Innovation in telecommunications

- The perspective of a satcom terminal developer

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We all know that innovation is the life blood of all companies that wish to grow, just as it is of all developed economies. Innovation is fostered throughout the economy by a supportive ecosystem that encourages investment - in R&D, venture capital, and the incubation of small growth companies; by nurturing human capital, and education in the sciences and technology; by encouraging collaboration, particularly between research organisations and industry; and by applying new technologies and ideas to meet customer needs. An often overlooked requirement is that innovation also requires great (or even heroic) customers – customers who seek the rewards of innovation but still have the risk appetite to be able to fund and trial innovations that might run late, be over budget, or that do not fully meet specification!

Innovation in telecommunications has proven crucial to global development - not only for innovations within the network, but also because it has provided new platforms for other global innovations to prosper. For instance, public telecommunications in past decades was circuit-switched, organised hierarchically into groups and supergroups, analog in nature, and networked as either broadcast or point to point circuits. The emergence of digital technology was a seminal innovation for the telecommunications industry, since it allowed massive improvement in spectral efficiency and saw the emergence of techniques like forward error correction, digital filtering and equalisation that improved communications quality over poor lines. This enabled the emergence of IP and then the Internet in the late 1990's, which perhaps proved more important. Packet switching has simplified multiplexing, improved accessibility, and expanded network architectures, while the connectivity of the Internet has provided the broadband applications that have massively driven the growth of global telecommunications carriers and global business more generally. Simultaneous advances in both optical and wireless technologies have opened up spectrum at higher frequencies, improved access for users, and further supported the growth in broadband communications.

However, the physics of satellite communications has always kept it somewhat remote (to forgive the pun) from these advances. Long hops and limited power budgets place much lower bounds on signal to noise ratio, and satellite practitioners look enviously at recent advances in terrestrial cellular networks (for example), where MIMO antenna systems, high order modulation schemes, and low cost terminals are meeting the ever growing demands for high speed data – where service is available. But we in the satellite community are fortunate, because satellite still remains the only communications technology that is available any place, any time. And of course, satellite technology has continued to innovate as well.

For satcom terminal developers, innovation has progressed but lagged behind that of mobile (cellular) terminals. Consumers cannot roam between networks on satellite as they can with their mobile phones, getting off the plane and simply allowing the phone to roam until it finds an alternate operator. Nor can they communicate at broadband speeds. The directivity of signals at microwave frequencies, and the need to avoid interference with adjacent satellites has also meant that most satellite terminals must be pointed. However, advances in high throughput satellites and low earth orbit satellites, and in new tracking technologies are improving both speed and access to satellite communications, in the same way that the iPhone revolutionised ground telecommunications. Cheaper flat panel technologies also hold the promise of bringing mobile satcom to the masses, although flat panel arrays are still be-devilled by the physics of insufficient gain off-axis to close the link budget.

Why shouldn't a satellite terminal be able to roam between satellites in the same way as a mobile phone? For the Royal Australian Navy, our company will be in ship trials later this year with a 1-m maritime terminal that operates simultaneously at X- and Ka-bands with the WGS satellite, and can fall back to commercial Ka-band when needed. We are also completing development of 1-m maritime terminals that will provide national border force patrol boats access to both the WGS system and the Inmarsat GX broadband service. These will offer more robust and assured communications with a single terminal, by switching between bands and satellites all on the one platform automatically – just one example of innovation in satellite telecommunications.

With a more limited market, such innovations seem to emerge more slowly. The development of any new platform – such as an on-the-move satellite communications terminal involves a balance of performance (innovation) and risk. Because the three principal variables of a project are schedule, budget, and scope – innovation introduces the possibility that the development can run late, can cost more than intended, or may not fully meet specifications.

Innovation occurs by building on the shoulders of giants that have gone before. Terminal development requires very sophisticated control firmware – unimaginable without today's current generation of FPGAs and embedded processors in the one system. The power, efficiency, and bandwidth required is only enabled by the use of GaN technology – that come about simply because the semiconductor supports a higher operating voltage, so that load impedances can be higher and more easily matched over a wider bandwidth to antennas. Antennas today use new dielectric materials to achieve steering (in the case of flat panels) or broader bandwidth in more compact packages (in the case of high gain parabolic antennas).

At the 33rd AIAA International Communications Satellite Systems Conference (ICSSC) held on Australia's Gold Coast in September last year, delegates from around the world shared technical innovations such as these. It was a wonderful gathering in a convivial atmosphere, where delegates from Australia, Japan, the USA, and Europe came together to "build on the shoulders of giants before them".

But perhaps the real giants in the innovation puzzle are those customers who embrace innovation and are prepared to fund its development. Not content to buy off-the shelf, such customers are pushing the technol-

ogy envelope and driving innovation by demanding new requirements, new features, and performance improvements. Sure, they are the first to reap new benefits, but often such customers must share the risks with developers, and steel themselves through the uncertainties of the development cycle.

Let's have a round of applause for our customers!

Dr Rowan Gilmore

Rowan Gilmore is the CEO and Managing Director of EM Solutions Pty Ltd, an Australian designer and manufacturer of advanced microwave components, systems and terminals used in satellite and wireless broadband communications networks around the world.

Until June 2011 he was CEO of the Australian Institute for Commercialisation, where he helped numerous start-up companies and worked to accelerate technology transfer between research institutions and industry. Prior to this role, he worked extensively in the ICT industry, and was formerly based in London and Geneva from 1998 as Vice President of Network Services (Europe) for the airline IT company SITA, now France Telecom's Orange subsidiary. His previous experience was with Schlumberger, Telstra, and OTC (Australia).

He is an engineering graduate and winner of the university medal from the University of Queensland, and earned his Doctor of Science degree from Washington University in St. Louis in the US. He is a Fellow of the Australian Academy of Technological Sciences and Engineering, Chairman of the ARC Centre of Excellence in Engineered Quantum Systems, and holds adjunct professorships at the University of Queensland in both the School of Business and the School of Information Technology and Electrical Engineering.