



RTT TECHNOLOGY TOPIC May 2016

5G Vertical Markets

The 5G Public Private Partnership (5GPPP) have produced white papers on four potential vertical markets.

- [5G-PPP White Paper on eHealth Vertical Sector](#)
- [5G-PPP White Paper on Factories-of-the-Future Vertical Sector](#)
- [5G-PPP White Paper on Energy Vertical Sector](#)
- [5G-PPP White Paper on Automotive Vertical Sector](#)

5G PPP is an EU initiative set up to represent industry manufacturers, telecommunications operators and service providers and to *'deliver solutions, architectures, technologies and standards for the ubiquitous next generation communication infrastructures of the coming decade'*

The papers make an important contribution to the debate about the viability of 5G investment but reflect a European view of the future.

In this month's technology topic we review the underlying **global** demographic trends that are shaping our industry today and will likely determine where mobile broadband money will be made and lost over the next twenty to thirty years.

In particular, we highlight country to country differences and regional differences in vertical market requirements and the impact this has on market risk and cost.

Read on

It has been 80 years since the publication of Keynes General Theory of Employment Interest and Money. Keynes made the point that efficient markets are not necessarily effective. They do not achieve the results they were intended to achieve.

Keynes identified stagflation as the biggest potential economic challenge of developed economies. Japan provides a contemporary example. Japan's population is forecast to decline from 127 million to 87 million by 2050 by which time 40% of the population will be over 65. The consequence of this is that debt per head is increasing and will continue to increase faster than GDP. Japan only survives economically because Japanese individuals lend to the government at negative interest rates. Kenya by comparison has a labour force that will triple from 18 million to 48 million by 2050.

Over the next thirty years, 5G economic sustainability and 5G vertical market value will be determined by demographic changes, specifically the global redistribution of personal income and assets, country income and assets, regional income and assets and corporate income and assets.

Vertical market value is also determined by country specific technology and market requirements, regulatory regimes and competition policy which together frustrate global market scale and introduce additional market risk and cost.

5G vertical markets including the automotive market, energy market, health, factories and media and entertainment are therefore hugely different on a country by country and regional basis and it is essential to accommodate these differences in all aspects of 5G technical and commercial product and service design and economic modelling.

Regional and country specific differences in income and asset distribution – the impact of demographic dividends on 5G vertical market requirements and market value

A report released in July 2015 by the United Nations projected the global population rising to more than 9.7 billion by 2050, up from just over 7.3 billion today. Today more than one billion people live in Africa, a population that has doubled in size in less than thirty years and likely to more than double in size again over the next thirty years, a growth equivalent to the current population of China. By 2050, 1 in 4 of the global population will be African. Asia will add another 900 million people.

Nine countries are expected to account for half of the world's population growth and they are almost all in Africa or Asia: India, Nigeria, Pakistan, Democratic Republic of the Congo, Ethiopia, Tanzania, Indonesia and Uganda.

Due partly to the legacy of the one child per family policy in China, India will enjoy a demographic dividend over China. The Indian population will catch up with China within a decade; India has a labour force growing at 1.7% per annum and a rate of investment equivalent to 38% of GDP and is benefiting from lower oil prices (helping to reduce double digit consumer inflation).

In contrast, the UK represents 1% of the world's population and accounts for 2% of the global economy highlighting the absurdity of the present Brexit campaign led by politicians who apparently consider that Britain is still a globally important colonial power.

Over 4 billion people remain off line. Fixed broadband penetration in Africa is less than 1%. Mobile broadband penetration in Africa is below 20% compared to more than 80% in Europe. 600 million people in Africa have no access to mains electricity or clean water.

Personal income and personal asset distribution

An Oxfam/Credit Suisse study published in January this year suggested that by the end of this year, the wealthiest 1 per cent of the population will own more than 50% of the world's wealth. The \$1.9 trillion of wealth owned by the 80 top billionaires is equal to the bottom 50% of the rest of the world.

Equally significantly, savings often flow out of the host country. A decade ago, personal annual savings in China were in the region of one trillion dollars. Annual savings in China today are of the order of \$5 trillion dollars compared with \$3 trillion dollars in the USA. This at least partially explains why the last decade has been characterized by capital flows from savings rich emerging economies to highly indebted developed economies. \$4 trillion dollars of Chinese foreign currency has moved into US treasury bonds and other foreign currency assets and Chinese savers and companies could potentially own a much higher proportion of the world economy than do their US equivalents today.

Counter intuitively this means that vertical markets relying on infrastructure investment, for example roads, railways, hospitals and utility grids in developed economies, are largely financed by capital flows from developing economies. This is predicated on the assumption that there is more spending power in developed economies with spending power effectively determined by national and regional GDP. More spending power theoretically translates into higher investment returns.

Exchange rates theoretically reflect and balance out these changes in regional and country asset distribution at least for countries retaining control of their sovereign currency.

But this traditional model begins to unravel as developed economy markets become saturated. Mobile broadband ARPU provides an example particularly when analysed on the basis of traffic throughput. The assumption is that as bit rates increase, revenues should increase faster than

costs but this is not universally observable. Even in developed markets where ARPU has remained relatively high, the US for example, there must be some doubt as to whether this is sustainable in the longer term.

Inherently all developed economies have the problem of a decline in numbers of people working both in actual and relative terms. Developing economies are mostly heading in the opposite and potentially more positive direction.

At a minimum this suggests that vertical market value in developed economies over the next ten to 30 years will increase at a slower rate than vertical market value in developing economies. This shift would accelerate dramatically if asset flows reversed and started to flow back to developing economies.

The developing economies that would grow the fastest are the countries with the most equal income and policies that emphasize health, literacy and female empowerment. Our December technology topic referenced Tanzania as an example. These countries are also the most politically stable.

National GDP is therefore a poor indicator of potential vertical market value and needs to be qualified by a combination of other factors including capital inflows and outflows and country specific political attitudes to investment and investment return and social capital. State enterprises account for 60% of the Chinese stock market and the Chinese state is the biggest shareholder in almost all the top 150 biggest Chinese companies. Some of these companies are large, successful and growing rapidly. Huawei (a privately held company) achieved over \$60 billion turnover last year and posted profits of \$5.5 billion. Tanzania by comparison has a GDP of \$50 billion.

Corporate income and corporate asset distribution and the impact on vertical market value

The four US companies Google, Apple, Facebook, and Amazon, known as the GAFAM quartet, have a combined turnover equivalent to the GDP of Denmark (\$340 billion dollars). Apple has a cash reserve of \$200 billion dollars; Google has a \$70 billion cash reserve. Their combined turnover is equivalent to the combined GDP of Kenya, Sudan, Ethiopia and Tanzania.

All four companies have multiple touch points with telecommunications. Google have their Loon sub space project and significant investment in self-driving cars. Facebook have their low cost internet connectivity project and a joint project with Eutelsat to bring broadband internet to Sub Sahara Africa. Apple dominates the smart phone and apps business by value and Amazon want to deliver parcels using radio controlled unmanned aerial vehicles.

All four companies are therefore potentially in a position to influence and facilitate 5G vertical markets including emerging economy markets and perhaps equally important, can afford to invest \$20 or \$30 billion dollars on a 5G physical layer with a minimal impact on their existing cash reserves.

Regional and country specific differences in vertical market value

The definition of the physical layer is however also influenced by regional and country specific vertical market requirements. Denmark has the 32nd largest GDP in the world and the world's lowest level of income inequality. It is politically stable but has the highest consumption of anti-depressant drugs by volume and value in Europe and a higher suicide rate than the UK.

Denmark therefore has significant healthcare costs as does Europe in general with health care spending presently running at 10% of GDP. Africa has 20 times less health professionals per 100,000 people and the average distance between a person and a medical centre is five miles. 70 million people in China suffer from chronic obstructive pulmonary disease (COPD) and/or asthma though whether the Chinese government is incentivised to mitigate this is open to question.

So while ultimately we all tend to die of similar diseases, treatment cost and treatment methodologies and motivation vary widely from country to country. The regulatory environment can also vary substantially and products and services have to comply with country specific standards including health and safety and medical electronics safety and EMC standards. All of these slow market adoption.

One of the more intriguing examples is the automotive market. As with the eHealth market this is identified by 5GPPP as a critical enabling market, underwriting the future sustainability of 5G network investment.

There are over one million road deaths per year globally. The automotive market is dominated by a small number of very large companies who all have large R and D budgets. VW as an example spend \$12 billion dollars per year on research.

There are 35,000 fatal frontal accidents in Germany every year. This equates to 3.94 deaths per 100,000. Every death avoided can be calculated as 5G connectivity value. Iran by comparison tops the table of emerging economies with hazardous driving habits with 44 deaths per year per 100,000. There is therefore theoretically more vertical market value for 5G based collision avoidance in Iran than Germany though there are alternative options, more driving lessons for Iranians for example. The Germans could equally easily reduce their fatality rate to UK levels (less than three deaths per 100,000) by introducing speed limits on the autobahn.

Practical impact on 5G device and service design

So it becomes apparent that any specific vertical market is not actually one market with one set of requirements but a range of country and regionally specific markets with country and regionally specific requirements realising added value in a range of different ways.

This adds complexity and cost and risk to the specification process and frustrates global market scale. There is also an issue that all of these markets require a low cost entry level range of products and services to get technology adoption started.

A comment recently from AT&T suggested that an LTE device price of \$5 dollars would be needed to unlock LTE IOT market opportunities. The present device cost is of the order of \$25 dollars. This is at least partly explained by the non-recurring engineering cost associated with developing user devices for each generation of cellular radio, a cost that has increased by an order of magnitude for each new physical layer. Assuming this cost continues to increase, the implied investment risk of bringing a 5G smart phone or IOT or MTC device to market will be of the order of \$20 to \$30 billion dollars. This level of investment could only feasibly be recovered from an extended global market which would need to include emerging economy markets.

The problem is that this development cost has to be recovered through product sales and royalty payments. Intel recently calculated that royalty payments on a \$400 Android or Windows smart phone were of the order of \$120 dollars almost equal to the component cost, with the two largest items being the cellular baseband and Wi-Fi chip each costing about \$50 dollars in royalty payments.

It is hard to see how 5G vertical markets, particularly 5G vertical markets in emerging economies can be developed from this existing 4G cost base let alone a higher cost base incurred to recover 5G development costs. Equally it is hard to see how developed economy vertical markets on their own can deliver sufficient added value.

For certain it is wise to be cautious about technology adoption rates in all vertical markets, a product of market fragmentation, regulatory and standards barriers and risk adverse customers. Vertical markets can potentially realise exceptional added value but unlocking that value will be a prolonged and expensive process.

Ends

Learn more about these topics - two new resources for 5G engineering, marketing and policy teams

5G STUDY - 5G and its vertical markets: challenges and opportunities 2015-2030

Co-authored by Geoff Varrall, published and researched by Policy Tracker.

Based on in depth interviews and online surveys with over 40 industry professionals and covering 50 companies, the study analyses the costs and opportunities of 5G vertical markets and their relative value. The 5G business model depends on increasing speed, decreasing latency and dealing with massively increased network density. Which of these is the most challenging and how will that affect deployment?

£999 + VAT for up to five users within a single organisation.

[Order a copy here](#)

5G BOOK – 5G Spectrum and Standards – Geoff Varrall

published by Artech House, available for pre order.

The spectrum, band plan and standards choices for 5G radio systems and the relative technology and economic impact of these choices on the industry supply chain, operator community and end users.

£117.00 available to pre-order at a discounted price of £87.00

[Order a copy here](#)

Geoff Varrall is also presenting two ninety minute modules on the final day of the Policy Tracker 5 day Training Course [Understanding Modern Spectrum Management](#) at *Harris Manchester College, Oxford (September 19- 23 2016)* – to book a place follow the link

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[RTT](#), [Policy Tracker](#) and [The Mobile World](#) are presently working on a number of research and forecasting projects in the mobile broadband, two way radio, satellite and broadcasting industry.

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