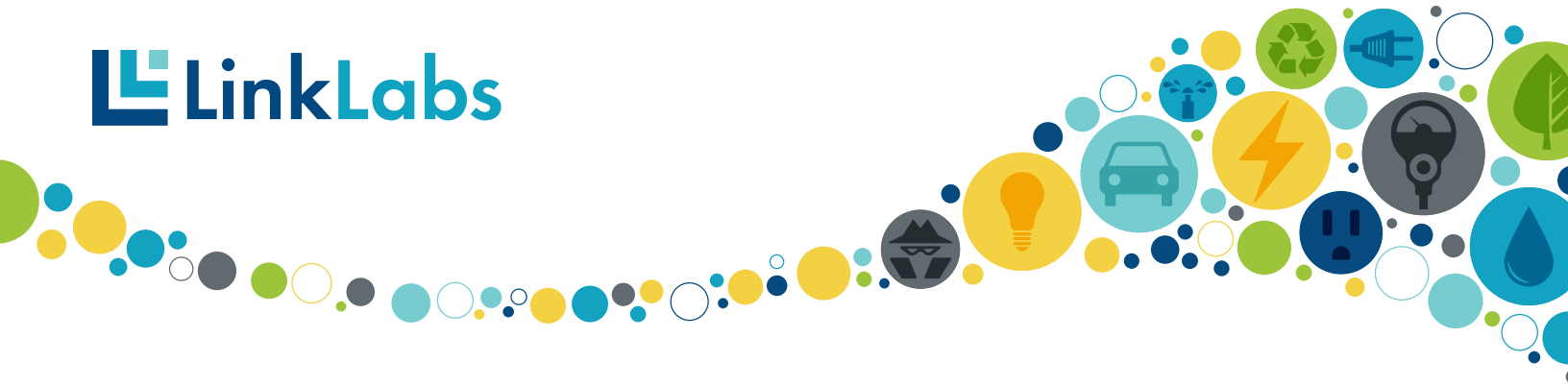
LinkLabs



Symphony Link™ Protocol

LINK LABS LONG-RANGE, LOW-POWER WIRELESS TECHNOLOGY

Symphony Link™ is a sophisticated wireless specification (MAC and protocol stack) built from the physical layer up to optimize long-range, low-power networks. Symphony Link™ takes lessons learned from both cellular and 802.11 standards, and incorporates an additional number of proprietary strategies to build a network that can handle massive numbers of end points that are transmitting uncoordinated amounts and types of data, while at the same time requiring very little energy from those endpoints. Symphony Link™ is architected as a star topology network, where a set of end nodes communicate with a single Gateway. Each star is centrally managed by the Gateway at its center, where it interacts with the modules in several modes, depending on the application as defined by the end user. This flexibility inherent in Symphony Link™ allows a wide variety of end user requirements to be easily met.

SYMPHONY LINK™ FEATURES

Quality of Services Tiers – Allow the limited time-frequency resources to be managed to meet the wide variety of end-user requirements, including: reserved frequencies / time slots for low-latency privileged nodes, high-duty cycle tiers for high-throughput nodes, store-and-forward mailbox features for energy-constrained nodes requiring remote control, and peak throughput optimization through uplink throttling of nodes with relaxed latency constraints.

Dynamic Scheduling – The LoRa® products are half-duplex, and thus communication is in only one direction at a time. The Gateways contain a dynamic scheduler that is responsible for splitting time resources into uplink and downlink segments. The scheduler decides in real-time how much of the available time resources to allocate to downlink and uplink, based on the instantaneous demand and QoS subscriptions. This allows Link Labs Gateways to be equally suitable for both downlink and uplink-centric applications, even adapting on-the-fly in hybrid environments.

Message Acknowledgement – Bi-directional acknowledgment of LoRa® packets is the default mode, with an adaptive acknowledgment encoder which optimizes acknowledgment throughput while consuming minimal time-frequency resources.

De-centralized Architecture – Gateways perform a large portion of network processing locally, eliminating the need for a single compute intensive processing server. Additionally, this means Gateways can continue performing most of their functionality through an internet outage.

Extensible API – End-users have the option of adding functionality directly into the gateway through an API, allowing for systems that receive a message from a local node to immediately process and generate response messages to nearby nodes without requiring any internet connection. This feature allows a wide variety of user-specific ad-hoc networks to be created using minimal engineering development resources. Additionally, this decouples critical functionality from the internet and maintains their availability through an internet outage.

Interference Avoidance – Up to 48 Gateways (and their star networks) can co-exist in the 915MHz ISM band without affecting one another's performance. The Gateways also run an interference avoidance algorithm that allows them to constantly monitor and avoid RF energy from other systems in the band.

Built-in security – Secure AES128 network encryption for all over-the-air transmissions, as well as application-specific encryption for customers requiring an additional level of security.

Repeaters - Rather than needing to add extra gateways to increase network coverage or, simple repeaters can be seamlessly added to extend the range of the network.

Real Time Adaptive Data Rate - Each node performs real time analysis on its link budget and adaptively adjusts its datarate and output power to optimize the link quality without sacrificing the capacity of the network.

For additional questions:
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Learn about our other products:
link-labs.com/

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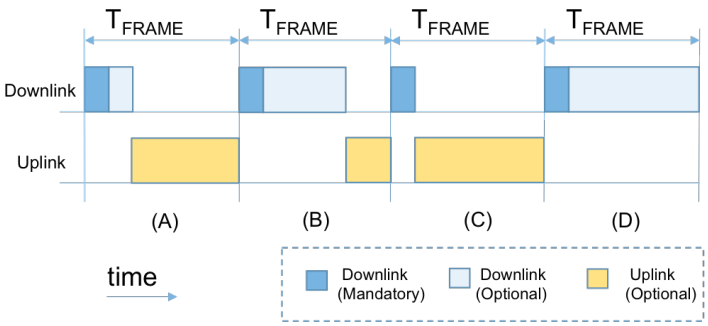
FIXED FRAME SIZE/DYNAMIC SCHEDULING

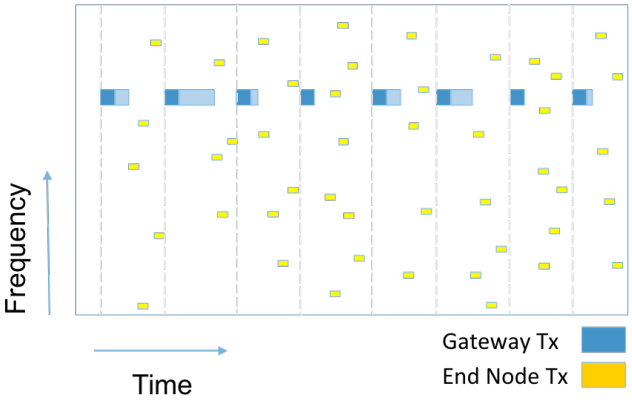
Centrally Managed Time Division Duplex



**LoRa Radios are Half-Duplex*

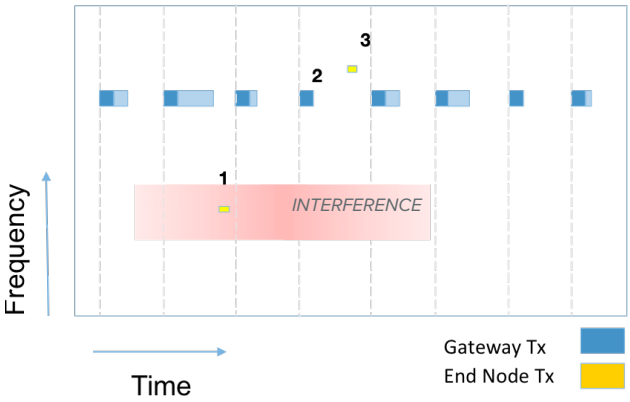
FREQUENCY HOPPING

TDMA, FDMA, SF-DMA, S-ALOHA, CSMA-CA, ARQ

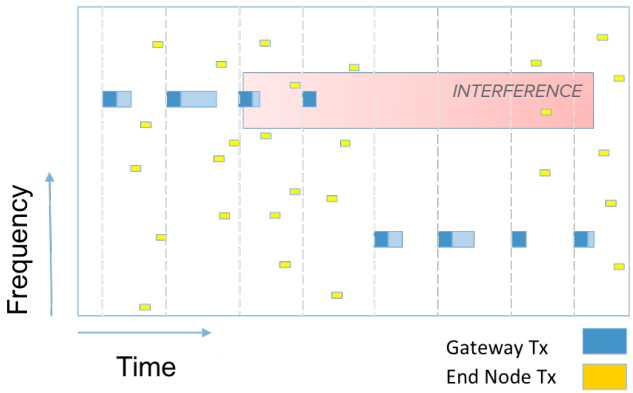


INTERFACE AVOIDANCE (UPLINK)

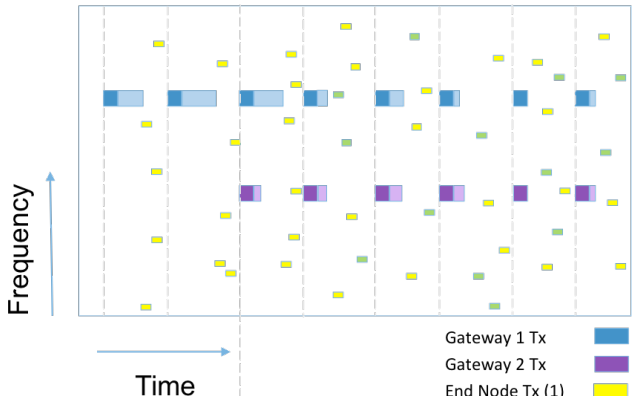
Frequency Hopping, Auto Repeat Requests



INTERFERENCE AVOIDANCE (DOWNLINK)



SOLVING THE DOWNLINK BOTTLENECK



1. Asymetric Bandwidth
2. Data Compression
3. Adding gateways multiplies downlink capacity seamlessly

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