BigBangBus

DECENTRALIZED
ULTRA-LOW-LATENCY
NETWORK FLOODING

infineon
AIRBUS
RWTH AACHEN UNIVERSITY
BIGBANGBUS

IT IS NOT REDFIXHOP (HW ACK)

ONLY SW-TRIGGERED TRANSMISSIONS
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FLOODING PROTOCOL

— BASED ON THE CAPTURE EFFECT
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FLOODING PROTOCOL

- BASED ON THE CAPTURE EFFECT
- NO PURE CONSTRUCTIVE INTERFERENCE AT 2.4GHZ
  - FREQUENCY DEVIATION (~200 KHZ) + RANDOM PHASE = BEATING EFFECT
  - BEATING EFFECT + DSSS = CAPTURE EFFECT
BIGBANGBUS

DECENTRALIZED

- NO MASTER
- SCHEDULING IS DONE ONCE IN THE LIFETIME OF THE NETWORK (BIGBANG)
- ONCE CONSENSUS IS ACHIEVED, SCHEDULING IS OVER (~10 MS)

CLASSIC TDMA SCHEME WITH 100% W-BUS UTILIZATION

- TIGHTLY SYNCHRONIZED CONTINUOUS BUS (NO GUARD TIMES, NO IDLE GAPS)
  - A SOURCE IS ALWAYS TRANSMITTING IN THE WIRELESS BUS
- EVERY SOURCE SENDS ONE REPETITION IN N CHANNELS
- OPTIMAL LATENCY
  - \( \text{PACKET\_TIME} \times (N \times S) / 2 \) (S SOURCES, N TRANSMISSIONS EACH SOURCE)
- DIFFERENT POWER MODES
BIGBANGBUS

NO JAMMING

- 4 SOURCES, 6 CHANNELS, MAXIMUM 1 REPLICATION PER RELAY
- EXPECTED LATENCY = PACKET\_TIME × (N×S)/2 = 512µS × (6×4)/2 = 6,1 ms
BIGBANGBUS

EXPLICIT JAMMING DETECTION

- 4 SOURCES, 6 CHANNELS, MAXIMUM 3 REPETITIONS PER RELAY
- EXPECTED LATENCY = PACKET_TIME×(N×S)/2 = 512µs×(6×4)/2 = 6,1 ms
**Packet Format**

- **SW Processing:** 192 µs
- **Sending/Receiving:** 320 µs → 10 B
  
  ~2,000 Packets/s
PACKET FORMAT

- **SW PROCESSING: 192 µs:**
  - COUNTER++
  - CHANNEL++ (SPI)
  - SEND (SPI)
  - LOAD NEW PACKET (SPI)

- **SENDING/RECEIVING: 320 µs → 10 B**
• **SW PROCESSING**: 192 μs
• **SENDING/RECEIVING**: 320 μs → 10 B
  - 4 B: PREAMBLE
  - 1 B: SFD
  - 1 B: LENGTH
  - 2 B: PAYLOAD
  - 2 B: CRC
**Packet Format**

- **Sw Processing**: 192 µs
- **Sending/Receiving**: 320 µs → 10 B
  - 4 B: Preamble
  - 1 B: SFD
  - 1 B: Length
  - 2 B: Payload
  - 2 B: CRC

  - Node Identification
  - Counter
  - Payload
  - BigBang Bit
  - Up to 3 Extra Payloads
TESTBED – CONNECTIVITY MATRIX

Connectivity (Level 0)

-100→80  -80→60  -60→40  -40→20  -20→0
TESTBED – JAMMING

[Graphs showing network performance and channel selection for different nodes.]
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THANK YOU

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