BlitzFunk® Whitepaper

BlitzFunk is a realtime-WLAN system for highly reliable switched Ethernet communication with consistent low latency in the millisecond range. It serves as a drop-in replacement for existing wired installations and enables high-mobility applications with seamless handover. Ethernet-based protocols, including PROFINET, PROFIsafe and OPC-UA, are supported out of the box. The technology is built upon Wi-Fi and operates in unlicensed frequency bands. Even with minor interference from third-party Wi-Fi networks, latency is kept low by leveraging diversity. A carefully crafted proprietary protocol ensures that concurrent data streams within the network do not interfere with each other, and that all communication is secured by authenticated encryption with per-device key management.

Access Point AW22R

Client CW22R

Topology

A BlitzFunk network consists of access points and clients. The network forms a star topology in which all access points act as a single coordinating unit. User devices (controllers, machines, sensors, etc.) are connected via Ethernet. From the application's perspective, the BlitzFunk network functions as a distributed Ethernet switch. Point-to-point connections are also supported (1 access point + 1 client).

Scalability

BlitzFunk features a modular system design that provides deterministic performance and scales as needed. It operates on channel sets, each comprising two non-adjacent 20 MHz Wi-Fi channels. Each BlitzFunk access point operates on such a channel set. When BlitzFunk clients are added to a channel set, they are time-multiplexed, resulting in increased system latency as the number of clients grows. To reduce latency and increase data throughput per client, multiple access points can be placed in the same location to provide additional channel sets. Two configuration examples are discussed at the end of the whitepaper.

For broader coverage, additional access points can be configured to use the same channel set. They are then positioned so that their individual coverage areas overlap. The access points synchronize to within milliseconds via a gigabit Ethernet backbone, allowing them to select the optimal access point for each transmission. This optimization is completely transparent to the client, resulting in seamless roaming with zero latency.

Time Behavior

BlitzFunk implements a deterministic time-frequency grid across access points, providing guaranteed resources per client. The selected channel sets are divided into time slots to multiplex clients and enable duplex communication. Each time slot is 2 ms, determining the system's one-way latency. As more clients are assigned to the same channel set, latency multiplies with the number of clients. In addition to the systematic latency, some jitter is expected (up to 2 ms additional latency with a probability of 99.9999%), as shown in Figure 1. The sum of systematic latency and jitter doubles for round-trip communication between access point and client and for communication between clients.

Spectrum

BlitzFunk is based on Wi-Fi technology and operates on unlicensed Wi-Fi channels in the 2.4 GHz, 5 GHz, 5.8 GHz, and 6 GHz bands.

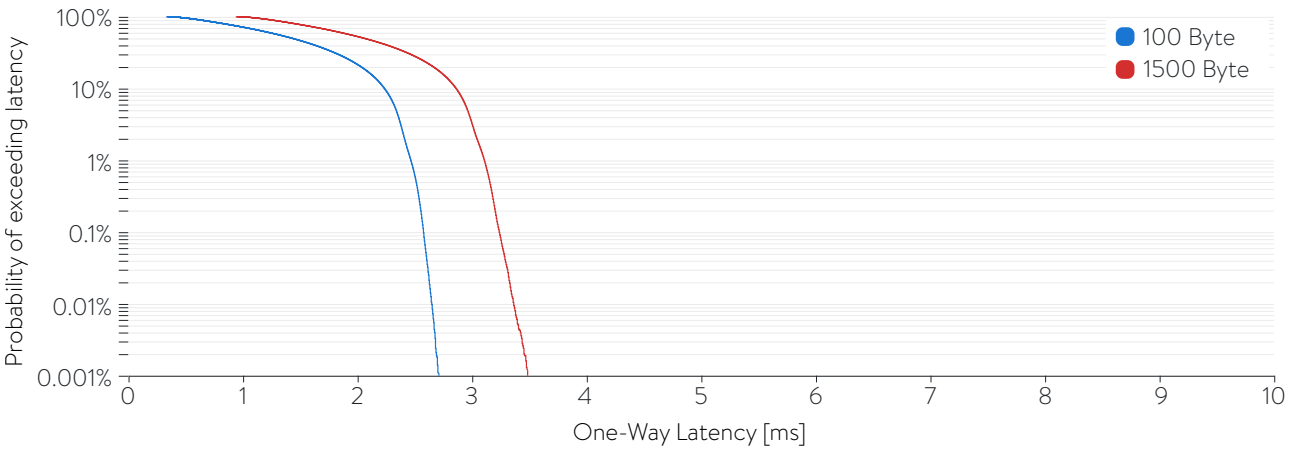

Fig. 1: Measured cumulative latency distribution for a single client

BlitzFunk requires at least one pair of non-adjacent 20 MHz channels for operation.

Coexistence

BlitzFunk coexists with other Wi-Fi networks by adhering to CSMA/CA (Listen Before Talk). However, interference can lead to increased jitter and, consequently, a higher functional packet error rate. In the case of a small third-party network with low traffic (e.g., condition monitoring), the impact on BlitzFunk will be negligible, but high traffic (e.g., video streaming) will degrade performance. Conversely, a BlitzFunk network can significantly impact the performance of third-party networks.

Plug & Play

BlitzFunk was designed with performance and user-friendliness in mind. It is intended to be Plug & Play for the vast majority of Ethernet-based applications. BlitzFunk is fully transparent at the Ethernet layer and supports the full standard MTU of 1500 bytes per frame, ensuring maximum compatibility with existing applications. For system configuration and status monitoring, BlitzFunk access points offer a user-friendly web interface accessible without the need for additional software installation. Configuration changes and firmware updates are sent wirelessly to the clients. When multiple access points are connected via a switch, configuration is automatically synchronized between the access points. Advanced users can utilize the HTTP API to integrate BlitzFunk into existing in-house configuration and monitoring solutions.

Security

Since BlitzFunk is designed for critical applications, security is a top priority. All communication within the BlitzFunk network is authenticated and encrypted, protecting against forgery, man-in-the-middle, and replay attacks. Each client is assigned an individual key, which can be revoked at any time through the web interface if the device is lost or needs to be removed from the network. For maximum security, BlitzFunk devices feature a secure boot process to prevent malicious tampering.

Physical Interfaces

The physical interfaces consist of a 12V - 48V DC power connector, an M12 D-coded (client) or X-coded (access point) Ethernet port, and four (client) or five (access point) coaxial RF ports for external antennas.

Maturity

BlitzFunk is CE-certified and supports IP65 protection. It has been extensively tested in industrial environments. Completed projects include networking for welding robots, overhead cranes, and AGVs, in both safety-critical and non-safety areas.

Example Configurations

An example configuration with one access point and six clients is shown in Figure 2. The clients transmit alternately with a slot duration of 2 ms, so each client gets a transmit opportunity every 6 × 2 ms = 12 ms. Including 2 ms jitter, this results in a worst-case one-way latency of 14 ms. With up to 1500 bytes per transmission opportunity, each client is granted a net bitrate of

1500 bytes × 8 bits/byte ÷ 12 ms = 1 Mbps.

Latency and throughput can be improved by adding a second access point operating on a separate channel set, allowing clients to be distributed across channel sets as needed. For example, if some clients are connected to machines with stricter latency requirements, they can be assigned to a separate channel set. An example configuration with four clients on one channel set and two clients on another is shown in Figure 3. On the first channel set, one-way latency, including jitter, is 4 × 2 ms + 2 ms = 10 ms, with a net bitrate per client of 1.5 Mbps. On the second channel set, latency is 2 × 2 ms + 2 ms = 6 ms, and the bitrate per client increases to 3 Mbps.

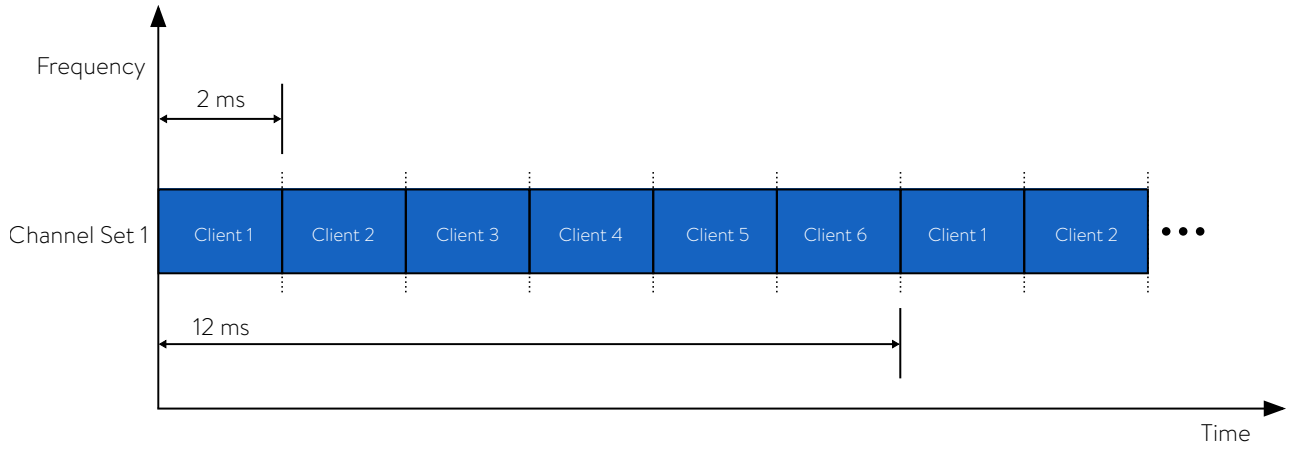

Fig. 2: Resource grid of six clients sharing one channel set

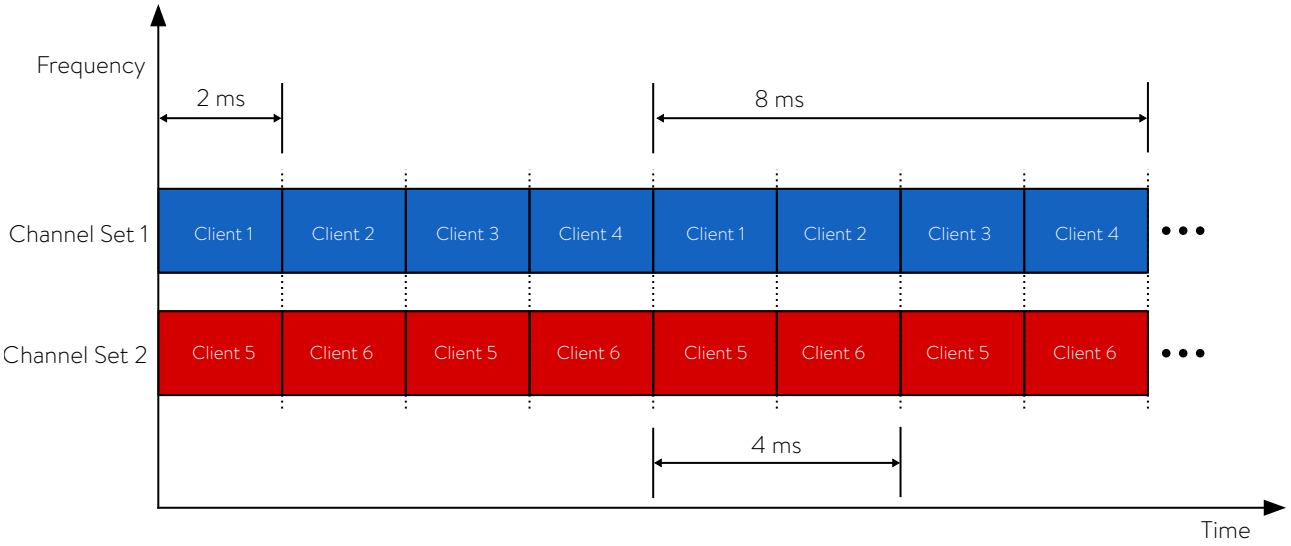

Fig. 3: Asymmetric resource grid of six clients sharing two channel sets


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