



Preparing for Growth No Strings Attached

The much-hyped 3G broadband wireless standard, agreed in 1997, is finally coming to market through a groundbreaking development project by IPWireless Inc. Although US based, the company chose to undertake a very aggressive design and development phase in Europe, supported by a European test specialist, Test Solutions Ltd.

Although the internationally recognised 3G wireless standard was agreed in 1997, few companies have made significant progress in bringing technology that utilises the TDD part of this standard to address the broadband data opportunity currently existing in the market.

Hailed as the ultimate goal for mobile communications, the 3G FDD part of the standard has proven difficult to implement for many of the telecommunications companies around the globe who have invested in frequency rights. Behind the scenes, however, one company has been quietly developing a 3G TDD data solution which is set to make part of the dream into reality. An American company, IPWireless Inc., with headquarters located in San Bruno, California, has been developing a broadband solution over a three-year period, using a European-based team of over 100 world-class engineers, driven from a base in the United Kingdom.

The company now offers a groundbreaking, advanced 3G standards-based broadband wireless technology solution that enables service providers to offer true high-speed mobile wireless Internet access to worldwide consumer and business markets with two-way data transmission speeds of up to 3 Mbps.

The potential for mobility, affordability, and breadth of coverage of 3G makes it an attractive alternative to other broadband technologies - including DSL or cable modems and represents a breakthrough in the industry.

IPWireless is led by a world-class management team comprising a number of seasoned entrepreneurs and executives with experience from established communications companies. The formation of the company coincided with the release of the 3G specifications and reallocation of the MMDS frequency band in the USA some 3 years ago. It was immediately apparent that for design and development, the UK would be the ideal place to find experienced engineering talents. Adrian Temple Brown, the Project Manager with responsibility for production of the high volume user equipment (UE) describes how the project came together.

“The founders felt that a dual country start-up would demonstrate the desire to be recognised as a global company and acquire the best talent available in key required fields. The UK has an

excellent track record of realising technical solutions and with major telecommunications players located in the M4 corridor, the IPWireless offices in Wiltshire are in the midst of 3G development. The project was intended from the outset to create a high volume product and the development timescales have been aggressive from day one. The fact that we have brought a viable product to the market in such a short space of time is a credit to the experience and passion of the engineers we have, and the close working relationships with partners. IPWireless would appear to be at least a year ahead of any competitor as a result.”

In a short period of time, operations at the three Wiltshire sites have grown from zero to over ninety engineers, many involved in software development.

The result is a solution consisting of three core elements; **An Integrated Network Controller (INC)** which controls data traffic through up to 12 “**Node B**” base stations and connects them to the Internet. Each Node B can communicate with up to several thousand **3G Broadband Modems or PCMCIA cards** across the UMTS air interface. The portable, pocket-sized modem provides USB, RS232 or Ethernet interfaces to the customer’s PC or PDA. The sleek, compact design allows for easy



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transport for consumer and business users and does not require an additional aerial to be mounted on the customer's premises, resulting in a highly flexible, and truly mobile solution. The IPWireless solution interworks with standard network infrastructure equipment to provide an end-to-end solution from the Internet to the pocket-sized wireless modems. The technology is designed for operation in the US and European licensed bands: IMT-2000 1.9 GHz, MMDS 2.5 GHz and has already been modified for deployment in other, operator-specific bands in other areas.

Originally aimed at the US market, where it is now being deployed by a number of telcos, the company's foresight has meant that the product can be quickly configured for operation virtually anywhere as soon as the network cell structure is established. For example, Maui Sky Fiber, a new Maui-based telecommunications carrier, announced recently that The Ritz-Carlton, Kapalua, Hawaii, is offering advanced broadband services to its guests, using the system. Cell planning is similar to that for the current GSM system, allowing existing basestation sites to be used where appropriate.

The modem, an impressive component in the package, was developed by IPWireless but manufactured using local contract manufacturer Ddi in Wiltshire, where IPWireless has established an office of resident engineers.

“The core of the modem is a custom ASIC with over 2 million gates and 4Mbit of RAM. Unlike many large scale ASICs the resources are not used by small repeated blocks of functionality, making it a complex design that was an enormous challenge for back-end ASIC design tools. The printed circuit board is also very dense, with digital functionality on one side of the board and radio circuitry on the other, and a count of 820 components on a 13-layer, 10cm x 8cm board. This has also meant some significant test challenges,” says Mark Woodiwiss, the company's Manufacturing Director, “We started our test development phase once the product was stable enough in April 2001 and used Test Solutions Ltd as a local partner to support the product with board level functional test expertise. The resulting test software and fixture development programme has provided test capacity without significant capital equipment outlay in the early stages of product

manufacture, through a rental programme.”

The partner, Test Solutions Ltd (TSL), is an established sales and service house based in High Wycombe, about 50 miles away from IPW. TSL's Tim Lyons takes up the story: “IPWireless were entering a difficult phase in the manufacturing cycle. Whilst the product was in prototype and low volume manufacturing, the company required all the necessary test technology and expertise to ensure effective test applications. However, the product development plan has always projected a move to high volume manufacture in a relatively short space of time. The solution has had to accommodate the IPWireless plan to contract out the manufacturing of the product to CEM partner Solectron so the test suite would need to be portable to Solectron at an undefined future date. We co-developed the test suite with IPW's engineers to ensure that standard test functions would integrate with their software, and there were other reasons too - like 24hr support, and turnkey solutions that a local supplier is able to offer.”

“This resulted in a very comprehensive range of functions to

enable fast development and prototyping, and which is structured so that development test functions can be removed/batch tested as the CEM's yield improves and the requirement for rigorous testing lessens."

TSL also supplied Teradyne Spectrum test systems and fixtures throughout the project, on a rental basis, to give IPWireless maximum technical capabilities at minimum capital cost. The Spectrum Manufacturing Test Platform is a unified test environment that spans the entire range of board-test applications: classic in-circuit test (ICT), in-line process test, single-stage test (ICT plus functional test), high-performance digital functional test, and depot-based diagnosis and repair with a software environment, TestStudio, which is flexible, efficient, scalable, and reusable.

"We took advantage of the Spectrum's flexibility and portability, making particular use of third-party JTAG boundary scan software and the capabilities of the system's TestStudio software. The final suite which is part ICT (5% in time), part JTAG (5% in

time) and part functional test (90% in time), can be implemented effectively on the Teradyne platform and easily transferred to any CEM with this type of system," says Lyons, "The rental options, part of TSL's Test On Demand initiative also gave IPWireless key benefits. By renting the test system and function cards, rather than purchasing, IPWireless were able to keep capital expenditure to a minimum without losing capabilities or capacity during the early development phase and transition to high volume CEM, they can either release the system or re-engineer it for the next product."

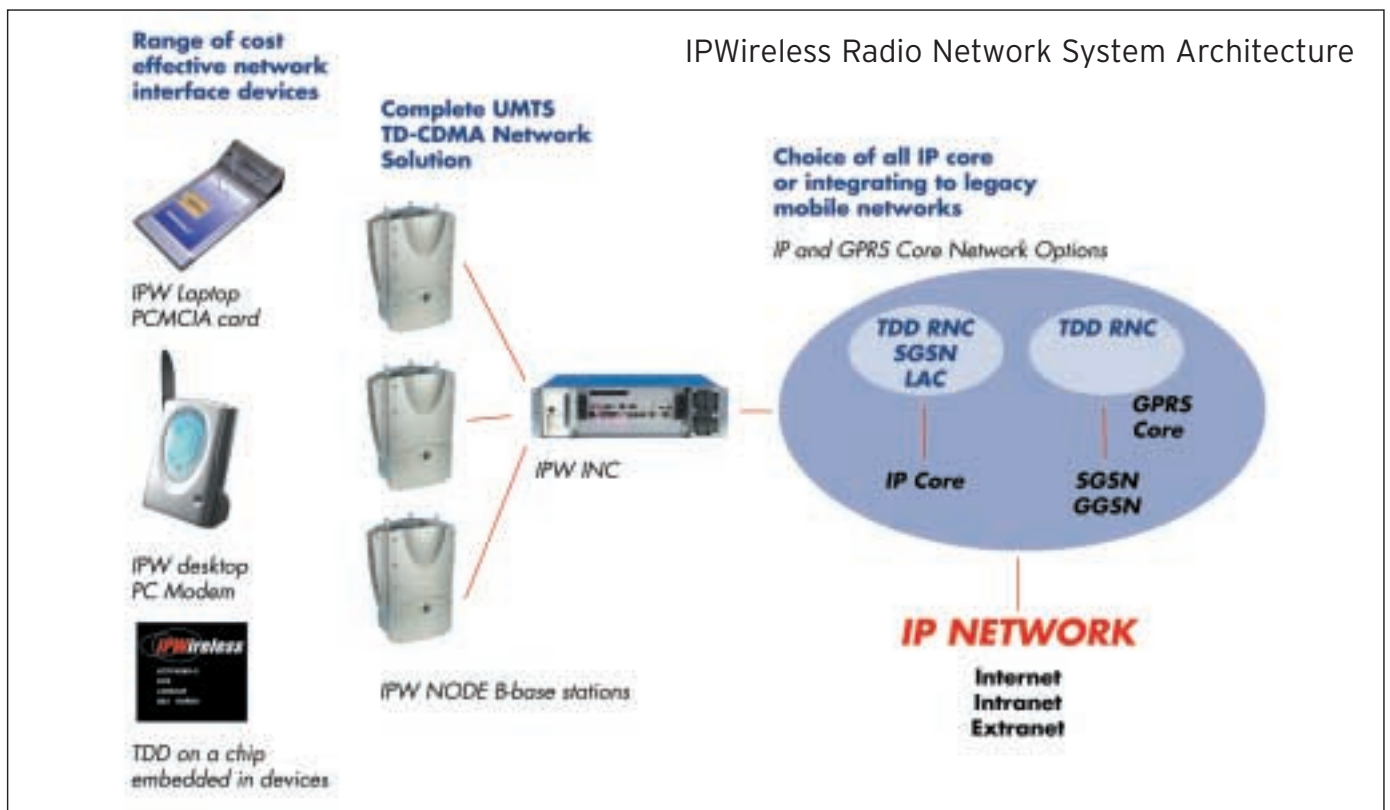
IPWireless has not forgotten that a forward development programme will be essential in maintaining its lead against competitors and keeping up with consumer demands. Teradyne's test platforms and software support a wide range of digital, RF and power tests enabling it to effectively test both current offerings and future products, such as a PCMCIA version of the modem which is currently completing



preparations for volume manufacture.

In its preparation for growth, IPWireless has met and exceeded many challenges, but even as the first solution begins commercial deployment around the globe, the company is already moving onward. Remaining ahead of the competition is a core value in the company's philosophy.

www.ipwireless.com
www.testsolutions.biz



WHAT IS 3G BROADBAND?

Advanced 3G Broadband provides very high data rates and excellent coverage while maintaining full 3GPP standards compliance. TD-CDMA maximizes spectral efficiency and fits into all radio spectrum bands currently available.

Genuine Non Line-of-Sight (NLOS) operation provides the true portability of cellular with high speed data performance and eliminates the need for cumbersome, expensive customer premise equipment. Advanced signal processing techniques maximize receiver sensitivity to operate with high path loss and building penetration loss, and to cancel interference.

The UE offers high speed data services using the peak 3Mbps always-up packet rate transmitted in a 10 or 12MHz channel, or 1.5Mbps in a 5 or 6 MHz channel.

IPWireless has selected standards-based UMTS TDCDMA over proprietary air interface technologies, like OFDM, primarily for its superior ability to deal with the difficult Non Line-of-Sight multipath environment, produce high spectral efficiency and to create a product suitable for future interworking with UMTS FD-CDMA operators.

APPLICATIONS FOR 3G

Typical market segments that can be profitably served by IPWireless are residential, small/medium business, travelling users, and mobile users within large enterprises or organisations.

Genuine Non Line-of-Sight operation supports subscribers in most urban and suburban coverage environments, including high-rise buildings, single family dwellings, and roamer locations such as airports. Extended coverage can be provided in rural locations using optional subscriber antennas.

Typical applications include Internet access and secure access to IP-based Virtual Private Networks (VPNs) and

intranets. Within these applications, customer services include Internet Web access, Internet Email access, FTP, Telnet, advanced messaging, low rate videophone and Internet telephony, as well as corporate servers and intranet extensions.

HOW DOES IT WORK?

The IPWireless radio network consists of a number of base stations, termed "Node Bs", controlled by an Integrated Network Controller (INC). A typical "macrocell" site utilises three Node B radios in a 3-sector configuration, each communicating with up to several thousand "3G Broadband Modems" (User Equipment or UE) on the UMTS TD-CDMA air interface. Node Bs can also be deployed in microcell and supercell architectures, according to operator requirements.

The controller and core network consists of three logical elements operating on a single hardware and software platform:

- Radio Network Controller (RNC),
- Serving GPRS Support Node (SGSN),
- Layer 2 Tunneling Protocol Access Concentrator (LAC)

Standard Internet protocols are used on the gateway network side. All supporting systems, including the Element Manager and other management systems, as well as the Home Location Register (HLR), communicate with the access network elements using standard IP protocols, allowing flexibility in the location and network connectivity of these systems. Typically, a virtual private network would be used to provide the necessary security and reliability.

Subscriber traffic is tunneled from the gateway network side to the point of connection with the Internet using the Layer 2 Tunneling Protocol (L2TP), and typically would be terminated by a Layer 2 Tunneling Protocol Network Server (LNS) at the point of connection. Separate tunnels can be established for each subscriber on the system. This architecture can equally be used to connect any or all subscribers to a private IP network, such as a corporate Virtual Private Network (VPN).



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