How to Build a Fully Managed and Scalable Long-range Network with Low-power Nodes



Connecting low power nodes to the Internet is possible today with a variety of different wireless technologies.

Among all of them, the communication in the Sub-1 GHz band has the ability to reach the longest range and is better suited for indoor environments (office, building, home), at an overall lower system cost and complexity (no relay nodes) and with the lowest power consumption.

But when it comes to realizing the full potential of the Internet of Things (IoT), the requirements go far beyond "creating a link to connect a node to the Internet".

Cloud-based management systems for diagnostics and automation need the ability to control a large number of sensors in a coordinated way. Centralized servers for factory, building and retail must manage and automate procedures on a large scale to reduce maintenance costs.

Consumers at home require that the data communication flow of multiple low-power sensors and nodes are coordinated and funneled through a central hub (like an alarm panel of a security system), and available all the time via the Internet.

Wireless connectivity as a solution for the IoT responds to the challenge of deploying a system where a large set (from tens to hundreds) of nodes 'live and breathe'. This also means defining techniques aimed at identifying what type of data they can transfer depending on their role and adapting to the different use cases.

So, how can we leverage the great advantages of Sub-1 GHz as a wireless communication link and realize this potential, morphing it into a connectivity "system" solution?

- We need to provide a networking infrastructure, where we make sure that a large set of nodes can be easily set up and maintained, and communication is secure. Nodes must discover the network they can attach to and commission to it. Their roles and services must be explored and the link maintained over time.
- We must guarantee the reliability of the communication when nodes transfer or receive data and that the air medium is efficiently utilized to avoid traffic stall and network inefficiencies. These ultimately translate into poor user experiences and impact battery life of the nodes themselves.
- We need to be able to service different types of traffic profiles for various scenarios. In generic sensor networks for instance (let's take the case of a diagnostic system), data is reported to a central hub. On the other hand, in retail networks for example, the data is mostly dispatched to the peripheral devices (like in the case of a retail server sending updated pricing information to the end points).
- All the above must be done while maintaining low power operations, with nodes staying asleep if they are not
 involved in the data communication. But striving for the best power consumption means also minimize the 'on'
 time in transmission and reception and using the least amount of power when in active mode.
- And last but not least, we must be able to bridge the data local in the Sub-1 GHz network over an IP-Internet connection.

The design challenges people face when trying to address all the above requirements are now solved with the new TI 15.4-Stack software solution from TI. TI developed this software to bring true application-oriented Sub-1 GHz connectivity solutions to the IoT.



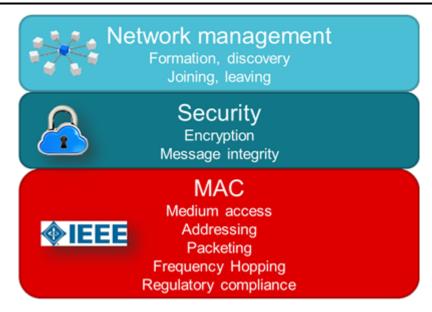


Figure 1. New TI 15.4-Stack is a standard base Sub-1 GHz wireless networking solution.

The TI 15.4-Stack is a software development kit (SDK) running on the SimpleLink™ Sub-1 GHz CC1310 wireless microcontroller (MCU). Based on the proven IEEE 802.15.4 standard, it implements the 'g' amendment of the specification for operations in North America and Europe in the Sub-1 GHz band (regulated respectively by FCC and ETSI).

The IEEE 802.15.4 standard is used as a data-link layer of many popular networking standards deployed in the market (6LoWPAN, Wi-SUN, ZigBee®, Thread and WHART). It guarantees a solid wireless foundation thanks to features like air arbitration (through CSMA-CA), acknowledgments and retransmissions and built-in AES security.

To improve link robustness and reliability, TI developed a frequency hopping scheme for the U.S. FCC band. The scheme relies on the Wi-Sun FAN standard, and TI optimized it for low power operations. Applications can directly benefit from the increased link robustness, as this translates into smaller latency for data and low power savings (as re-transmissions can be avoided).

TI 15.4-Stack software can be configured to operate in asynchronous mode (ideal for battery-powered sensor operations) and synchronous mode (suited for coordinated downlink traffic operations with low-power node reception), thus serving different types of application needs.

Additionally, the TI 15.4-Stack software is delivered on top of TI-RTOS foundation and comes with a complete set of application examples for sensor and collector devices. Both applications feature a logical link controller module (running on top of the 802.15.4 standard), that encompasses network and device management procedures.

This gives the user of the software a full reference solution which answers the design challenge of building a fully managed low-power network. TI 15.4-Stack software can support deployment from 10s to 100s of devices, depending on the configuration selected.

TI 15.4-Stack software also includes a Linux-based gateway software, which implements a local network controller and collector application. Through the gateway software, data coming from the Sub-1 GHz peripheral node can be monitored and actuated from a web browser interface.

This new software is built on Tl's low-cost development platforms: SimpleLink CC1310 LaunchPad™ development kit and Sitara™ AM335x processor BeagleBone Black development board. Through the development kit ecosystem of BoosterPack™ and cape plug-in modules, and relying on the TI-RTOS framework, applications can be easily extended.

Using narrowband modulation which gives the best performance of sensitivity and resistance to interference at a given external crystal cost, TI 15.4-Stack software unleashes the advantages of Sub-1 GHz wireless into the IoT.



By providing a full reference system solution for low-power managed networks, users can easily integrate the Sub-1 GHz wireless functionality into their existing networks.

Now creating applications with a network of low power nodes covering a whole building, an entire house or a parking lot area is not just a task for wireless technology experts.

And yet more is to come....

Additional Resources:

- For more information on TI's Sub-1 GHz technology, visit www.ti.com/sub1ghz
- Get started with SimpleLink Sub-1 GHz CC1310 wireless MCU today!
- Download the TI 15.4-Stack SDK
- Read our white papers:
 - Diversifying the IoT with Sub-1 GHz technology
 - Frequency hopping for long range IoT networks
- · Learn why you should choose Sub-1 GHz for your IoT applications in this blog
- Why Sub-1 GHz video

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