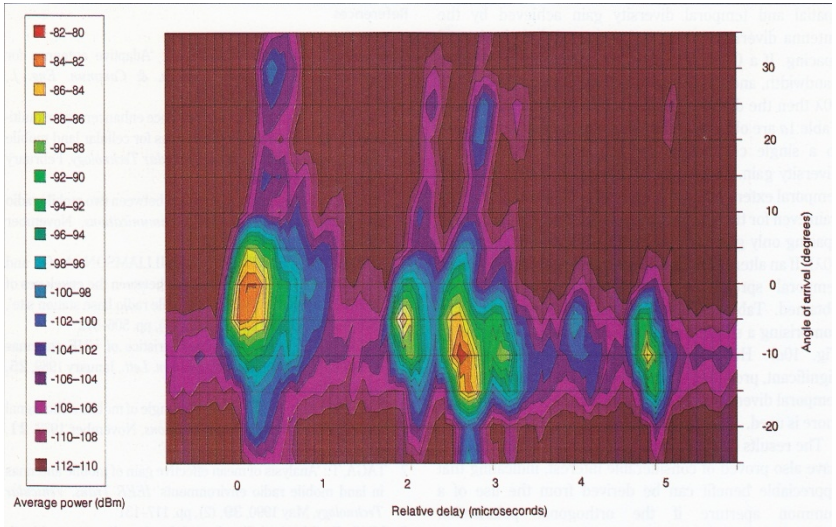
Impact on the Evolution of Cellular Wireless Technology

In the late nineties - early two thousands, Radio Technology was engaged in such programmes as advanced military communications & processing, numerous antenna developments, air-interface design for Nortel's satellite business, Powerline Communications , and wireless technology evolution for Nortel's cellular business. Described below, are some key technology landmarks achieved by the group in relation to the evolution of cellular wireless technology. These successes were hinged on the integration of expertise in wireless systems , antennas, propagation and (smart) signal processing.

Mobile phone operators must always strive to improve their service quality/reliability while complying with standards and constraints. Of key importance is maximising system capacity from a limited spectral resource and of course minimising capital and operating costs. **Smart antenna technology, borne from our military foundations, has proven to be a pivotal factor in the evolution of mobile phone networks in addressing the desired operator goals.**

Characterising the Propagation Channel

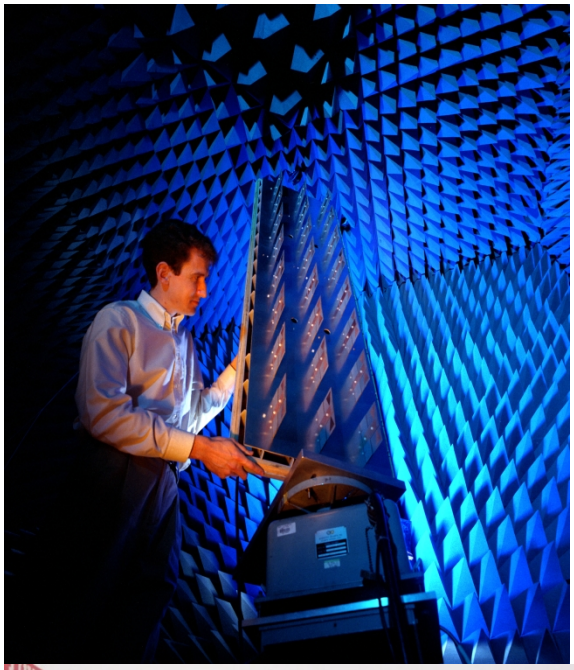


In order to quantify the potential practical benefits of smart antenna processing in mobile networks, one must first understand the underlying propagation channel. Hitherto information in this area was extremely sparse.

To the left is an example of the composite signal environment emanating from a single pure transmission. The data was collected in the field using Radio Technology's bespoke built aperture analyser. Received signal power is coded with colour versus signal delay horizontally and angle of arrival vertically. Measurements were captured at 1800 MHz.

Multi Beam Technology Trial

Increased understanding of the complex propagation channel allowed us to propose and simulate several system variants offering improved performance and cost trade-offs.



In 1998 we decided that it was vital to translate smart antenna simulations and predictions into irrefutable live network performance that would stand-up to the scrutiny of Nortel's customers. A new multiple beam antenna system was integrated into Cellcom's IS136 TDMA network in an extremely busy cell-site in downtown Haifa, Israel. An extended duration high tech trial, thousands of miles from home, in a live customer network is not an easy option – the team was really challenged.

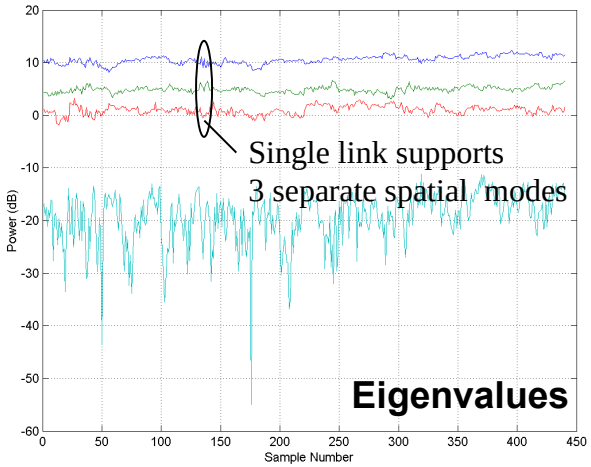
To the left, the multi-beam antenna is characterised in the Harlow anechoic antenna chamber by David Adams. Further below, the installed antenna aperture can be seen amongst the general installation atop of the central building.

Specialised proving trials were conducted around the Haifa site. Following these, a dedicated 3 week trial was conducted where the new system supported all customer traffic.

This trial constituted a world first demonstration of multi beam technology within a live IS136 network. Critically the live trial confirmed a 3dB improvement of Carrier to Interference ratio for both forward and reverse links while maintaining handover and dropped call performance.

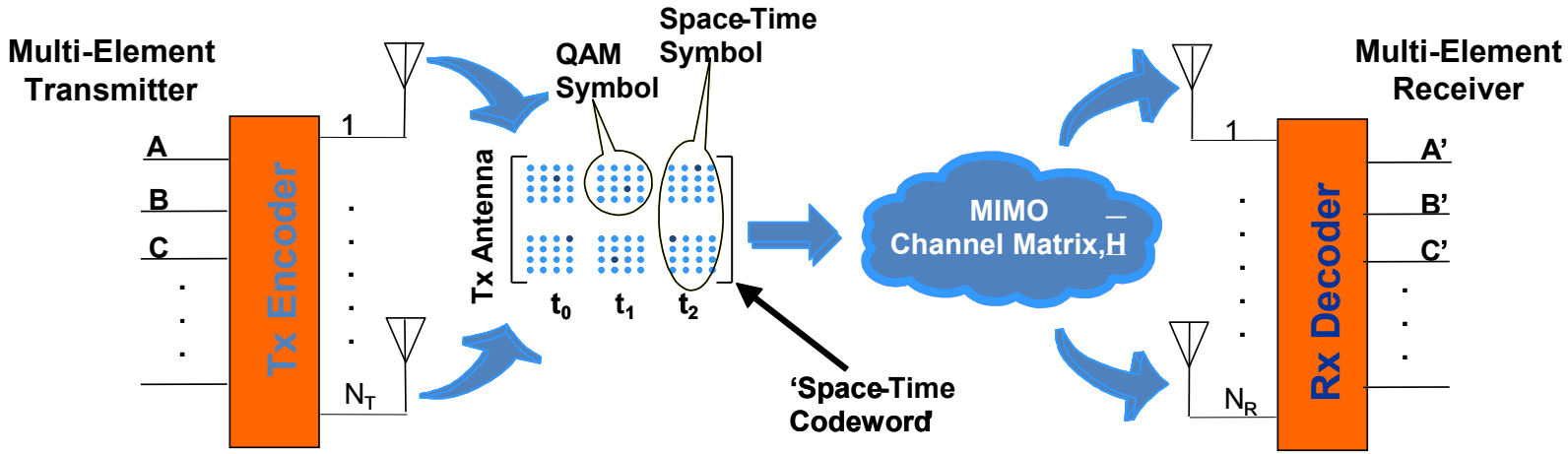
Space Time Coding Prototype - Background

The next major step towards higher performance/capacity systems was to employ multiple antennas at both transmit and receive ends of the link in conjunction with advanced information coding – so called multiple input, multiple output (MIMO) systems. **This coding in both Space and Time allows the system to capitalise on the various diversity benefits that are implicitly made available by the complex nature of the channel.**



Specific MIMO propagation trials were conducted to characterise this MIMO channel in practical environments and thus form a basis for system simulation - an eigenvalue decomposition reveals the distinct spatial modes supported by the channel.

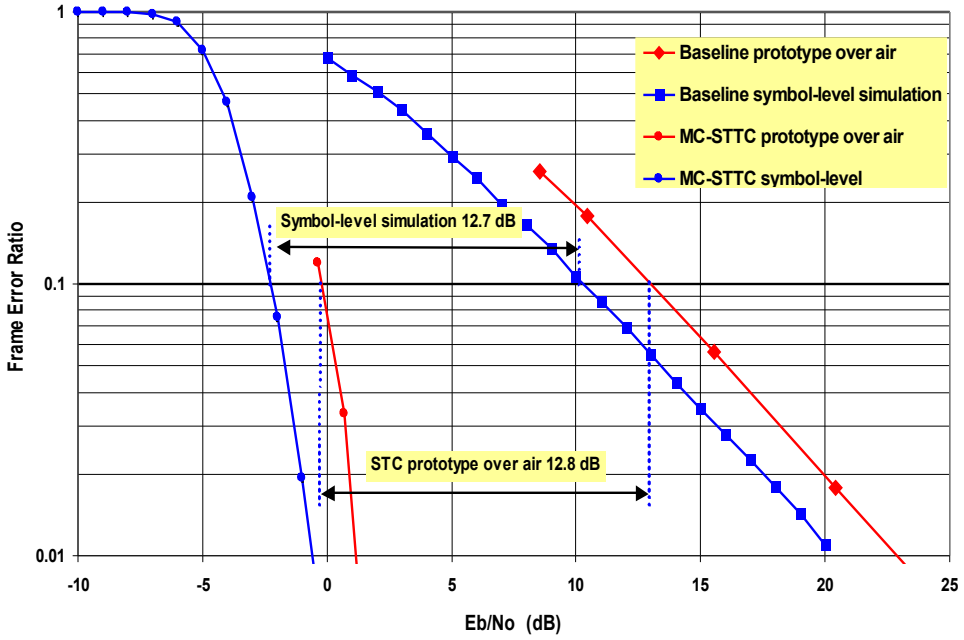
An eigenvalue decomposition for an example channel is shown to the left. The essential architecture of the MIMO system is indicated below.



Space Time Coding Prototype – Performance

A joint team operating across Al Javed's Wireless Technology Labs in Harlow and Ottawa put together a STC Prototype in order to confirm 'over the air' performance while employing a 'real air interface format' – 1xRTT.

Over-the-air trials confirmed that 4:4 MIMO mode achieved near-theoretical 12.8dB performance gain over Baseline 1xRTT mode.



World first live air demonstration of MIMO for cellular wireless (2001)

Of key importance is the fact that these and other Harlow Wireless Technologies have not been dissipated and lost. The core wireless team from Harlow now operates under the leadership of Andy Jeffries for AceAxis Wireless Technology Lab* and this group continues to register important wireless technology landmarks and product developments.

* Part of Ace Technologies Corp. - Korea