RTT TECHNOLOGY TOPIC
January 2010

From steam to silicon – the economics of global connectivity

This is the last in our short series of Technology Topics in which we draw on the archives and artefacts of the Science Museum from the steam to the silicon age to provide us with reference points that suggest how the mobile phone industry might evolve in the future.

The Flight Gallery and Making the Modern World Galleries were made available for **Cellular 25**, an event held on the 21st January to mark the 25th anniversary of the cellular industry in the UK and the 100th anniversary of the museum.

The afternoon conference and evening dinner were held in the Flight Gallery.

The presentations made at the event are available **here**

Photographs taken at the event are available **here**

At first glance the relationship between aviation and telecommunications might seem tenuous but in practice both industries can trace their origins back to the last years of the 18th century immediately before and during the French revolution, Joseph and Etienne Montgolfier's first successful **hot air balloon flights in 1783** and the first hydrogen balloon flights two weeks later, also in France, coincided with the first practical demonstration of a semaphore system by Claude Chappe.

Steam is not generally considered to have played a major part in aviation history but in 1852 **Henri Giffard** was the first person to successfully fly a steam driven dirigible from Paris to Trappes, 17 miles away.

Forty years later **Clement Ader's steam driven flying machine** was the first aeroplane in the world to take off under its own power from level ground.

Models or full scale replicas of all these flying machines are on display in the Flight Gallery along side a full size replica of **Orville and Wilbur Wright's first aeroplane** flown in 1903.

Original aircraft include the Vimy used by **John Alcock and Arthur Brown** in the first non stop crossing of the Atlantic in June 1919, the Gypsy Moth used by **Amy Johnson** on her flight to Australia in 1930 the **Supermarine Seaplane**, Winner of the Schneider Trophy in 1931, Britain's first successful jet aircraft, the **Gloster E28/39** May 1941 and the **Hawker P.1127 VSTOL Experimental Aircraft,** the first prototype to achieve vertical take-off in 1960, the year in which Charles Kao and George Hockham proposed a way of making low loss **optical fibre.**

Connectivity broadly defined and more stuff on steam

In last months technology Topic we discussed the difference between computing engines and connection engines – telecommunication networks are connection engines but so are railways and the electricity grid, gas, water systems and transport systems including aviation.

Transport and water systems have to be efficient in the way that they use power, electricity and gas grids have to be efficient at moving power around, water systems have to be efficient at moving water around.

Telecommunication networks have to use power efficiently but their added value is based historically on the value created from moving information around in various formats, data, voice and video. Future value is likely to be increasingly realised from the improvements in social, economic, environmental and intellectual efficiency that can be realised from personal broadband access and related efficiency and environmental gains achieved from machine to nachine connectivity.

To put this in historical context, at the end of the 18th century James Watt and Matthew Boulton realised that the secret to extracting power efficiently from steam was to improve the accuracy and tolerances of the moving parts used in the engines and then to set up production methods that could reproduce the engines on an industrial scale including small engines that could be used in small workshops

The power was then used to drive the cotton mills of Lancashire, the economic genesis for the industrial revolution.

Thirty years later Robert Stephenson applied the same principles to the steam locomotive, introducing a multi-tubular boiler to improve the heat transfer from the firebox gases into the boiler water; the 'blast pipe' which used the steam exhaust to improve the air draught through the firebox; and direct coupling, by connecting rods, from the pistons to the driving wheels, the basic building blocks used in **the steam engines still being built today**.

Steam didn't have the impact on aviation that it might have done though it did transform the economics of terrestrial and maritime transport but whatever the source of their power, all transport systems add value by moving people and materials around faster and more efficiently than other methods. Railway and aviation and maritime transport networks are financially successful if the added value created exceeds the indirect and direct cost of delivery. This is not always achieved.

Mobility adds value as long as the cost does not exceed the value created.

Mobile phone networks move photons and electrons around rather than things and people but the economic principles are similar. The added value created must exceed the direct and indirect cost of delivery.

But mobile phone networks don't just move photons and electrons around they also capture, store and provide access to information. Information can acquire additional value when combined with knowledge of position, location and context.

As we have said in previous Technology Topics, first generation cellular phones allowed us to talk to one another, second generation (so called smart phones) aspired to make us more efficient, third generation phones help us to interact with the physical world around us. Fourth generation phones with integrated sensing and an ability via the network to remotely measure and manage energy use and carbon consumption may make this interaction more environmentally efficient.

There is nothing particularly clever of surprising about this. The changing form factor and functionality of mobile phones and mobile networks can be directly linked to component innovation - the transistor in the 1950,s the integrated circuit in the 1960's, the microcontroller in the 1970's, the DSP in the 1980's, fast memory in the 1990's and in the last ten years touch screen displays, imaging sensors, satellite geo location and MEMS based position sensing have each in turn transformed the user experience and user realisable value.

If this is true then we should be able to predict the future with significant accuracy given that we have relatively good visibility to developments in materials and manufacturing processes and performance metrics such as energy efficiency and power budgets at least over a period of ten years or so. The future of an industry is predictable providing the past is analysed in sufficient depth and detail.

Why prediction is not always as easy as it should be
We are not short of detail – we work in an industry that is closely recorded. So the question might be why are we not better at predicting the future? The problem we would suggest lies in the analysis methodology.

Analysis is the process by which we revisit the past in order to predict the future.

It could be argued that predicting the future ten years forward in our industry is pretentious and pointless but this would be missing the point.

The purpose of prediction is to provide a reference point. The difference between a prediction and what actually happened provides us with insight in to what will happen next.

So for example the **RTT technology topic ten years ago** today suggested that the industry was faced with a significant over supply of spectrum and that this implied that delivery bandwidth should decrease rather than increase in value. In parallel we suggested that future profits would be based on memory bandwidth rather than delivery bandwidth.

The prediction proved accurate up to a point. The industry today has more spectrum than it can use and has had to write down much of the investment made in the noughtie auction era.

Essentially there is a Safe Absorption Rate at which spectrum can be introduced to the market. Over the past ten years the industry has tried to absorb spectrum at a faster rate than it can afford.

Affordability is determined by price and cost. The price paid for spectrum has been too high. The combination of spectral cost, infrastructure cost and network running cost has resulted in a negative return on investment. The same thing happened to the railways in the 1840,s
http://en.wikipedia.org/wiki/Railway_Mania
The aviation industry similarly can be pretty effective at absorbing money faster than it makes it.

In the telecommunications industry the justification for spectral investment was based on a belief that technology would deliver a step function improvement in delivery bandwidth efficiency and that this would translate directly into increased profitability.

This was a false assumption. This is important because it tells us that new network technologies in our industry do not result in any significant cost or performance efficiency improvements.

New network technologies can deliver increased profitability but the profitability comes from new services not from cost efficiency savings.

So in practice delivery costs have increased not decreased over the past ten years. Even if network investments had delivered an efficiency gain these gains would have been dwarfed by the escalating price of spectrum.

Delivery costs have not decreased but memory costs have halved more or less on an annual basis.

Memory value, the money made from the services that memory supports have also increased but not all of that value has been captured by the telecoms industry though some of it has. SMS is a memory bandwidth based service, picture and video messaging is a memory bandwidth based service, positioning is a memory bandwidth based service.

The telecommunications industry however failed to capitalize on the fastest growth opportunity of the decade - the exponential expansion of the World Wide Web and the value realisable from the search engines that made the web accessible and useful.

So we were sort of right with the memory bandwidth prediction but missed where the value would fall.

So the past is the past, what of the future?

We would suggest that the telecommunications industry is at a point where it can reinvent itself by broadening the definition of a network.

Technology with a social, economic and environmental purpose applied to social networks, business networks, and energy networks, environmental and educational networks (networks that make us more intellectually efficient).

We return to this subject in next month's technology topic 'Lost in the Cloud, The Wisdom of the Cloud?' in which we analyse the merits and demerits of Cloud computing in terms of information distribution efficiency.

About RTT Technology Topics

RTT Technology Topics reflect areas of research that we are presently working on.

We aim to introduce new terminology and new ideas to clarify present and future technology and business issues.

Do pass these Technology Topics on to your colleagues, encourage them to join our Push List and respond with comments.

Contact RTT

RTT, the Shosteck Group and The Mobile World are presently working on a number of research and forecasting projects in the cellular, two way radio, satellite and broadcasting industry.

If you would like more information on this work then please contact

geoff@rttonline.com
00 44 208 744 3163