

# Communication & Protocols

## The Ko-TAG communication protocol

The Ko-TAG communication protocol is based on three non-overlapping channels used for management operations, distance measurements, data transmissions and angle estimations. An overlapping star topology was chosen with a single localization unit (LU) as the center of each star. The network management runs completely autonomously. No interaction from outside is required.

A specific communication protocol was developed to answer the specific user requirements.

During communication each LU performs three different subsequent steps:

### Registration

- Observation of the management channel
- Reply to registration requests of the TAGs
- Assignment of addresses and time slots

### AOA (Angle Measurement)/Data

- Transmission of a Request-Beacon
- Transmission of the replies by the addressed TAGs
- Angle Measurement of the arrived signal

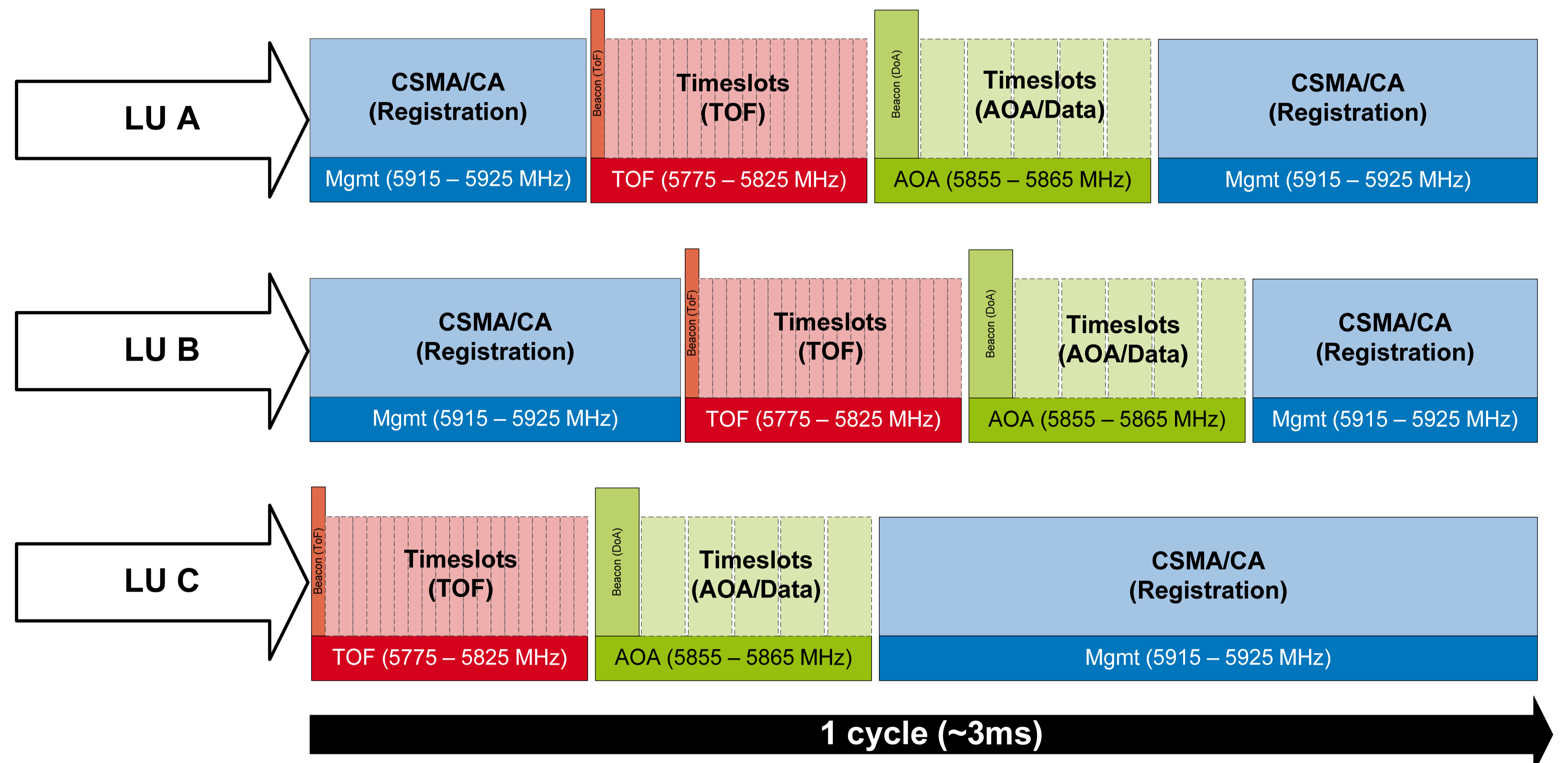
### TOF (Distance Measurement)

- Transmission of Beacons
- Time-Of-Flight Measurements for each TAG in its time slot
- Duration of a time slot < 15µs

The communication frames in the data and in the management channels are derived from the 802.11p-Specification.

For Time-Of-Flight Measurements use short bursts to increase the update rate.

Packet collision probability can be significantly reduced with a time slotted channel access mechanisms within the own network.



## Network Simulation

Verification was performed using the OPNET® Modeler simulator for wireless networks.

The picture shows an example measurement of the maximum time required until a distance measurement has been performed for all TAGs. The corresponding test setup used 500 TAGs and 75 time slots per cycle.

The single curves represent the behavior regarding a different dwell time of the devices in the management channel.

In this scenario a simultaneous registration of all devices in the network is simulated.

