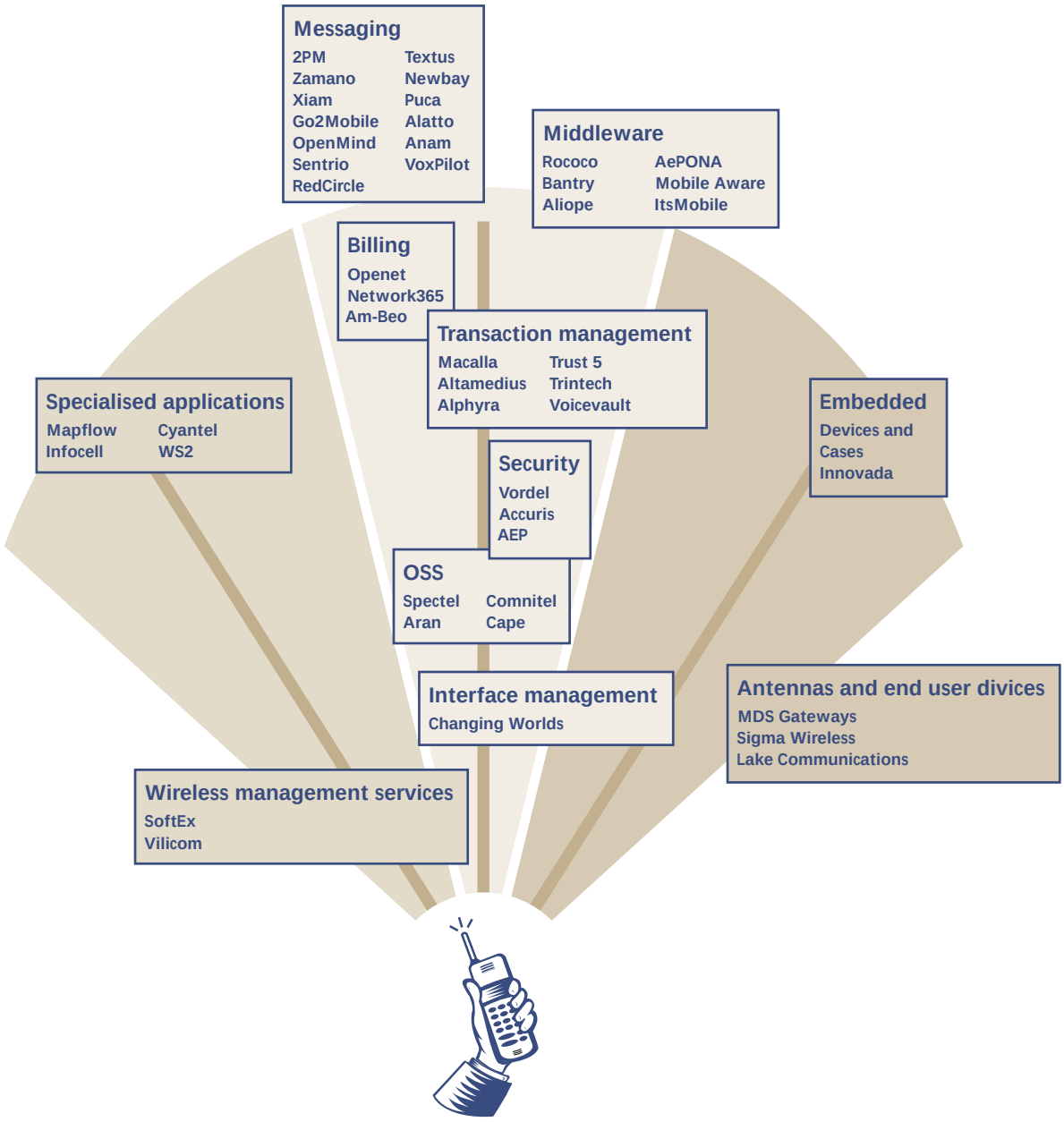
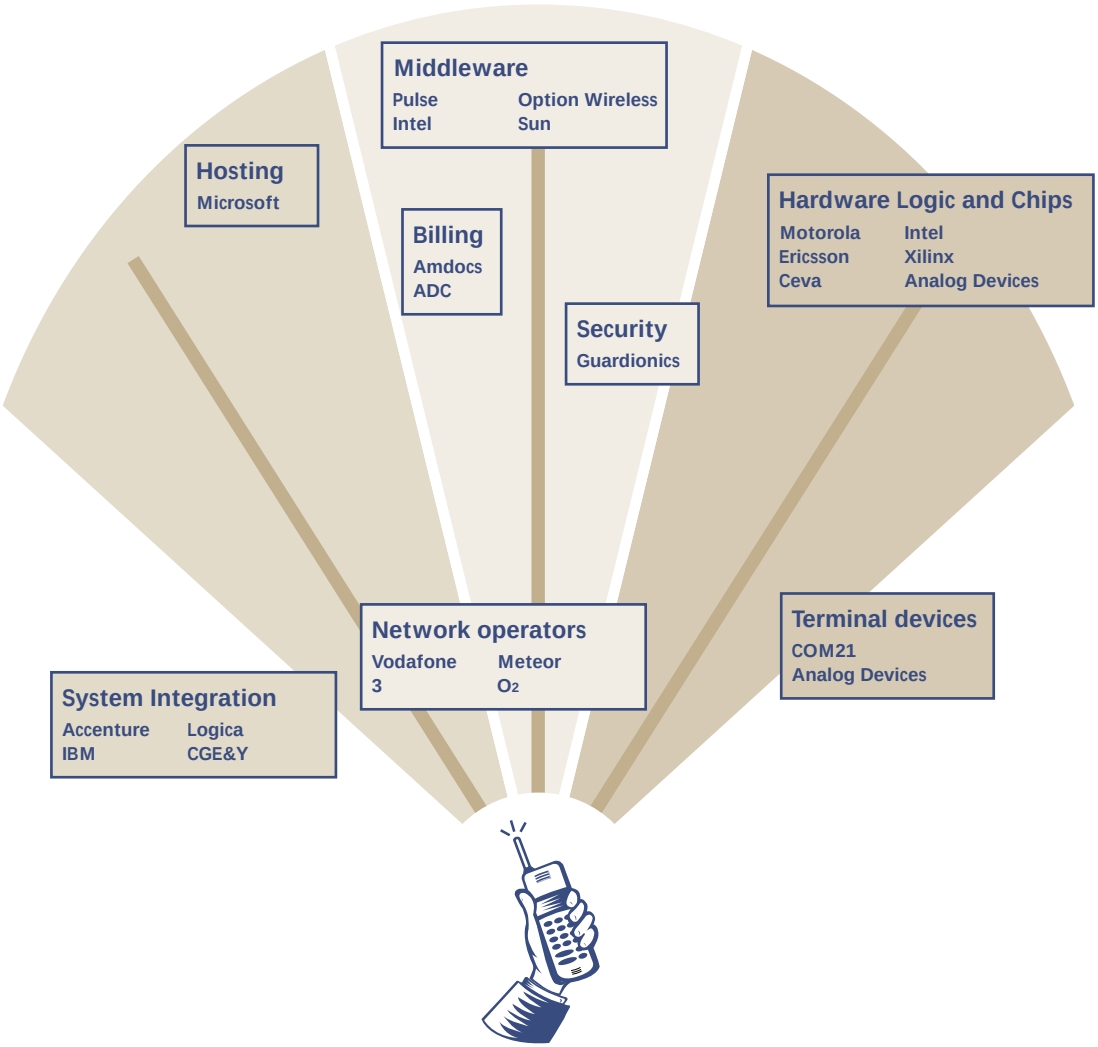


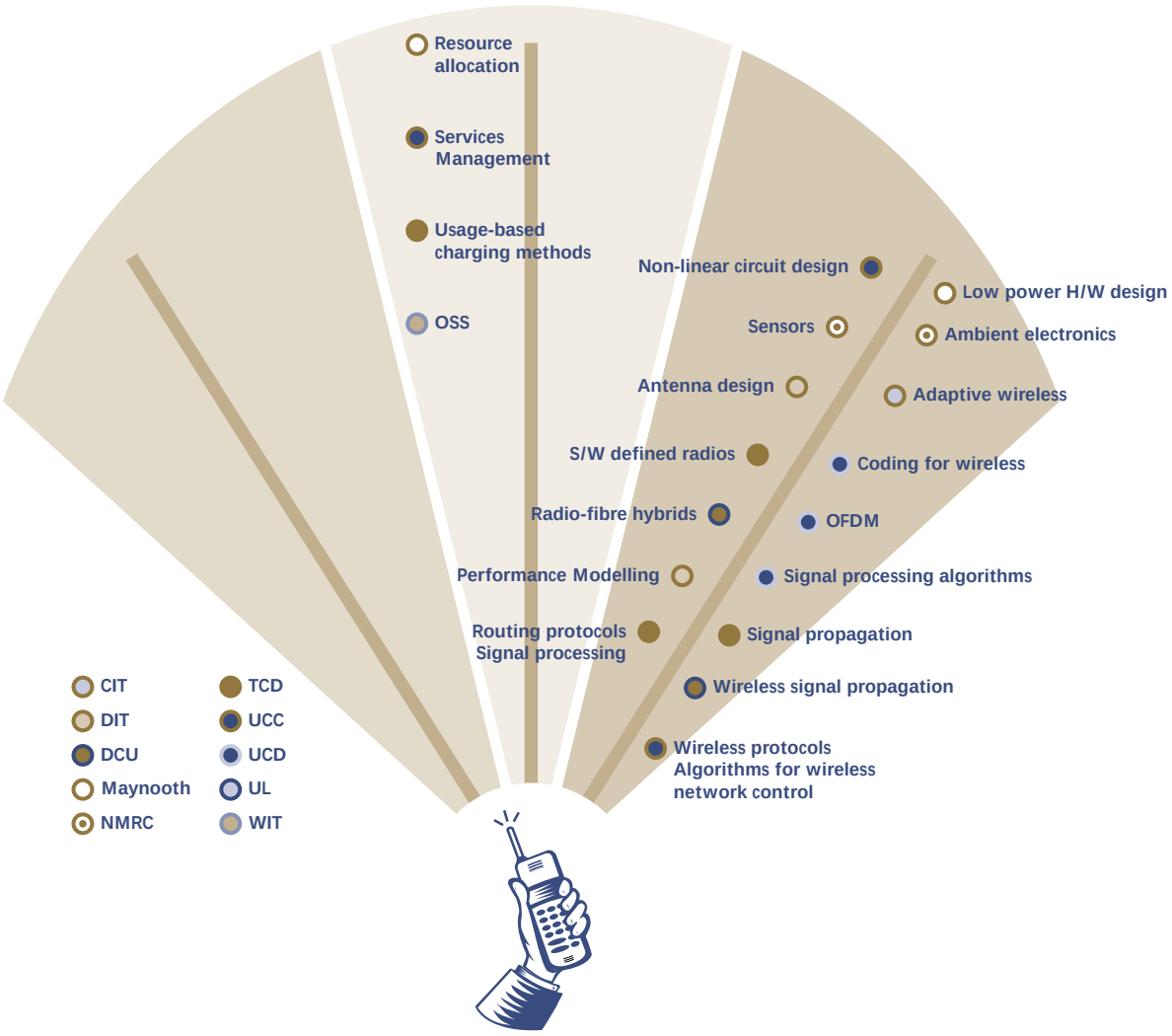
Figure 8: *Sample of Overseas Companies with Wireless Activities in Ireland across the value chain*



Research and Development

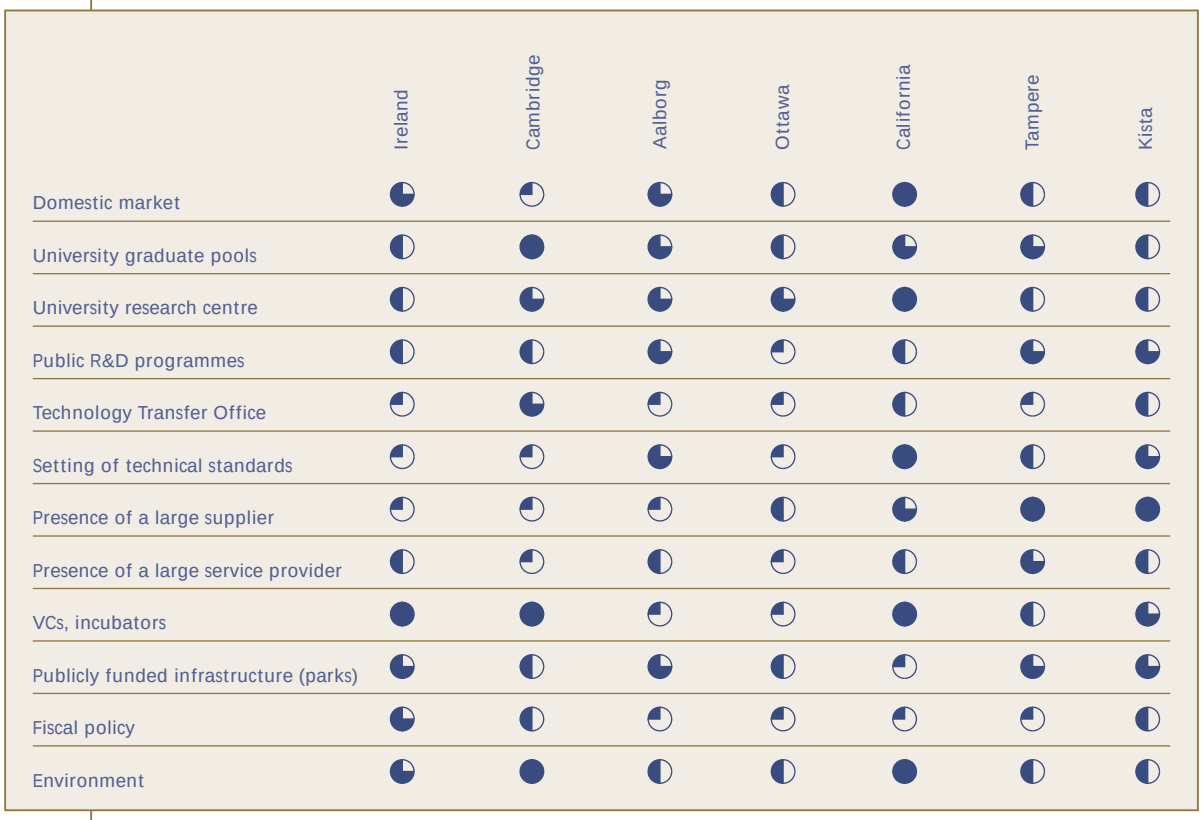
The figure below shows the spread of research activity by Irish research institutions over the wireless value chain. There is a strong focus on the infrastructure value chain.

Figure 9: *R&D Wireless Activities in Ireland*



Appendix III: International Wireless Cluster Comparisons

Figure 10: *Cluster Development Criteria*



Legend: ○ ◔ ◐ ◕ ●

Weak - Strong

Figure 10 above shows that Ireland has a number of competitive advantages when compared with leading international wireless clusters:

- a strong presence of seed and venture capital funds;
- a comprehensive publicly funded infrastructure;
- an attractive fiscal policy;
- the presence of large, established operators (Vodafone, 02) also constitute an opportunity for companies to access via the local market a broader customer base.

Looking at success factors in other clusters highlight a number of weaknesses in the current Irish environment:

- the lack of a large supplier driving the cluster (as in the case of Nokia, Ericsson and Qualcomm) may, however, not be offset by a recognised research 'brand'; the sub-optimal collaboration between research and industry may in fact hides quality research in other, adjacent fields (notably signalling systems, or computer systems).
- the potential shortage of a sufficiently large pool of graduates is also a weakness; many have warned of a critical shortage of graduates against a successful development of a wireless cluster.

Appendix IV

Figure 11: *Relative strengths of the Irish Wireless Sector*

Relative strengths of the Irish wireless sector Source: Analysys, 2003

	high barriers to entry	potential to succeed at low scale	ability to exploit standardisation	ability to exploit Ireland geographic position	Cluster core competencies
Niche player					
CPEs	–	–	–	–	✗
Smart antennae	+	+	+	–	✗
Embedded devices / core	+	–	+	–	✗
Interface management	–	++	+	+	✗
Established player					
OSS	++	+	++	++	✓
Billing systems	++	+	+++	++	✓
Transaction management	+	+	+++	++	✓
Security	++	+	++	++	✓
No presence in Ireland					
Certification	+++	+	+++	+++	✓
Hosting	++	–	–	+++	✓
Emerging player					
Middleware	+	++	++	++	✓
Messaging	–	+	–	+	(✓)
Location-based services	–	++	–	++	(✓)
Vertical applications	+	+++	–	++	(✓)

Legend

- + ++ +++
Weak - Strong

not a core competence ✗
potential core competence ✓
core competence (✓)

Appendix V: Glossary of Terms

2G+	Enhanced second generation mobile technology - generally refers to mobile communications based on GSM which can carry data at rates higher than standard GSM
3G	Third generation mobile technology - the next generation of mobile communications technology which is expected to be launched in 2002
Analogue	Transmission method whereby signals (voice, images) are transmitted in a continuous way and not digitised
Application	An application program is a program designed to perform a specific function directly for the user or, in some cases, for another application program. Examples of applications include word processors, database programs, Web browsers, development tools, drawing, paint, image editing programs, and communication programs
ARPU	Average revenue per user
ASP	Application service provider - an organisation which takes on specific applications such as payroll or server backup and manages those applications over high-speed communications links. Also, application service provision
Bandwidth	The width of a communications channel, typically measured in kbit/s (in digital systems). This measure gives an indication of how fast data flows on a given transmission path
Billing	An organisation's computer systems that store data on customers and generate bills
Bluetooth	An evolving standard to use radio communications for local communications rather than wires - PC to printer communication by radio for example
Broadband	A high speed connection which allows communications of 2Mbit/s or higher
BWA	Broadband wireless access
CAGR	Compounded Annual Growth Rate
CDMA	Code-division multiple access - a sophisticated scheme which uses spectrum very efficiently for mobile communications
CDMA2000	Code Division Multiple Access 2000. A third generation wireless system, cdma 2000 is a trademark of Qualcomm, the company that commercialised CDMA.
CDMA2000 1xRTT	The first phase of CDMA2000 technology designed to double voice capacity and support data transmission speeds up to 144Kbit/s, or ten times the speed available today.
CDMA2000 1xEV-DO	CDMA2000 1x Evolution Data Only. A data-only overlay that uses a 1.25 MHz channel to provide a peak rate data throughput of 2.4Mbit/s
CPE	Customer premises equipment - the in-building equipment necessary to provide services that run over the network
CRM	Customer relationship management
Database	A collection of data organised in such a way as to allow easy access to information of interest
Digital	The use of a binary code (ones and zeros) to represent information
EDGE	Enhanced data for GSM evolution - one of the 2G+ standards which will allow higher data speeds to be achieved using existing GSM technology
Encryption	Encoding data to ensure it is read only by the intended recipient with the decryption key

Extranet	An Internet-like network run by a company to conduct business with its employees, customers and suppliers. Similar to an intranet, except it can be accessed by people outside the organisation
FRA	Fixed radio access - using radio for the link between the telecoms operator and the customer where the customer is not mobile (hence fixed)
FWA	Fixed wireless access - see FRA
GPRS	General packet radio system - one of the 2G+ standards which will allow higher data speeds to be achieved using existing GSM technology
GSM	Global system for mobile communications: second generation digital pan-European mobile system - the most successful mobile standard globally
Intranet	Private network that uses the same technology as the Internet
IP	Internet protocol - the communications standards used by the Internet
ISP	Internet service provider - an organisation which allows companies and individuals to connect to the Internet
Mobile	An abbreviation commonly used for mobile cellular communications - referring to mobile telephone networks
MVNO	Mobile virtual network operator - an organisation which provides all of the services of a mobile network operator but uses the network of an actual network operator
OSS	Operational support system
Portal	A Web site marketed as an entrance to other sites
QoS	Quality of service - how good the service provided by an operator actually is. It covers technical issues such as failing to connect calls and dropping calls, as well as how quickly an operator responds to requests from the customer
Service provider	The provider of a telecoms service. An SP may not have its own network but uses the network of another organisation to provide its service, e.g. cricket scores
SMS	Short message service - the paging facility that is built in to the GSM standard
TD-SCMA	Time Division Synchronous Code Division Multiple Access. TD-SCDMA was incorporated by the 3rd Generation Partnership Project 3GPP in March 2001 as part of the UMTS Release Phase 4
UMTS	Universal mobile telecommunications systems - a name for 3G mobile telecommunications
WAN	Wide area network - a network which covers a large area - usually a public network covering a country or region
WAP	Wireless application protocol - a protocol that allows a form of Internet access from mobile devices such as mobile phones
W-CDMA	Wideband code-division multiple access - the standard which will be used for delivering 3G mobile services
Wideband	Network or circuit with greater capacity than narrowband (typically greater than 64kbit/s)
Wireless access	Access via a system that operates locally without wires
WLAN	Wireless local area network
TDMA	Time-Division Multiple Access (technology used in one of the US digital mobile phone standards)
PHS	Personal Handyphone Systems
PDC	Personal Digital Communications network
UWB	Ultra wideband

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