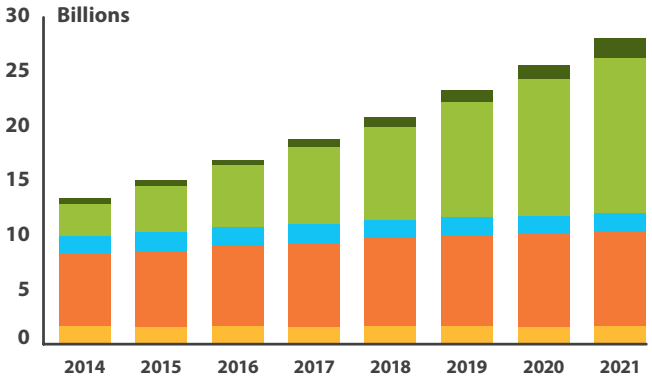
SOLUTION BRIEF

Planning the Internet of Things - New Technologies, New Challenges

RF Planning for the Diverse Needs of the IoT Ecosystem

The IoT Opportunity

IoT is a popular topic these days inside the traditional wireless ecosystem and beyond. Not to be confused with the "to be defined" 5G technology path, the Internet of Things (IoT) is a reality today. Forecasts for the proliferation of connected devices are substantial and have the attention of traditional wireless vendors and a host of new application/hardware vendors looking to wirelessly connect to the IoT.



	2015	2021	CAGR 2015-2021
Cellular IoT	0.4	1.5	27%
Non-cellular IoT	4.2	14.2	22%
PC/Laptop/Tablet	1.7	1.8	1%
Mobile Phones	7.1	8.6	3%
Fixed Phones	1.3	1.4	0%
	15 billion	28 billion	

Figure 1. Connected devices forecast from Ericsson Mobility Report, June 2016. SIGFOX and LoRa fall under Non-cellular IoT; NB-IoT is considered Cellular IoT.

Defining IoT

There are a number of technologies utilized today to enable IoT but M2M networks have been used for many years by utilities, banks and others. Some typical applications supported by these networks include smart meters for electric companies, valve operation and leak detection in pipelines as well as credit card processing. Many original M2M networks were based on the IEEE 802.15.4 standard, including ZigBee, WirelessHART, and MiWi. The 802.15.4 standard was created for low data rate monitor/ control applications and extended-life low-power-consumption uses. These systems are still in use in a number of industrial settings, and along with WIFI, NFC and Bluetooth continue to support M2M communications.

WHAT IS IOT?

IoT is the term used to address a host of technologies that support low-power, wide-area networks (LPWAN) for what has been traditionally called "machine- to-machine" (M2M) communications.

However, none of these 802.15.4-based derivatives achieved the mass success – or marketing hype – that has been attributed to SIGFOX, LoRa and NB-IoT.

The 1990s had ~1 billion users connected to the Internet through their PCs, with another 2 billion mobile users connecting in the 2000s. Some have called IoT the third

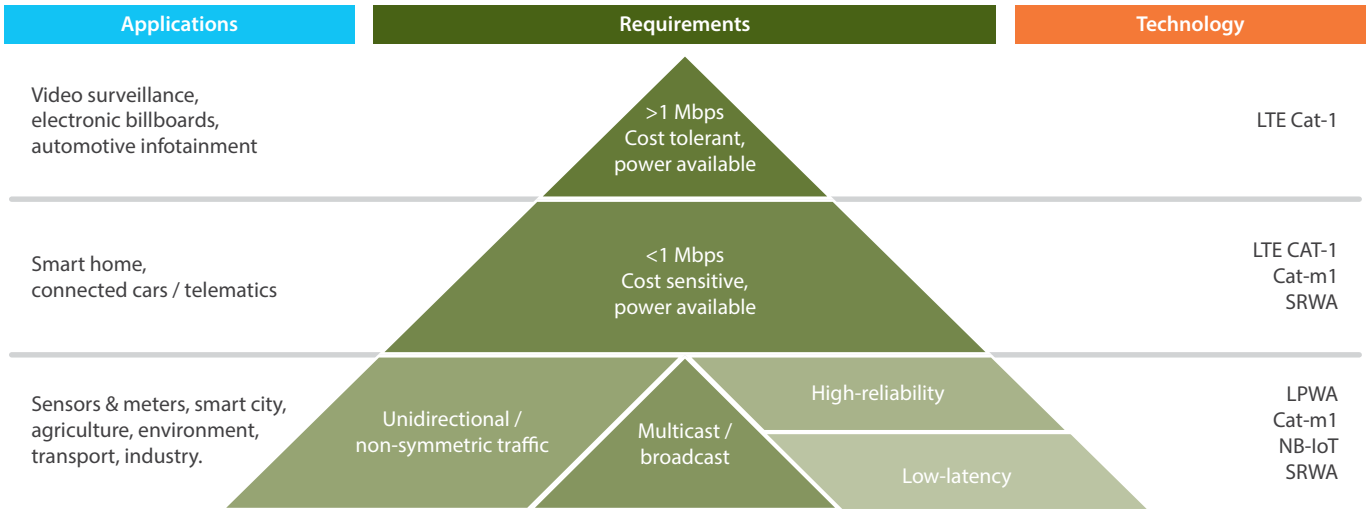


Figure 2. Range of IoT technologies and their real-world applications.
Source: Mobile Experts, Mobile and Wide-Area IoT: LPWA and LTE connectivity, 2016.

wave of the Internet, when according to Ericsson 28 billion devices (see Figure 1) will be connected to the Internet to empower the smart cities of the future – and much more. This next wave of the IoT will be empowered by low-power wide-area nationwide networks (LPWA/N), based predominantly on NB-IoT, LoRa and SIGFOX technologies.

Existing wireless operators and their vendors have many choices to consider before determining the best IoT technology for their network strategy. Do they adjust their traditional wireless service to rollout NB-IoT and ensure they handle all of their customers' wireless connectivity needs through their owned and operated network? Or do they market another company's purpose-built IoT network and brand it as their own, continuing to own their customer relationship for IoT but giving up control of the network and some of their margin? On the other end of the spectrum, wireless operators could stick to what they do best and let the new entrant networks handle the burgeoning IoT opportunity. This last scenario, however, seems unlikely for most Tier 1 operators.

SIGFOX and members of the LoRa Alliance have already deployed networks around the world. With an ever-expanding list of new non-traditional "wireless customers" (thermostat manufacturers, fitness device makers and medical equipment manufacturers, etc.), IoT network operators are scrambling to launch. To date, these operators and their vendors have been using internally developed or smaller RF planning applications. Increasingly, they are looking to traditional wireless vendors with a longer track record in planning and executing larger network deployments.

In Q2 2016, the 3GPP ratified NB-IoT ahead of schedule given the success of SIGFOX and LoRa in the marketplace. It is expected the first NB-IoT networks will launch in 2017.

Differing business approaches and technical options to deliver IoT make it a difficult market to predict. The ability to simulate an operational network, and dimension it in a manner that allows for accurate forecasts, provides operators and vendors building their business case for IoT with a strategic advantage. Advanced wireless planning solutions, initially used in the cellular world and now adapted for use with these unique technologies, enable operators and the vendors that support them to confidently chart their IoT strategy.

	SIGFOX	LoRa Alliance	NB-IoT
Organization Support	Owned & operated by SIGFOX of France	150+ operators and vendors	3GPP
Modulation	UNB/GFSK/BPSK	Chirp Spread Spectrum FSK	OFDMA
Channel width	200 KHz	7.8 KHz to 500 KHz	200 KHz
Spectrum Type	Unlicensed	Unlicensed	Licensed
Propagation distance	x < 10 km	x < 10 km	x < 15 km
Targeted Link Budget	156 dB	156 dB	164 dB
Deployment Status	20+ countries	Various cities and countries	Expected H1 2017

Figure 3. Comparing the three leading systems for IoT.

Key Challenges for Operators & Vendors Deploying IoT

Operators undertaking an assessment of any new wireless technology are often at the mercy of the vendor ecosystem for their ability to investigate their options. One of the first requirements for any technology, given its use at the start of the network lifecycle, is RF planning software to design the radio access network. RF planning and optimization software lets operators consider:

Demand forecasts: where do I expect my customers to come from? Where do I need to build first? How do I stage my rollout to meet my IoT CAPEX? OPEX plan?

Spectrum issues: various RF pathloss propagation scenarios and related coverage differences for various frequencies; interference considerations in unlicensed IoT bands (i.e., industrial, scientific and medical (ISM) radio bands targeted by operators); interference from other systems (radar) or networks, and channel strategies for existing LTE operators planning for NB-IoT

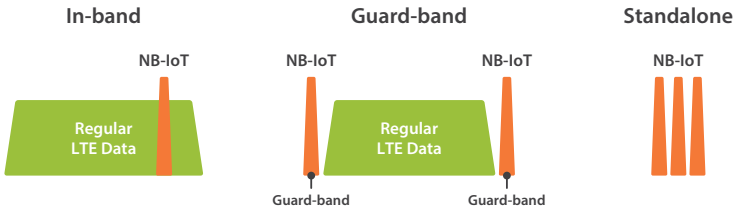


Figure 4. Comparing the three leading systems for IoT.

Integration with existing networks: can my IoT analysis be compared and overlaid with an existing network — either my own or a potential partner for infrastructure (i.e., tower sites) or backhaul? What are my best existing sites to deploy IoT? Will my trained cellular engineers be able to utilize their knowledge of my system in the planning software we are using?

Key technology considerations of the new technologies: spread factors for LoRa planning; diversity penalties for SIGFOX. Taking the innovative attributes of these systems, preloading related network parameters and modeling them accurately so that the simulation translates into the real world

Urban environments: the most important area to consider given the populations they support are also the most difficult from an RF planning perspective. Planning software needs to scale to be able to manage these RAM and CPU-intensive computations

Overcoming limited RF skillsets in an organization: traditional wireless operators may find IoT far easier to deploy than a new entrant. Many vertical market providers (utilities, etc.) have small internal planning teams. It's harder for these smaller teams to stay aware of evolving standards

IOT TECHNOLOGIES

- 802.15.4
- WirelessHART
- ZigBee
- Ingenu
- LTE-M
- SIGFOX
- LoRa
- NB-IoT
- EC-GSM
- Weightless

KEY CONSIDERATIONS WHEN ASSESSING IOT PLANNING SOLUTIONS

- Propagation modeling to accurately simulate the real world
- GIS capabilities for traffic planning and customer segmentation
- Ease of use
- Enterprise-grade application with data management and API(s) to integrate with other systems
- Strong dimensioning capabilities to ensure optimum CAPEX rollout
- Adaptive platform – standalone (PC), enterprise and private/public cloud user options
- Integrated geodata - with flexible use options
- Broad technology support - run comparisons between 802.15.4/SIGFOX/LoRa/NB-IoT*
- Scale, breadth and stability of vendor
- Support in your time zone

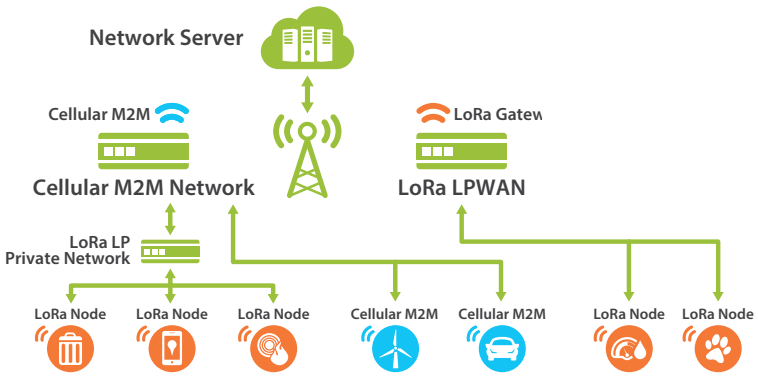


Figure 5. LoRa architecture highlights unique characteristics of LPWN vs. traditional LTE networks.

Planet: Unparalleled Planning Capabilities for IoT

As the original planning software, developed to rollout 2G wireless networks in the 1990s, Planet has a long pedigree and a strong user community around the world. It has been used extensively by operators of M2M networks for utilities, surveillance and military applications. With the launch of Planet for IoT in Q3 2016, Infovista provides its extensive platform to a waiting community of network operators and their vendors. The Planet value proposition for IoT includes:

MAPINFO GEOGRAPHIC INFORMATION SYSTEM

Operators planning their network and related demand forecasts are trying to solve an RF geospatial problem. Planet is the only software to include a leading geographic information system — MapInfo Professional™ — native to the application. MapInfo lets IoT engineers have access to layer statistics, population coverage and related RF coverage statistics in formats that can be viewed by any user in the organization with access to this ubiquitous GIS standard.

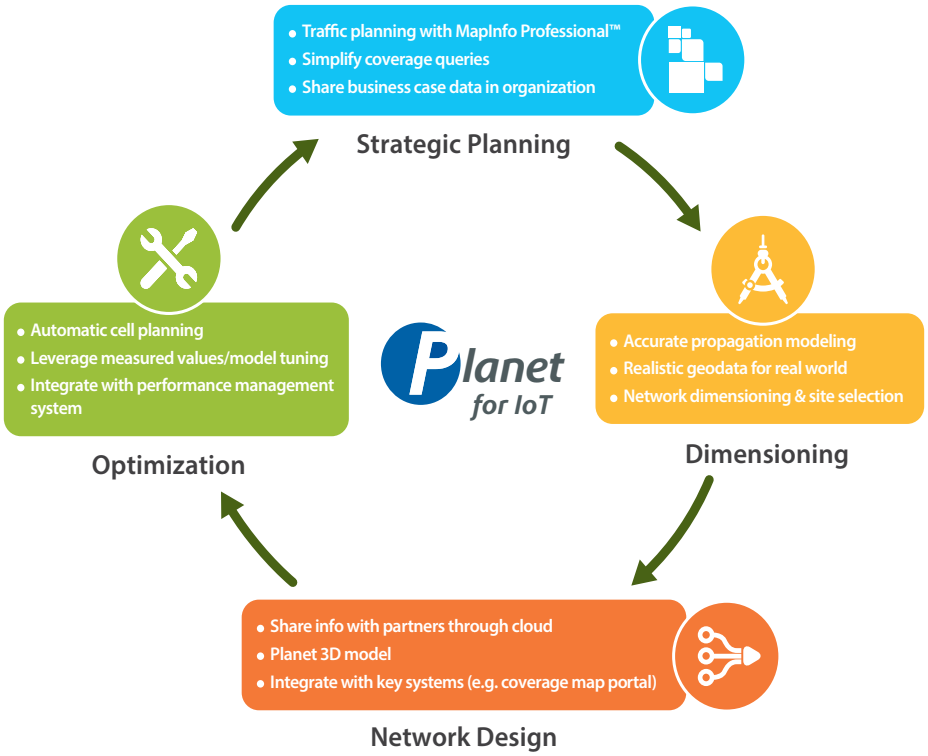


Figure 6. Planet IoT and the network lifecycle.

PROPAGATION MODELS

RF propagation models are a core component of any planning software. Propagation models are the algorithms that attempt to simulate how radio frequencies will move from one point to another through free space, as well as over and through obstructions. Infovista is the only company offering CRC-Predict – a 2D model ideally suited for broadcast technologies outside of urban areas. Its speed and accuracy with minimal tuning make it an excellent choice for dimensioning and bid planning exercises. The Planet 3D model, in conjunction with the Metro Design Package, is also available along with leading 3rd party algorithms for accurately simulating urban environments.

OPENNESS

With a long pedigree in tier one wireless operators around the world, Planet offers multiple means to integrate 3rd-party solutions or key systems through application programming interfaces (APIs). The possibilities with IoT vendors/operators are limitless, and could include performance management and provisioning systems, as well as site databases and more.

IOT - NEW CAPABILITIES

Starting with Planet 6.1, the software supports SIGFOX and LoRa through an optional module. NB-IoT capabilities will be included shortly thereafter. Network analyses (best server, signal strength, SIGFOX diversity levels, Uplink LoRa, best available modulation based on spreading factors) will all be available. Real world measurements can be integrated to tune propagation models and make them more accurate for reuse in other similar morphologies. Planet automatic cell planning (ACP) is also available for performing site selection. Beyond this network dimensioning capability, the ACP can also be used to optimize antenna positions (e.g., tilts, azimuths) if directive antennas are being utilized.

CONTINUING INNOVATION

Planet R&D is focused on the requirements of its users. IoT features will continue to be added, including NB-IoT capabilities and more requested to our account and product management teams by our global user community.

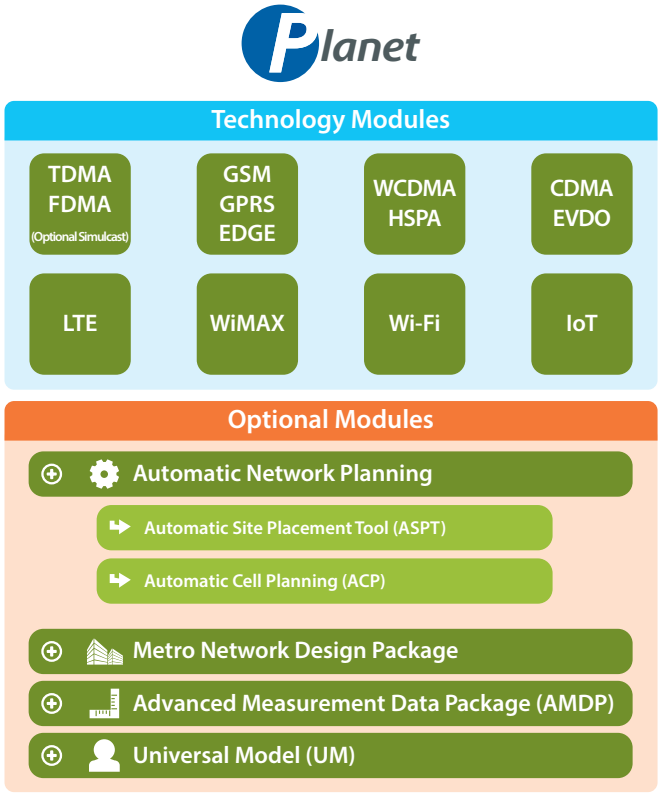
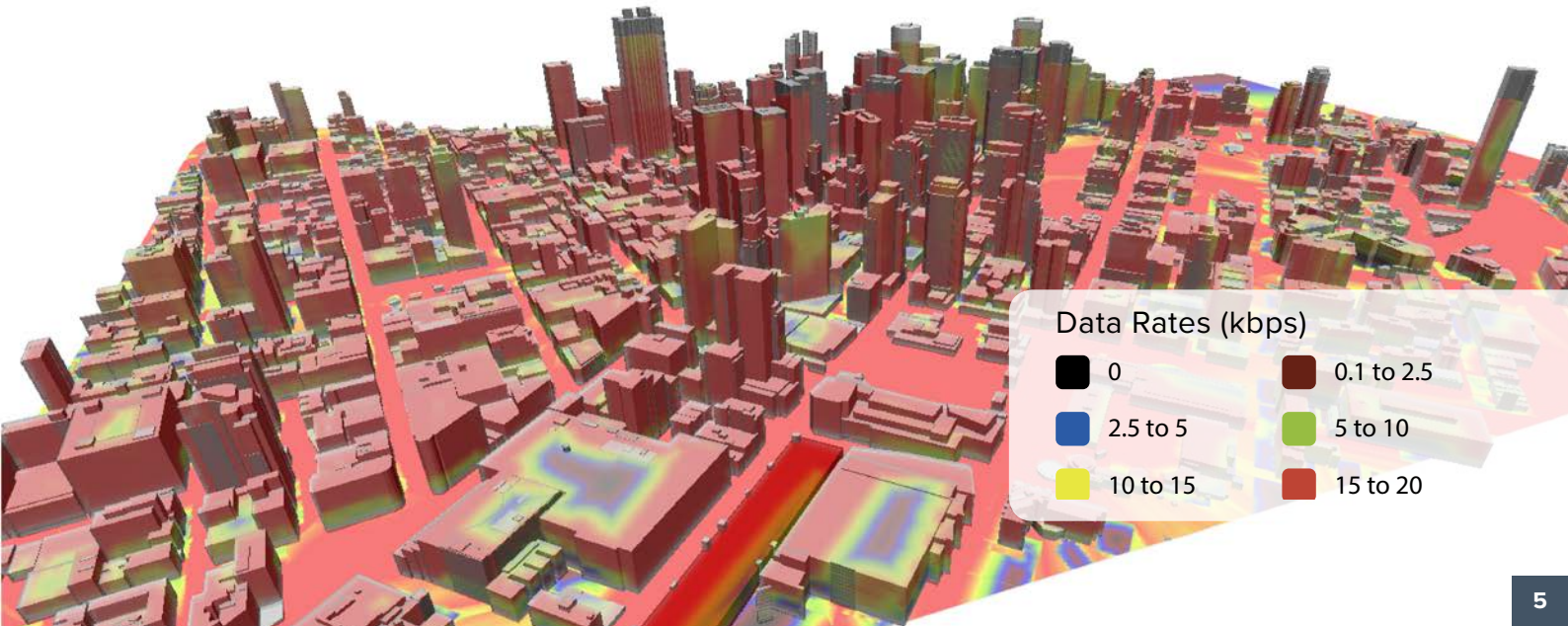


Figure 6. IoT is now available as an optional module in Planet.

GEODATA

Infovista develops its own geodata in conjunction with key partners to deliver turnkey planning products to its end users. This means we can suggest the most cost-effective approach to your planning requirements. Users of Planet cloud capabilities, including vendors and systems integrators, can lease 2D and 3D geodata for as long as they are using the software.

A LoRa network in San Francisco illustrating uplink capacity



FLEXIBLE DEPLOYMENT OPTIONS

Planet has a deployment model to fit your requirements. New options include public and private cloud implementations that let customers add new user licenses and privileges in real time. Of course, traditional desktop, client-server and enterprise models that have become the industry standard continue to be available.

EXPERT CUSTOMER SUPPORT 24X7

Our global support team is ready to serve around the clock. We understand that deadlines have to be met and RF engineering doesn't always respect a traditional work day.

As a provider of planning software with a leading research group for new wireless technologies, Infovista can help your organization navigate its way through evolving IoT standards.

Figure 8. Planet can be used in the cloud, as well as on a standalone (PC) and via client/server architectures.

Summary

The Internet of Things (IoT) provides new entrants and legacy wireless operators with another option for delivering connectivity. Without a single dominant standard, operators will want to assess the merits of different technologies to meet their end goals. SIGFOX, LoRa and NB-IoT have advantages and disadvantages for incumbent and new entrant operators to consider.

A robust RF planning application such as Planet for IoT with strong GIS capabilities for demand forecasting, flexible digital map accessibility and platform configurations, advanced propagation modeling and the ability to integrate into customer systems, provides operators and vendors a competitive advantage in building business cases and deploying IoT networks.

An analysis of improved coverage achieved through SIGFOX diversity levels

About Infovista

Infovista, the leader in modern network performance, provides complete visibility and unprecedented control to deliver brilliant experiences and maximum value with your network and applications. At the core of our approach are data and analytics, to give you real-time insights and make critical business decisions. Infovista offers a comprehensive line of solutions from radio network to enterprise to device throughout the lifecycle of your network. No other provider has this completeness of vision. Network operators worldwide depend on Infovista to deliver on the potential of their networks and applications to exceed user expectations every day. Know your network with Infovista.

KNOW YOUR NETWORK™