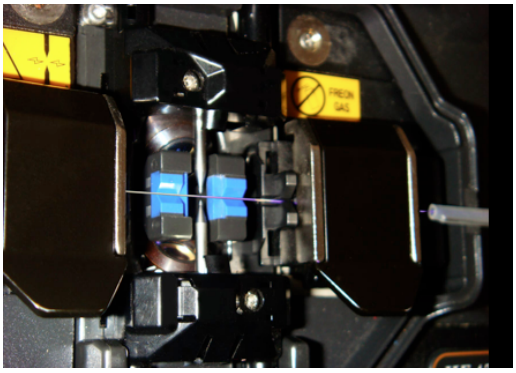
Smart Alternatives



http://www.next-up.org/Newsoftheworld/OpticalFibre.php

Smart Grids

The classification of RF/microwave radiation as a Class 2B carcinogen (WHO/IARC 2011) taken alongside the recommendation the Parliamentary Assembly of the Council of Europe (PACE 2011) that electromagnetic emissions should be "*as low as reasonably achievable*" (ALARA) – *a call similar to that of the BioInitiative Working Group* (2007) - create strategic challenges for smart grid infrastructures.

"*Wireless is not necessary - just cheaper and easier to implement*", Powerwatch (2010).

Not all smart grids are wireless. Some utilities companies have already opted for fibre-optic cabling for their primary communication needs. Others have opted for Power Line Communications (PLC), or use it as a backup channel or for simple installations they consider do not merit the installation costs of fibre-optics.

Practicality of Fibre-optics

The high up-front costs of smart grids present financial challenges (*as do those of broadband projects*). Whilst utility companies use only a small amount of the broadband capacity that they put in to support smart grid applications, a strong case can be given for investing in that capacity to increase revenue potential, particularly if they choose to do so in an environmentally-friendly manner.

As proposed by Kennedy (2011), if utilities were to lease very high bandwidth '*future friendly*' fibre-optic capacity to providers of general broadband services; they, the general broadband providers, and their customers would all benefit. This would allow more broadband projects to become economically viable and lower prices for broadband customers – a true 'Win/Win' situation.

Additionally, in situations where fibre-optics have already been put in by broadband providers, they could lease bandwidth to the utilities and avoid the need for wireless Smart Meter connections.

The ruggedness of fibre-optic cables can provide tremendous benefits over their competitors. They are very secure, non-corroding, immune to water damage, electromagnetic and radiofrequency interference, difficult to damage (when in steel armoured cables or in underground conduit), and are more reliable than their competitors during poor weather and catastrophic events. They also have longer service lives – *fifty years plus* - and lower maintenance costs (Kennedy 2011, Fehrenbacher 2009).

With longer service lives, lower maintenance costs, additional potential revenue streams, extra bandwidth for future requirements, and a greater degree of ruggedness than their competitors; fibre-optics can bring tremendous benefits to smart grids and utilities companies over their competitors.

Whilst the costs of fibre-optic and copper cables are similar at present, the price of copper cabling is likely to become more expensive, particularly as networking requires faster speeds and greater bandwidths.

As noted by Fehrenbacher (2009), "*Some cities ... have decided to build out their own [fibre-optic] networks, largely to use it as a way to boost economic prosperity in their regions, delivering jobs and high-speed connections for businesses.*"

Fibre-optics case study

The Electric Power Board (EPB) utility company is presently installing a 100% fibre-optic network for smart grid applications for Chattanooga, Tennessee, USA, using specially designed fibre-connected (and wireless-enabled) Smart Meters (Baker 2011, Fehrenbacher 2009). The network also provides Internet, telephone and video capacity.

According to Fehrenbacher (2009), EPB claim that building out their $200 million fibre-optic network (*with the help of a DOE ARRA stimulus grant for $111.5 million to accelerate the project*) will create almost $850 million in added value from both communications and smart grid services for the city (*including new jobs and energy savings*).

It is predicted that for business, its time-of-use (TOU) rate program will save the 22 manufacturers that have already signed up to it $2.3 million [£1.44 million] annually (Baker 2011).

The creation of their fibre-optics infrastructure has already led to Chattanooga attracting new business (the new North American manufacturing headquarters for Volkswagen and an Amazon distribution plant).

As a result of its utilisation of fibre-optics Chattanooga is now ranked as one of the World's top seven Intelligent Communities (ICF 2011). No UK communities are presently listed in this ranking.

Chattanooga's ranking was in part achieved as a result of its fully-accessible fibre-optic one gigabit residential Internet service being "*200 times faster than the current [US] national average and ten times faster than the FCC's National Broadband Plan (a decade ahead of schedule),*" (Baker 2011).

"Our 100% fiber-optic network will serve as a platform for accelerated innovation, job creation and deep creativity while serving as the backbone for the next generation of energy efficiency. All in all, with this infrastructure, we can't even imagine today what will be possible in the future – but we will be ready." David Wade, EPB's Executive Vice President and Chief Operating Officer (Baker 2011).

A fibre-optic network is also being built for Opelika, Alabama, USA. It is planned that the city's public power utility will use the network for smart-grid services and a private company be contracted to deliver triple-play services (Christopher 2010).

The UK seeks to have the best Superfast Broadband Network in Europe by 2015 – *perhaps fibre-optics will contribute to this?*

Investment returns in France

Fibre-optics are additionally being used for the 25 year European Union supported €123 million digital development project by the Syndicat mixte Ardèche Drôme Numérique public body (created by the Conseil général de l'Ardèche, Conseil général de la Drôme and Région Rhône-Alpes in France).

Its fibre-optic network provides ultra-high speed broadband connection (100 Mbps), for a population of about a million people, with neither signal loss over distance nor creation of electromagnetic fields.

Estimated returns on investment (*non-binding*)

The total cost of the project cost is €123 million. The outlays from different parties are as follows: ADTIM (a subsidiary of Axione / Eiffage / ETDE / ETDE Investment) €73 million; the General Council of Ardèche €10 million; the General Council of the Drôme €10 million; Rhone-Alpes €20 million; and the European Union through the ERDF €10 million.

There are 372,000 homes in the area. If a minimum of 27% of these opt for the 'triple play' service (Internet, telephone and television) offer at €20 per month, the annual turnover will be 100,440 x 20 x 12 = €24,105,600 ($32,883,900).

As the basic outlay by ADTIM is €73 million ($99,564,312), the gross return on its investment would be met in approximately 3 years. Going by the minimum estimate, the company should be making a clear profit margin in year 5 or 6 (Next-up 2010).

As the fibre-optic network's extensive installation is indicated as creating a substantial short-term profit for both public and private investors - *even under difficult circumstances* - and is able to do so without creating environmental risks; it is proposed that similar schemes should be undertaken in the UK, and elsewhere, incorporating smart grid connections.

"*Considering the developments in technology and in economic matters … and in view of the fears expressed by some … concerning the effects of intense radio waves, the committee … has decided to modify its strategy for providing this service for those areas not yet covered. As a result no new wi-fi or wi-max antennas will be used …*"
Didier Guillaume, President of Conseil Général de la Drôme and Senator of the Upper House of the Parliament of France.

"*I am keenly aware of the need to keep in mind the potential health risks linked to radiation, I give my full backing to this decision, which bears out the wish of the General Council to limit the sources of intense radio wave emission,*" (Guillaume 2009).

Fibre-optics use in other countries

At present fibre-optics have been adopted in part for Smart Metering purposes areas in Canada and the USA (SMPM 2011).

Fibre-optics networks present a more secure, cost-effective, alternative to wireless Smart Meters. They are also more biologically friendly and 'future proofed' than wireless options.

" …when you add a demand for reliability and resiliency (as well as a technology that doesn't conduct electricity) to the trends already highlighted, fiber offers a exemplary conduit for the intelligence, two-way communications, and control and monitoring capabilities smart grid applications demand." (Hardy 2010).

Fibre-optics is the smarter environmentally friendly alternative to adopt for general rollouts to gain public acceptance and attract investment.

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Power Line Communications (PLC/'Linky'/BPL)

This is also known as Broadband over Power Line (BPL), 'Linky', Power Line Access (PLA) and Power Line Telecommunication / Technology / Transmission (PLT).

PLC frequencies

• 20-200 kHz frequencies used for home-control PLC devices.
• 100-200 kHz low-frequency carriers on high voltage power lines.
• 15-500 kHz low speed narrow-band. Utility usage including meter reading used for telemetry on high voltage power lines. May be used for meters, domestic appliances and switches.
• 9-500 kHz medium speed narrow-band. Used for home automation. Typically utilise carrier wave in 20-200 kHz range on household wiring. Can be used for automatic meter reading (AMR).
• ≥1 MHz high-frequency. HLAN and broadband over power lines (BPL). PLC modems transmit in the 1.6-80 MHz region. System expected to operate in the 10-30 MHz region.
• ≥100 MHz ultra-high-frequency (E-Line technology). It can operate anywhere in the 20 MHz – 20 GHz region.

Utility companies use PLC operating in the 24-500 kHz range (Wikipedia 2011).

PLC Effects on shortwave broadcasting

Whilst low speed PLC (below 150 kHz) present no apparent problems - *in terms of causing radiowave interference with broadcasting* - High speed Power Line Communications (HS-PLCs) can and do reduce the effective deployment range of broadcasting to different countries unless transmitter power output levels are substantially increased (Marshall 2010).

"*There is strong evidence that the wide deployment of high-speed [PLC] will seriously impact radio communication. If we allow this to happen we sacrifice a proven long-distance universally accessible technology of considerable commercial and social importance for what can only be described as a short-term gain in convenience for local data networks*." Richard Marshall*

*Managing Director and Principal Consultant of the RF and EMC-related electronic design, consultancy & training firm Richard Marshall Limited.

Effects on power usage for broadcasting

The increased use of High speed Power Line Communication (HS-PLC) for Smart Meters may create unforeseen demands in the energy usage of shortwave broadcasters worldwide.

Marshall (2010) predicts that in order to match these additional power requirements worldwide "*Each year this would require the installation of a further electrical generation resource equivalent to some 30,000 wind turbines*!"

Aircraft communications are particularly at risk of receiving interference from PLC (Marshall 2010).

PLC Effects on radio astronomy

In addition to space satellites, radio astronomy laboratories on Earth investigate solar emissions from the Sun and other planets. Their effective operation is vital in predicting possible disturbances that may seriously compromise the integrity of electrical grids and other infrastructures unless sufficient warning is given. The sensitivity of the measurements taken by these laboratories is in large part determined by their 'radio-noise' environment in the High Frequency range.

Ohishi et al. (2003) calculated that to protect HF radio astronomy antenna from interference caused by a *single* PLC system, it is necessary to have a separation distance from it of 424 km. Far larger separations will be required if PLC are widely deployed.

PLC Effects on Military Communications and Intelligence

NATO in its report on the effects of HF interference on Communications and Intelligence (COMINT) suggested that (whilst having no authority itself to implement regulatory measures) it would be highly desirable for limits on PLC emissions to be harmonised throughout NATO countries. It stated it would be willing to work with national and international regulatory authorities to do so (NATO 2007).

Deployment of PLC internationally

PLC are being used in whole or part of the following countries: Argentina, Austria, Bosnia & Herzogovinia, Brazil, China, Columbia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, India, Mexico, Netherlands, Norway, Portugal, Puerto Rico, Russia, Serbia, Sweden, Spain and the USA. (Echelon 2011, SMPM 2011, ResearchAndMarkets 2010).

PLC in France

Électricité Réseau Distribution France (ERDF) manages the public distribution of electricity to over 95% of the French mainland. It is in charge of the French Smart Meter rollout through its PLC 'Linky' project (ERDF 2011, 2010). Linky is a "slave" system that receives and executes orders, and transmits reports and validated readings to minicomputers in transformer substations, which then inform the distributor's supervision centre.

It uses powerline carrier technology (using a low-voltage electric network) to exchange data and orders between wired Smart Meters and the substations' minicomputers. Its extended communication network allows those minicomputers to talk with the central information system using the telecommunications network.

According to Fontana (2010), ERDF took into account the Canadian and US experience with wireless Smart Meters when deciding to opt for wired units. They are apparently "*very conscious*" of electromagnetic problems. The effectiveness of their proposed measures has yet to be assessed.

Over 35 million wired Smart Meters are to be installed in France.

Unlike Canada and the USA, meters in France are usually located inside homes, as is the general case in the UK.

It appears that PLC will not be used *en masse* for smart grids in the UK. This is primarily due to the present risk of PLC causing significant disruption to communications equipment.

UK perspective on PLC

Resistance to PLC use in the UK has come from the BBC, Civil Aviation Authority, Electromagnetic Compatibility Industry Association and The Radio Society of Great Britain, which are all extremely concerned over the possible damage PLC "would cause" to radio broadcasting and the electromagnetic environment (EMCIA 2011, Ray 2010, RSGB 2011). A report commissioned by Ofcom additionally found that PLC devices tested failed to satisfy essential requirements of the Electromagnetic EMC directive (Smith 2008).

Effects on flora and fauna

The biological and environmental effects of radiofrequencies created by PLC do not appear to have been assessed in detail by those using or seeking to deploy it. This is an important omission that should be rectified at the earliest possible opportunity - Refer to section on '*Environmental Concerns*'.

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