



Smart Water: debating the future

arqiva

Introduction

With an increasing number of technologies now part of the smart water conversation, we look at this evolving landscape and explore where the key debate is today. The value for water companies lies in the frequency and accuracy of meter reads and the insights they provide. But, of course, the data needs to get back to be analysed. Here the quality, resilience and management of the underlying network becomes critical. While cellular technologies are certainly generating a significant amount of noise in the market, can they guarantee delivery?

Perhaps this isn't even a technology discussion at all, but rather a clash of network management approaches – between open and shared, and protected and dedicated?

With the help of industry commentators, we cut through the hype, explore the issues and uncover how best to support the delivery of the insights that are transforming the water industry today.

Contributors:

Professor William Webb, CEO of Webb Search, an independent consultancy and a Former President of the Institution of Engineering and Technology (IET)

Andrew Tucker, Water Efficiency Manager, Thames Water



Why are we having this conversation?

In 2019, Thames Water announced a £1 billion technology investment to revolutionise its water and waste operations, transform customer experience and boost efficiency over the course of its new 5-year AMP cycle. It will, according to its Chief Digital Officer, take the old and make it fit for the future by creating a digital-first water company.

Working with Arqiva, Thames Water has already deployed the largest smart water network in the world.

Thames Water isn't alone. Anglian Water's Strategic Direction Statement 2020-2045 highlights, amongst other things, its objective to digitally transform, while its revised Water Resources Management Plan (WRMP) sets out its intention to install Advanced Meter Infrastructure (AMI) as an integral part of leakage strategy and to inform and change customer behaviours (by taking 15 minute reads and making usage data available to customer via a dedicated website or portal).

Looking across the sector, we see similar statements of digital intent from all other providers.

Stepping behind the buzzwords, a 'digital' business is simply one capable of accessing and leveraging its data driven decision-making. In the water context, that can mean taking live readings from sewer depth monitoring points to prevent pollution, or changing supply-side consumption behaviours by enabling households to accurately monitor their water usage (and bills) through smart meters.

What has begun with taking hourly-read data from smart meters will evolve over time to analysing data provided by a wealth of devices including pressure loggers, noise loggers, temperature sensors, and water quality monitors. The insights generated will inform more strategic decision-making to improve operational efficiency and service quality.



Why are we having this conversation?

What is less clear, however, is how best to build out that data communications infrastructure. Not only to connect millions of homes and businesses, but all the treatment works and facilities across the water company's physical infrastructure too.



Should water companies, for example, leverage fast emerging cellular technologies from mobile networks operators (MNOs)? While these are shared networks already supporting millions of subscribers, water companies would be able to enjoy the advantage of not having to build out their own. On the other hand, emerging IoT and 5G are still in their infancy. Outages and holes in coverage are more common than one would like. And with meter traffic likely to be a tiny proportion of the data passing across these networks, water is not a core business for MNOs. Will operators be sufficiently incentivised to boost reliance or be able to commit to the kind of service level water companies need?

The other option is, of course, for water companies to continue to focus on building out their own dedicated networks. While this has been the proven route to success to date, it certainly lacks the commercial and financial flexibility of an MNO consumption model.

Ultimately, water is a uniquely long-term industry. Today's choice of data communications network could potentially impact delivery against AMP targets for decades to come. So, it's crucial they make the right choice for their business. Because digital transformation cannot work without the network.

¹ <https://corporate.thameswater.co.uk/media/News-releases/News-Release---Digital-Revolution>



Framing the debate

While there are a number of potential approaches to designing a smart water network infrastructure, water companies are chiefly looking at two main options here in the UK: the already-deployed private dedicated Arqiva approach and an NB-IoT network offering.

There are some LoRa (long range, low power) wireless platform trials that share many characteristics of NB-IoT, but these are rather more limited in both scale and number. Therefore, with Arqiva and NB-IoT the principle technology protagonists on either side of the debate, it makes sense to focus attention on these.

At this point it is worth remembering that while worldwide smart meter (electricity, gas, water) shipments are expected to pass the 1bn mark by 2021, actual deployments of smart water data communications networks are relatively limited in the UK. Indeed, only Thames Water has a large-scale

deployment of some 480,000 meters. Anglian Water is catching up, and its Newmarket pilot has resulted in impressive supply-side leakage reductions of 108,000 litres per day. Both Thames Water and Anglian Water have adopted Arqiva.

In contrast, the relative immaturity of NB-IoT means that there has yet to be any meaningful 'at-scale' trials. Activity chiefly remains at the proof of concept stage. How likely this is to change in the medium term is a matter of debate. But with MNOs focusing energy and investments on 5G deployments, the timescale could be measured in years rather than months.

It's easy, therefore, to think about the data communications discussion in terms of 'old' (Arqiva) versus 'new' (NB-IoT) or perhaps even 'open' versus 'proprietary'. But it's a much more nuanced debate than this. And such definitions aren't necessarily accurate or particularly helpful.



Framing the debate

For example, proprietary doesn't mean closed by default. While Arqiva is a propriety technology – in that it's a specific advanced smart water infrastructure – it offers the freedom to connect any number of multi-vendor devices. And not just meters, but a wide range of smart endpoints. At the same time, just because a technology is standards-based (as with NB-IoT) this doesn't always guarantee 'plug and play' openness. Integration work still needs to be done.

Plus, there's a hype cycle around new technology which may (or may not) stand up to engineering scrutiny. That's not to say that 'new' doesn't work, just that it's unproven. That shouldn't detract from NB-IoT's potential to do the job, but it may not be the panacea some have claimed if it manages to leave the lab and is deployed at real-world scale.

Added to which, it is also important to note that the smart water network debate is unavoidably technical in nature. Radio technologies are essential to get the data off devices

that are typically embedded in pavements or other hard to reach places. This brings up important issues of licensed and unlicensed radio spectrum and frequency. Which leads to discussions of network coverage, building penetration, contention (or interference) and congestion. All of which impact the effectiveness of any smart water network.

Taking the network characteristics of Arqiva and NB-IoT into account, it is perhaps more accurate to frame the discussion in terms of 'dedicated' and 'non-dedicated'. Arqiva, with its

purpose-built, private smart water network sits in the dedicated category. By contrast, NB-IoT networks are a layer on existing mobile networks so fall into the non-dedicated box.

Regardless of definition, it is important to consider the operational and commercial implications of the different approaches. Speed of roll-out matters for those water companies that have committed themselves

to delivering smart metering in their AMP cycles. And it's not just about demonstrating delivery to OFWAT.

The right financial model is crucial if water companies are to strike a balance and avoid adversely driving up costs for customers or driving down dividends for shareholders.



So, this is the debate. Is a dedicated private network that has to be built (like Arqiva) a better option than a shared, but still evolving, network they can buy into (like NB-IoT)? Let's take a look.



Exploring the key issues

As we have just touched on, the most telling difference between a dedicated and a non-dedicated data communications network is that one has to be built, the other can be consumed. There are weaknesses and advantages to both approaches.

Business models

Leaving aside the fact that an NB-IoT network has yet to be rolled out across the UK, the ability to simply 'buy' into an existing national network must be a tremendously attractive proposition. In this non-dedicated scenario, the costs of building, managing and upgrading the network are carried by the MNO. This is particularly key if major upgrades are needed – like the transition to 5G. With water companies engaged in considerable upgrade and investment programmes of their own,

the ability to get your data through a 'pay as you go' package has considerable benefits.

However, this strength can also be a weakness. Benefiting from high economies of scale – which can reduce data costs for water companies - MNO networks are naturally built to meet the needs of many different customer groups. It's a one size fits all approach that can mean technical compromises to ensure the operator's investments viable. With the relationship typically backed off to a third-party systems integrator, long-term service levels are almost impossible to guarantee. Water companies may find themselves waiting in line for the MNO to act should network issues impact the delivery of smart meter data

Dedicated smart water networks offer the opposite. Built for, and tailored

specifically to smart water use cases, the water company is in total control. The network is optimised for its intended purpose while SLAs can be agreed and maintained according to specific requirements. Plus, because water is a dedicated provider's core business, customers can rely on proactive network management and ongoing optimisation.

The downside, of course, is the potential for capital outlay at the beginning of the relationship. However, with flexible commercial terms, this can be less of an issue. Studies show that over a typical 15-year smart water network lifecycle, the costs of build and management are lower than the ongoing subscription costs of a non-dedicated network.



Exploring the key issues

Coverage and congestion

Delivering millions of meter readings is, of course, impossible without optimal network performance and predictable coverage. MNOs have built out national networks, and have vast experience delivering connectivity into both urban and rural areas.

But with rural not spots and areas of poor coverage still a fact of life in the UK, ensuring 100 percent smart meter coverage to a particular area is likely to require the roll-out of additional base station infrastructure.

The same is true should existing networks become congested – particularly in the urban areas. As we have seen through the evolution from 3G to 4G, more bandwidth

attracts more traffic. Masts become saturated and congestion becomes a major issue.

There is little evidence to suggest that the same won't happen in a 5G scenario. With MNO business models increasingly predicated on delivering (and prioritising) multi-media traffic, the low levels of water company data are likely to be deprioritised outside of peak hours.

In an electricity example, Western Power Distribution has moved from using shared cellular networks to its own dedicated network. It has done so because the saturation of masts around secondary schools has prevented data being delivered from its sub-stations at peak school hours.

For water companies, while off-peak transmission may be acceptable in a customer billing scenario, where real-time data is less relevant, the same cannot be said for water leakage, pollution identification or flood risk applications.



Exploring the key issues

To know, in real-time, is to act and head off reputational damage, regulatory action and increased costs. Plus, instant access to data enables real-time analytics – something that’s at the very heart of digital transformation. Data lost (or unavailable) due to congestion (or poor coverage) is a very real challenge that must be avoided.

The solution, of course, is to fill the not spots and eliminate congestion by densifying the network. The question is “who pays?”. Whether there are commercial incentives for MNOs to invest the time and money in building out infrastructure to support water companies – that are likely to represent no more than one percent of their business – remains an open question.

A dedicated provider, with 100 percent of its business in the water sector, has considerably more incentive to get it right – building out the network to

provide full coverage of specific areas identified by the water company, and using sophisticated planning tools to predict and ensure full meter coverage. Crucially, because of the dedicated nature of the network, only water-related data crosses it.

Not only does this dramatically reduce the potential for congestion, dedicated providers are able to use multiple channels within its frequency to, for example, carry priority data to enable valve activation in the event of pollution events or to address real-time flood risks.



Exploring the key issues

Penetration and interference

In addition to coverage and congestion, efficient and uninterrupted connectivity and data delivery across the smart water network relies on optimal levels of penetration and non-interference. This takes us from an engineering and planning discussion into one of spectrum and frequency.

A high level of signal penetration is needed due to the location of devices. Water meters, temperature sensors and noise loggers are typically situated underground, in buildings and basements. This placement downgrades the radio signal - by how much depends on the materials in the walls, pavements, etc.

The frequency of the underlying radio network can have a major impact on success here. In the UK, MNO frequencies are 800 MHz while the existing Arqiva dedicated frequency is 412 MHz.

It's generally accepted that the lower the frequency, the better the penetration. While higher frequencies can certainly provide device connectivity, this requires additional infrastructure investments. By contrast, Arqiva regularly achieves better than 99% connectivity – even in difficult to reach locations at ranges up to 5 km in urban locations and up to 20 km in rural areas.

Battery Life

Smart water networks need devices with 15-year plus battery lives. Despite advances in battery technology, lifetimes can be hard to predict without taking into account a number of variables – particularly network performance.

This is certainly true of non-dedicated networks. Here, battery performance can degrade rapidly as the network becomes congested or if connectivity to the base station is lost. This forces smart meters to 'stay awake' and

attempt to retransmit data multiple times. Should they be unable to connect, typical IoT devices are designed to 'try' up to 28 times per session. This has a considerable impact on battery life.

Much of the solution lies in the service provider's ability to control and manage the network. An efficient and optimised network, that delivers device connectivity and transmission first time, will ensure batteries last the required multi-year timeframe without needing high-cost replacement.

As we have seen, a dedicated water network allows for high levels of customisation and control – something that's more challenging in a shared network MNO environment, where competing priorities mean networks are optimised for multimedia use cases.



Charting the differences: a quick comparison

Dedicated (Arqiva)

- Networks can be tailored & optimised for water companies
- Can be optimised to achieve connectivity to the most challenging locations at the most economic cost
- Typically 'closed' to ensure capacity is available when and where needed
- SLAs can be tailored to customer's specific requirements
- Fewer external connections reduces potential vulnerabilities from cyberattacks.
- Licensed spectrum operates at higher transmit powers and maintains higher signal-to-noise ratios needed for reliable communications.
- Signal strength 10-100 times higher than unlicensed spectrum requiring fewer radio towers, and eliminating the need to for in-fill solutions to reach 'not-spots'

Non-dedicated (MNO)

- Networks are built to meet the needs of many different customer groups
- Shared networks provide high economies of scale but can mean technical compromises
- Capacity provided based on the average and peak demand of all users can compromise performance
- Network maintenance and upgrades occur at quiet times (but may coincide with peak times for water companies)
- More challenging to contract services with SLAs
- Shared networks likely to have multiple connections to the public internet – must rely on security protection and controls provided by the MNO to maintain data security
- Spectrum can be either licensed or unlicensed. Devices operating in unlicensed spectrum are restricted to low transmit powers and low duty cycles so as not to cause harmful interference



Industry opinions

Two industry experts look at the issues and share their expert perspective on the debate.

Above all, longevity is my key consideration. By Professor William Webb

This dedicated versus non-dedicated (or public versus private) debate is an important one to have. Finding the right balance is critical – as is deciding if these approaches can coexist or whether one is better than the other. It's a conversation we have seen mirrored in the energy and emergency services sectors. And it's certainly happening in the IoT space.

While the MNOs may seem to hold all the cards in terms of their national networks, I suspect that 90 percent of all IoT connections will be private networks – if for no other reason than they don't move around so don't require the kind of nationwide coverage you get with working with an MNO. And if you don't need the nationwide coverage, why pay for it? It may make more financial sense to deploy private networks in local areas.

But while low cost provision is certainly a factor – water companies are commercial enterprises after all - above all else, I would look for longevity of supply.

The last thing I want to do as a water company is put tens of thousands of smart meters into the ground, then have to change them within a few years because my communications service provider changes. I'd be forced to access every single meter,

pull it out of the ground and change the communications module. The cost would be enormous, the disruption huge and the reputational damage significant.





I would want my supplier to guarantee comms to my devices for the next 15-20 years. And maybe even sign up to a hefty penalty clause should they leave the market.

Ultimately, I'd be prepared to pay more for longevity because I believe the risk of someone pulling out over the lifetime of a smart water network is so great. While it's unlikely that a dedicated provider would – because it's their core business – I'd be less sure about an MNO simply because carrying smart meter data would be such a tiny proportion of its business, and priorities change.

A good degree of certainty of coverage is also very helpful. If I know an area isn't covered, that's OK. I just won't deploy smart meters.

However, if I install meters across Cambridge believing 100 percent of the area has good coverage, but 20 percent of my meters can't be reached, that's a problem and I've wasted time and money.

Of course, I would also like some level of reliability. If the network goes down for half an hour, that may be OK if I can get my meter reads later. But with water companies now looking to use the network for valve activation, being unable to access these values and sluice gates in the event of a flood risk, reliability suddenly becomes a major factor.

“It's very hard to tell how fast NB-IoT will roll out in the UK. The only MNO that seems actively interested is Vodafone. This is perhaps quite telling and suggests that the others don't see a market. I think that adds a level of risk in water companies focusing solely on NB-IoT at a nationwide or regional level.”



Customer perspective

It's the data and the insights that matter, says Andrew Tucker, Water Efficiency Manager, Thames Water

Ours is possibly one of the most perverse business models in the world. As a monopoly, 100 percent of people inside our geographic area are customers, and 100% of those people use our product every day. My role, along with my teams in the field, is to try to get our entire customer base using less of it.

We do it through a range of online and on-the-ground [education] programmes, and by improving the physical devices installed in homes and businesses to make our customers more aware of how much water they are using and to instil better behaviours.

For us, frequent meter reads and the insights that come from the data is a game-changer – not just for Thames Water but for the whole sector. As we're not in competition, we share all our insights. The more we have, the more we can share.

Right now we have a huge amount of actual consumption data coming through hourly from our smart meters.

It's better than any consumption information the nation currently has, and I'm using the insights it uncovers to steer a fundamental change in policy and regulation going forward.

In terms of technology, I look at it from the user's perspective. I'm less wedded to the methodologies and technology platforms that provide the route from point A to point B. But I'm hugely interested in making sure it does, in fact, get to me so I can use the insights. Therefore, security and stability delivery are critical. I simply can't afford breaks in the data.





When it comes to providing evidence to inform company or industry strategy, I can't have my data analysts making assumptions because of multiple downtimes, or periods where the data hasn't come through. Worst of all, I can't have any contractual issues that cause my data to be held back. This latter point is so significant (and can be as much a blocker as the technology) that I'd go so far as to put this statement in flashing lights.

As a result, if I have multiple technology providers in front of me and one is easier to deal with than the others, I'd go with them.

Water is an essential service. And in the UK – particularly the South – we're hugely vulnerable to water scarcity due to a lack of large storage systems, and because over 100,000 people move into our region every year.

This all means we need to be pragmatic and confident in the choices we make – after all, we're planning for the long term. This point is as relevant in selecting the right partner as it is in developing the right national strategies. It's the data and the insights that matter, and we need to look at every option to ensure we get a solution that allows us deliver against the Act of Parliament, and for the next 100 years. Sometimes, in all the debate, this can get lost.



An Arqiva perspective

Final thoughts on NB-IoT, innovation and dedicated/non-dedicated debate

As new technologies emerge, such as NB-IoT, it is natural that water companies be curious. And not just water companies. While Arqiva has invested in its dedicated infrastructure, and believe that this is the best way forward, we are constantly looking to new technologies – whether that be in the device or network space – to continue to provide the highest levels of service, and the most appropriate solutions, to meet water company needs.

NB-IoT technology itself certainly offers an interesting option, and it may form part of our own roadmap moving forward. However, echoing Professor William Webb's opinion, NB-IoT's roll-out in the UK remains in the very early stages, and Vodafone is the only tier one service provider actively pursuing a cross-sector adoption strategy. This shouldn't preclude evaluation of the technology, but it certainly raises questions about the immediacy of a real-world solution and its longevity moving forward. We also believe that NB-IoT (as it stands

today) doesn't pass the more detailed congestion, penetration and interference tests that must be applied to realise real-time and reliable delivery of data.

Of course, there's more to the debate than the technology. The business model, we believe, is the critical issue at stake. In the MNO shared network model, water companies risk being consigned to be a small part of the larger whole.



An Arqiva perspective Final thoughts on NB-IoT, innovation and dedicated/non-dedicated debate

Quite apart from the very relevant questions of commitment to the water sector, we strongly believe that the challenge of influencing either the strategic direction of, or the ability to maintain adequate control over, the network, will be damaging to the short and long-term digital objectives of water companies.

Without comprehensive area coverage, the ability to customise and optimise the network based on your needs, and the challenge of establishing a direct and meaningful relationship with the network provider, poses significant risks.

For our part, we offer an already proven alternative – having deployed the largest smart water network in the world. We are focused on helping water utilities deliver against their AMP cycle plans and operate a dedicated private network that's entirely device agnostic and places water companies in complete control. Because of this, we guarantee service levels and assurance of long-term partnerships. We can, and are, doing it all at scale today.

Join the conversation

While this paper details our own perspective built on over 10 years' experience in the smart water sector, and those of expert commentators and water companies, we certainly recognise other views in the market. We would be delighted to hear your thoughts on this key debate.

Share your thoughts here



Thank you for reading.

If you would like to find out more, let's talk.

Call [+44 \(0\)1962 823 434](tel:+44(0)1962823434)

Email enquiries@arqiva.com

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