LPWA Technologies

Unlock New IoT Market Potential

Machina Research

A White Paper prepared for the LoRa® Alliance

LoRa® Alliance

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SUMMARY & CONCLUSIONS

In essence, Low-Power, Wide-Area (LPWA) technologies complement existing cellular mobile network and short range technologies, enabling lower costs and better power consumption characteristics What that means for you very much depends on who you are, and the impact will vary for different market participants.

However, since LPWA can be a significant competitive differentiator, very few participants in any Internet of Things (IoT) market can afford to 'do nothing'. Any company that elects to 'do nothing' can expect to be outcompeted by a company that has deployed LPWA (and other IoT) technologies to the maximum extent.

A wide range of players and alternative technologies are already engaged in the LPWA space. The most fundamental differences between these technology types includes the radio spectrum that the technologies use (licensed vs license exempt) and the commercial strategies of the companies that deploy them.

Clearly the LPWA space is a priority for the mobile industry, and initiatives have been ongoing for several years in an attempt to deliver standards that will enable mobile operators to offer LPWA-like connectivity.

The LoRa® Alliance's mission is to define a global standard for LPWA networks being deployed around the world to enable IoT, machine-to-machine (M2M), and industrial or consumer applications. The Alliance members collaborate to drive the global success of the LoRa® protocol (LoRaWAN™) by sharing knowledge and experience to guarantee interoperability between operators in one open global standard.

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Wide Area Networks for IoT

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IS THERE REALLY AN OPPORTUNITY HERE?

Low-Power, Wide-Area (LPWA) is a generic term for a group of technologies with the following key characteristics:

- Long battery life (often in excess of 10 years whilst supporting a benchmark smart metering application)
- Wide area connectivity characteristics, allowing for out-of-the-box connected solutions
- Low cost chipsets and networks
- Limited data communications throughput capacity

In essence, LPWA technologies complement existing cellular mobile network and short range technologies, enabling wide area communications at lower cost points and better power consumption characteristics. These same properties explain the potential for LPWA technologies: lowering the costs of wide area out-of-the box connectivity allows many more solution business-cases to 'cost-in', whilst untethering devices from a power supply allows for far greater freedom in terms of deployment locations.

As recently as early 2013, the term 'LPWA' did not even exist. The fact that the LPWA space has since then become one of the fastest developing aspects of the Internet of Things (IoT) market is testimony to the incredible potential for LPWA technologies.

Machina Research forecasts that there will be 3.6bn LPWA connections by 2024, growing from today's base that has numbers in the low 10s of millions. This extremely rapid growth rate is driven by a wide range of applications, each of which is the product of a rapidly evolving technological landscape.

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Key applications for LPWA connectivity include:

- Connecting power-consuming (or storing) assets to a managed electricity grid to enable the increased use of renewables.
- Consumer devices that are connected in order to enhance the overall value proposition, particularly in the areas of home automation and assisted living.
- A range of smart city applications to increase the day-to-day efficiency of cities and smooth the way to a highly urbanized future.
- Diverse agricultural monitoring and control applications to allow for more effective and efficient use of agricultural land and resources.
- Intelligent building applications to increase building efficiency.
- Supply chain applications to increase operational efficiencies and allow for new business models and optimal customer satisfaction.

Currently there is no widely adopted standard available in the LPWA market; however, it is clear that some significant level of standardisation will be required before the expected 3.6bn LPWA connections by 2024 can be achieved.

If the full potential for LPWA connectivity was not clear in early 2013, it is certainly is clear now.

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WHAT DOES THAT MEAN FOR ME?

What that means for you very much depends on who you are. The impact of LPWA is assessed for six different kinds of entities over the following pages, including:

- Mobile Network Operators
- Non-mobile network operators
- Systems integrators
- Large industrial areas and campuses
- Product manufacturers
- Sensor original equipment manufacturers (OEMs)

Whilst the impact of LPWA differs for each of these constituencies, there are a number of common themes.

- LPWA unlocks new market potential by lowering costs and increasing the flexibility of solution deployment.
- LPWA can disrupt markets for wide area connectivity by allowing for the entry of new kinds of providers.
- LPWA can act as a significant competitive differentiator for a wide range of players in different circumstances.

LPWA can generate value for IoT market participants either by allowing suppliers to get closer to their customers or by reducing churn or by introducing new connectivity-enabled services, or all of the above.

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LPWA FOR MNOs

What's the opportunity?

MNOs are the default providers of wide area wireless connectivity in today's telecoms markets. The provision of LPWA services is thus a natural extension of a core business, and channels to market and support infrastructure are likely to already be in place. A secondary strategic benefit for MNOs is to define optimal price differentiation and move away from the ever decreasing price per Mb in their existing machine-to-machine (M2M) business.

How to generate value with LPWA?

As is the case with traditional cellular connectivity, the provision of LPWA connectivity should be seen as a route to securing and maintaining customer relationships. Generally, such direct customer relationships are more profitable than the provision of connectivity services and by offering both traditional cellular and LPWA connectivity options, MNOs are better positioned to defend and grow revenues. Specifically, many clients will need multi-technology solutions, and such clients can best be supported by service providers that can offer multiple connectivity options.

What are the priority opportunities?

Top priority opportunities in terms of device count include consumer electronics, white goods, security and building control solutions. Distributed and field industrial solutions offer potential for MNOs to provide solutions that use both cellular and LPWA connectivity.

Which kind of LPWA solution might work best?

LPWA solutions that can be deployed as multi-client shared networks are the best fit for MNOs and fixed carriers. Open standards and "lego style" eco systems should allow for competitive offerings whilst ensuring optimal security, local hosting and interoperability. Where licensed radio spectrum is available, it would be preferable to be able to use those frequencies (potentially in addition to unlicensed spectrum), in order to have more control over quality of service and to be able to offer enhanced forward-path (downlink and location) capabilities.

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LPWA FOR NON-MNO NETWORK PROVIDERS

What's the opportunity?

LPWA technologies present a good opportunity for non-MNO network providers to engage in IoT markets. A wide range of players (including fixed carriers and companies that operate radio towers networks) can be well-positioned to deploy LPWA networks on a nationwide basis. There are also opportunities to engage with the LPWA opportunity by installing (and potentially operating) campus-type LPWA networks or through supporting shared Radio Access Networks which other market participants use to support their LPWA services.

How to generate value with LPWA?

Any company that deploys a LPWA network, for example a utility that already has a service and billing relationship with multiple end users, will find it relatively easy to become an mobile virtual network operator (MVNO) and also offer cellular mobile connectivity to those same end users and other third parties. Effectively, LPWA technologies can be leveraged to help non-MNOs gain traction in markets that MNOs would typically regard as core.

What are the priority opportunities?

Priority opportunities depend on the local market environment in question. Both nationwide networks and more limited geography, 'campus', or 'city' style networks can represent significant opportunities, although both the risks and returns associated with nationwide networks can be significantly higher.

Which kind of LPWA solution might work best?

A range of different LPWA technologies could be relevant, depending on the market participant (and market environment) in question. In any case, the technology of choice needs to be flexible to support the overwhelming differentiation in use cases and involve a wide range of ecosystem partners to ensure competition and longevity. Where licensed spectrum is available, it could be advantageous to leverage that asset.

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LPWA FOR SYSTEMS INTEGRATORS

What's the opportunity?

LPWA technologies provide an opportunity for systems integrators (SIs) to extend reach in terms of the diversity of IoT solutions that can be supported. Deploying LPWA networks can also allow SIs to have more control over solution performance for specific clients, enabling the SI to, for example, optimize network coverage or quality of service for a specific client implementation. Clearly, such networks could be deployed by a specialist LPWA network provider, contracted to the SI in question.

How to generate value with LPWA?

The capability to offer an 'in-house' LPWA solution and so commit to certain levels of QoS for specific clients can be a significant competitive differentiator for SIs.

What are the priority opportunities?

The ability to offer LPWA services is likely to be particularly advantageous to SIs in scenarios that are characterized by 'campus' style deployments, including smart cities, industrial processing and manufacturing locations, farms and agricultural environments, and retail and other shared service environments such as docksides, airports and educational facilities.

Which kind of LPWA solution might work best?

License-exempt solutions are likely to be most suitable, unless radio spectrum is available. Of course, SIs could also focus on reselling LPWA connectivity provided by a nationwide LPWA network operator, but, in such a shared network environment, it would not be easy for the SI in question to differentiate when competing with other SIs with access to the same networks.

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LPWA FOR LARGE INDUSTRIALS & CAMPUSES

What's the opportunity?

Large industrial areas and a wide range of campuses (as listed in 'LPWA for Systems Integrators') can benefit significantly from distributed monitoring and actuating solutions supported by LPWA networks. The low power consumption characteristics of such solutions allow for extensive and detailed monitoring of assets and local environments over wide areas.

How to generate value with LPWA?

A wide range of IoT solutions are well suited for large industrials and campuses, and can include both cost-reduction focused solutions and also revenue-generation focused solutions. Examples range from simple asset location tracking and usage monitoring solutions to the support of sophisticated integrated solutions that might automate the operations of many of the world's largest docksides.

What are the priority opportunities?

The top priority opportunities are the opportunities that your competitors are addressing: in a competitive environment, LPWA solutions can be deployed as a competitive differentiator and any company that does not take full advantage of LPWA solutions may ultimately be outcompeted. Specific priority opportunities in the market today include supply chain and warehouse monitoring, parking monitoring and agricultural monitoring.

Which kind of LPWA solution might work best?

A wide range of LPWA technologies can potentially support large industrial and campus deployments very effectively, but a vibrant ecosystem is key for any technology and thus it can be advantageous to opt for solutions that can be deployed as private networks.

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LPWA FOR PRODUCTS MANUFACTURERS

What's the opportunity?

LPWA technologies significantly expand the scope of connected device solutions that can be offered by products manufacturers. The key capabilities that LPWA long battery life, out-of-the-box connectivity (either 2-way, or 1-way).

How to generate value with LPWA?

Products manufacturers can use LPWA connectivity to offer new services, maintain ongoing relationships with customers and increase customer loyalty.

What are the priority opportunities?

Immediate opportunities include a vast range of connected lifestyle solutions. In the longer term, the biggest opportunity is likely to be the integration of powered devices into smart grid infrastructure.

Which kind of LPWA solution might work best?

Since many consumer-goods supply chains are structured on at-least a regional level, homogenous multi-country LPWA network deployments are often needed to support connectivity for high volume consumer-oriented solutions. However, ultra-low power consumption solutions (for example: energy-harvesting powered) can be supported where there is potential to deploy a LPWA base station locally (for example: within a building), and many solutions for industrials and smart cities only require 'campus' style islands of connectivity. In all cases, commercial and counterparty risk is a significant consideration and product manufacturers must be confident that there is a vibrant ecosystem in place around a specific LPWA technology before utilizing that technology.

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LPWA FOR SENSOR OEMs

What's the opportunity?

Without question, LPWA technologies are ideally suited to sensor deployment allowing for the flexible deployment of a wide range of sensors without need for access to power. This will significantly increase the range of scenarios where 'connected device' monitoring is viable, whilst the low cost points of LPWA solutions will allow many new business cases to be costed into the product proposition.

How to generate value with LPWA?

Given the dynamics described above, the advent of LPWA connectivity technologies can be expected to significantly accelerate and expand the market for a wide range of sensors. From a sensor OEM's perspective that means rapidly increasing volumes.

What are the priority opportunities?

Immediate opportunities include all kinds of environmental monitoring (noise, light, and toxin monitoring) and a range of vibration sensing applications to detect stresses in man-made structures (including bridges, roads, railways and buildings). In the medium term, LPWA-connected sensors are very well suited to a wide range of smart city efficiency monitoring solutions, ranging from parking space and waste bin monitoring to footfall and traffic monitoring.

Which kind of LPWA solution might work best?

In many senses, all kinds of LPWA technologies are well suited to sensor OEMs. The key considerations when deciding which LPWA technologies to use include the presence (coverage) of those technologies in the target market environment for the sensor OEM in question and the vibrancy of the LPWA ecosystem in question.

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WHO ARE THE MAIN PLAYERS IN THE LPWA SPACE?

A wide range of players and alternative technologies are already engaged in the LPWA space. One of the most fundamental differences between these technology types is the radio spectrum that the technologies use.

LPWA technologies that are deployed in (license exempt) ISM spectrum will find an easier path to market and benefit from 'free' spectrum resource, but are more limited in terms of forward path capabilities and support for application security.

LPWA licensing approaches compared

	Licensed	License Exempt (ISM)
Pros	• Better forward path - *QoS transparency, authentication, security* • Potentiial to re-use existing cellular sites • Fast time to blanket coverage (post standards)	• Fast time to market • Option for new operators, specialist service providers • Better BYO option • Ecosystems developing • 'No Surprises' re: cost
Cons	• Relies on mobile operators • Service costs very much TBC • Spectrum cost	• Limited (remote) security • Few multinational players

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LoRa® is one of the leading emergent technologies in both licensed and license-exempt markets. .LoRaWAN™ is supported by many leading industry players that have bundled their efforts with the LoRa® Alliance. On the ISM side, many new entrants will challenge the same MNOs that support LoRaWAN™; however, the market impact of such solutions remains to be seen given the investments required for nationwide networks.

Another key difference between LPWA technologies is the commercial strategies of the companies that seek to deploy them. Certain types of connected devices are associated with nationwide (or even multinational) supply chains, and accordingly, only LPWA providers that can offer national (or multinational) solutions are well positioned to provide connectivity for these devices. Conversely, some applications (often supporting industrial or smart city solutions) only require connectivity within a limited geographic area. There is more flexibility for the provision of connectivity in this latter case since such solutions can rely on nationwide networks providing connectivity as a service, but also custom-deployed private networks could be suitable.

Application fit with LPWA network coverage

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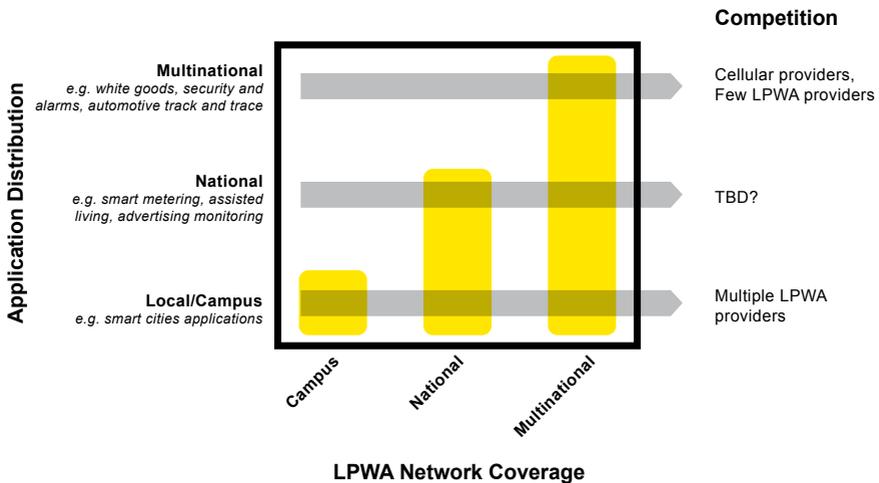
Clearly, the mobile industry and mobile operators, in particular, are alert to the developments in the LPWA space, and initiatives have been ongoing within 3GPP[1] for several years to deliver standards that will enable mobile operators to offer connectivity with the performance parameters now associated with LPWA technologies.

Work started in 2011, and currently, the main 3GPP study item related to LPWA solutions is TR 36.888 or "Study on provision of low-cost Machine-Type Communications (MTC) User Equipments (UEs) based on LTE". This project timed out in Release 11 (2012Q3), and currently two competing solutions are included within the NarrowBand-IoT work item agreed in Phoenix, Arizona in September 2015, aiming to contribute final agreed upon specifications to 3GPP Release 13, which is due in December 2015 (with an optional extension).

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[1] *The 3rd Generation Partnership Project for the development of mobile telecommunications standards and responsible for LTE standards*

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IS 'DO NOTHING' AN OPTION?

As detailed in Section 2, there is a compelling rationale for a wide range of IoT market participants to adopt LPWA technologies and solutions. LPWA can unlock new market potential, disrupt markets, and most of all, act as a competitive differentiator.

It is this last point that is key: since LPWA can be a significant competitive differentiator, very few participants in any IoT market can afford to 'do nothing'. Any company that elects to 'do nothing' can expect to be outcompeted by a company that has deployed LPWA (and other IoT) technologies to the maximum extent.

Essentially, the adoption and use of LPWA technologies will be a competitive necessity for many industries. If a company's competitors leverage LPWA to do something 'better', then the first company must also adopt the same techniques, or risk being outcompeted and losing market share.

LPWA is a key component of a wider IoT technology wave. For a company not to seek to deploy IoT solutions in today's market would be like companies in the 1970's deciding not to deploy computer systems. Seeking out new technologies and deploying them for competitive advantage is a key priority for any organization.

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SO WHAT DO I DO NEXT?

Based on an eminent identified need and long-term experience in connectivity centric solutions several leading IoT companies have joined forces with early adoptors in the mobile operator space and founded the LoRa® Alliance.

The LoRa® Alliance is an open, non-profit association of members that believe the IoT era is now. The Alliance's mission is to standardize LPWA networks being deployed around the world to enable IoT, M2M, and industrial and consumer applications. The Alliance members collaborate to drive the global success of the LoRaWAN™, by sharing knowledge and experience to guarantee interoperability between operators in one open global standard.

A first and crucial step for the Alliance has been to define the initial release of LoRaWAN™, which is available on the website for any company who wants to benefit from an open standard.

The Technical Committee of the Alliance is responsible for future enhancements drawing on inputs from all Committee Members to ensure the success of LoRaWAN™ in the IoT.

The Certification Committee is responsible for setting up the qualification programs, supported by multiple test houses, to ensure solutions adhere to the LoRaWAN™ standard. The end result being a LoRaWAN™ catalogue of products with guaranteed interoperability to maximize the opportunities for all involved.

To drive awareness and acceptance of the LoRaWAN™ standard, the Marketing Committee organizes events and Member Meetings, selects tradeshows for Members, and executes dedicated programs like the Global Challenge and Public Relations.

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As one of the fastest growing Alliances, doubling the member count each quarter since its inception early 2015, the LoRa® Alliance welcomes new entrants to benefit from the membership rights listed below.

LoRa® Alliance Membership Levels

MEMBERSHIP RIGHTS	Sponsor ($50k)	Contributor ($20k)	Adopter ($3k)	Public (Free)
The right to request Board of Director seat	●			
The right to submit Alliance Deliverables for final approval by the Board of Director	●			
The right to access Alliance operational data	●			
The right to initiate, participate in, vote and chair Committees	●			
The right to initiate, participate in, vote and chair Work Groups	●	●		
The right to contribute to Draft Deliverables and access Final Deliverables	●	●		
The right to participation in press articles and interviews	●	●		
The right to have certified Compliant Products	●	●	●	
The right to use Alliance and/or Certified Logo on certified products	●	●	●	
The right to access members only website	●	●	●	
The right to participate in general or annual meetings	●	●	●	
The right to receive Alliance communications	●	●	●	
Access to Final Deliverables	●	●	●	
Access to Released Deliverables	●	●	●	●

Any company that joins can start interacting with the Alliance's vibrant ecosystem to expand business prospects. Members also benefit from an emerging defacto standard and get access to all Members, participate in events, and secure a long-term position in the IoT for their company.

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ABOUT MACHINA RESEARCH

Machina Research is the world's leading provider of market intelligence and strategic insight on the rapidly emerging M2M, IoT and Big Data opportunities.

Machina Research's Advisory Service consists of thirteen Research Streams (as illustrated in the graphic below), each focused on a different aspect of IoT or M2M.

Advisory Service Research Streams [Source: Machina Research, 2015]
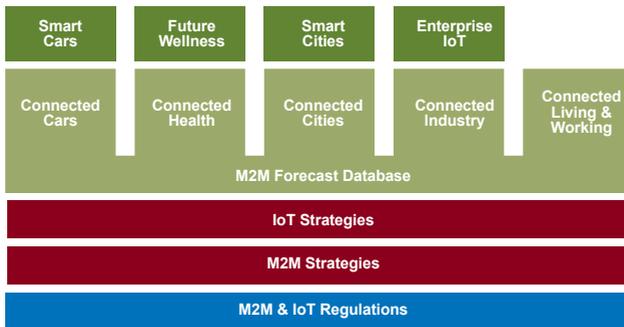
Our analysts also have a wealth of experience in client-specific consultancy and custom research.

More information can be found at https://machinaresearch.com.

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Wide Area Networks for IoT

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