Battery Powered Tags for ISO/IEC 14443

Klaus Finkenzeller
17.05.2011

Giesecke & Devrient
Creating Confidence.

Battery powered Tags for ISO/IEC 14443

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- Limiting factors of very small transponder antennas
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- Requirements to an active load modulation
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Contactless Smartcard according to SO/IEC 14443

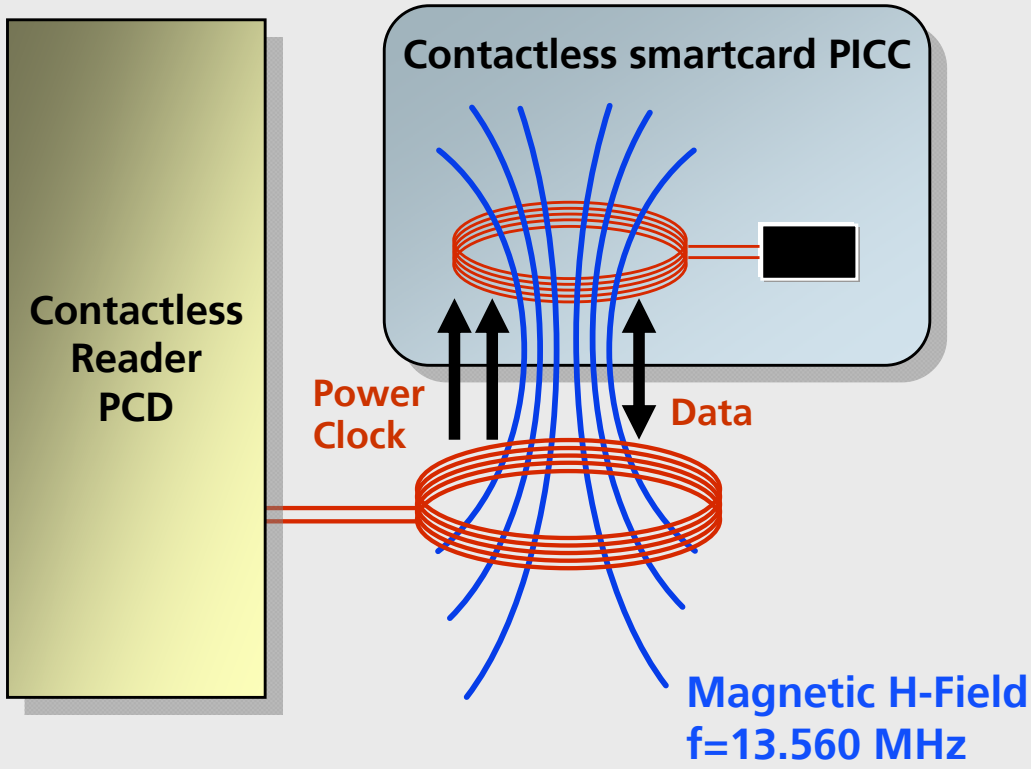
Back in 1993 the requirements are simple and straight forward. In the recent years, new applications and resulting requirements made ISO/IEC 14443 more and more complex

1993: Requirements and parameter for contactless cards and reader defined the first time

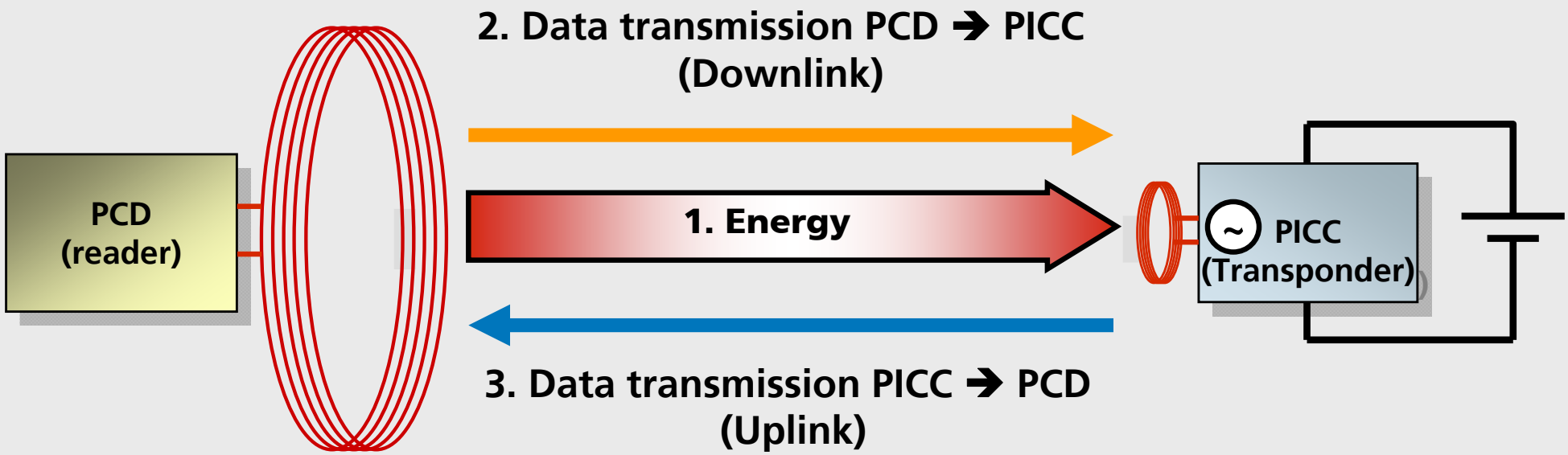
- Inductive coupled RFID-System
- Form factor ID-1 (smart card)
- Magnetic field strength 1,5 … 7 A/m (reader)
- Frequency 13,56 MHz
- Bitrate 106 kBit/s
- ➔ Resulting read range typically 3 .. 10 cm

2011: New applications and requirements

- Increasing demand for smaller form factors beside smart card
- Increasing demand to operate in metall environment (mobile phone)
- ➔ Communication not granted by default



Limiting factors of very small transponder antennas



1. Power: The small PICC antenna accumulates not enough energy from the field.

2. Downlink: Coil voltage for demodulation is too low

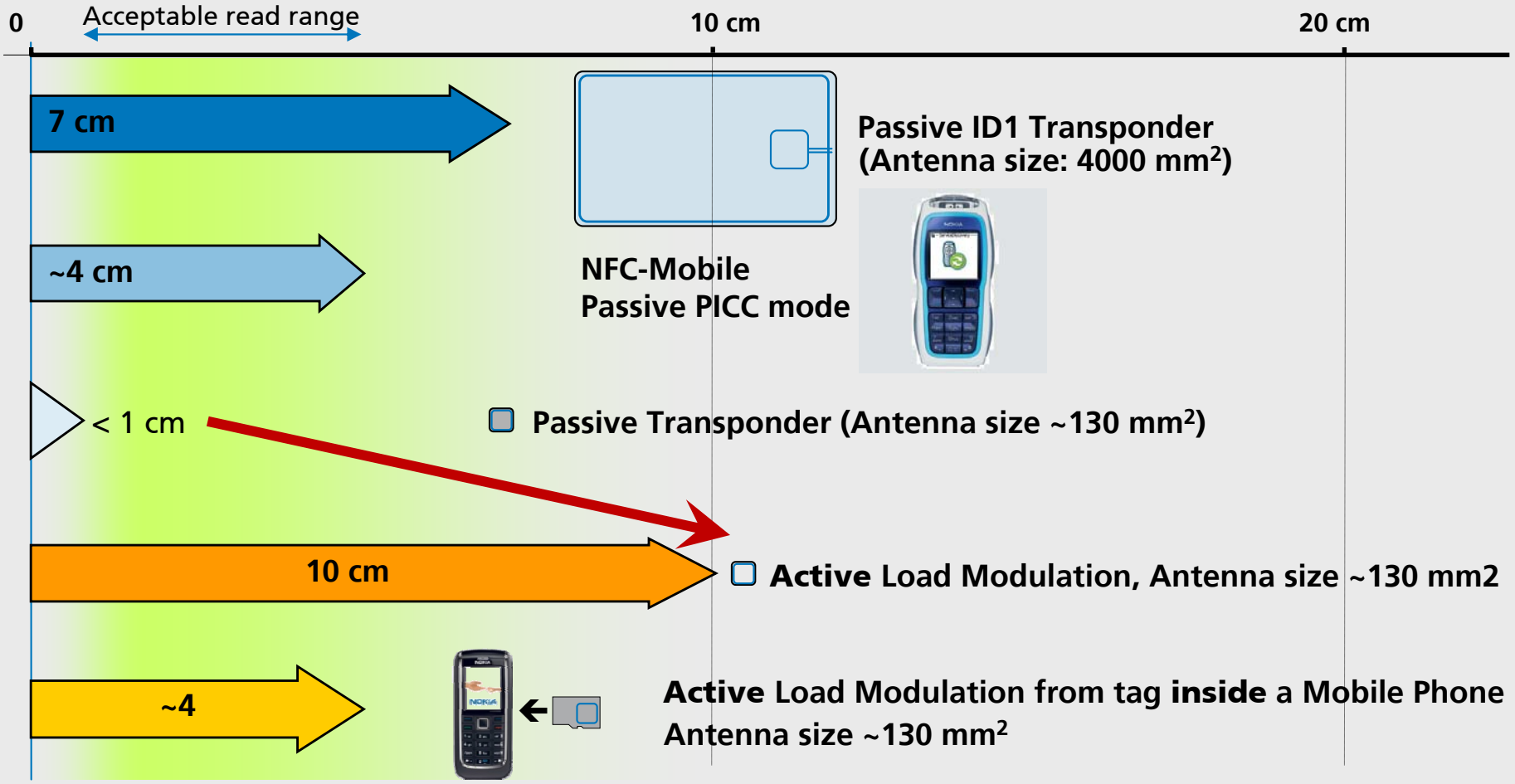
Solution: use battery power supply; improve receiver; transmit signal

3. Uplink: The load modulation effect with the small PICC antenna is too poor

Solution: active signal modulation and transmitting!

Communication Ranges with active load modulation

Active Load Modulation allows acceptable reading ranges even with very small tags



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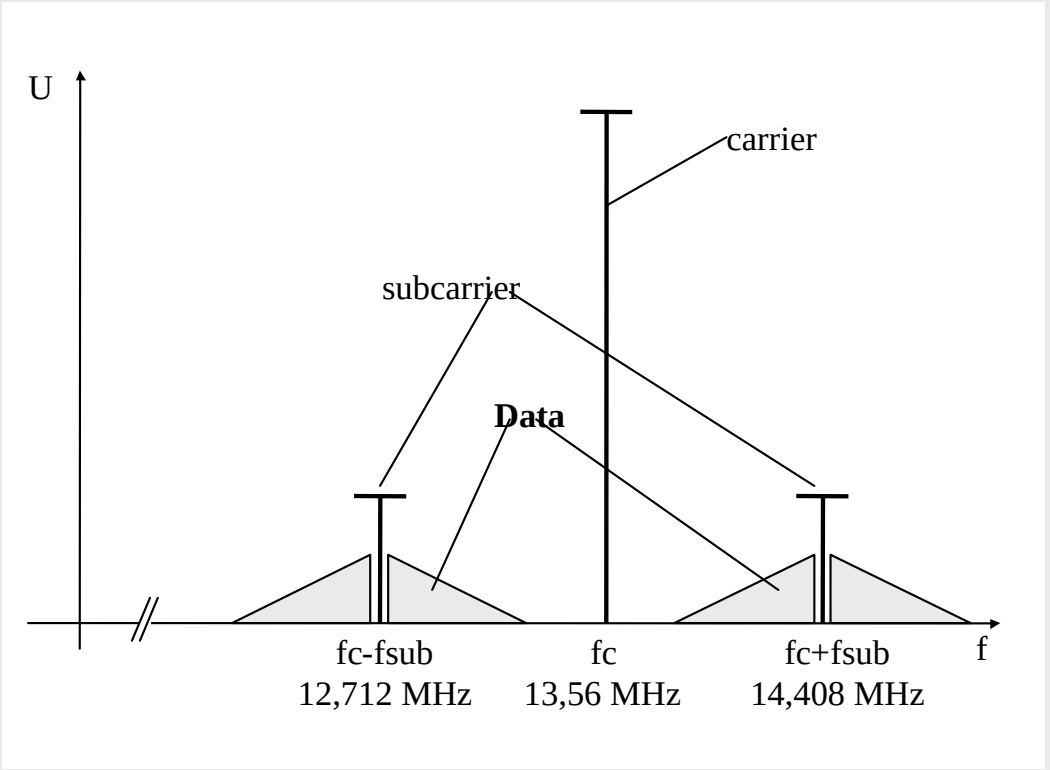
Load Modulation Spektrum @ ISO/IEC 14443

Requirements for Enhanced Modulation

- ALM must be fully compatible with a passive standard load modulation.
- A reader need to get a signal spectrum, identic to load modulation.
- Available power hast to be used as efficient as possible
  ➔ signals not carrying any information should not be transmitted.



Frequency spectrum of a common load modulation signal

Active Load Modulation = Double Sideband Modulation

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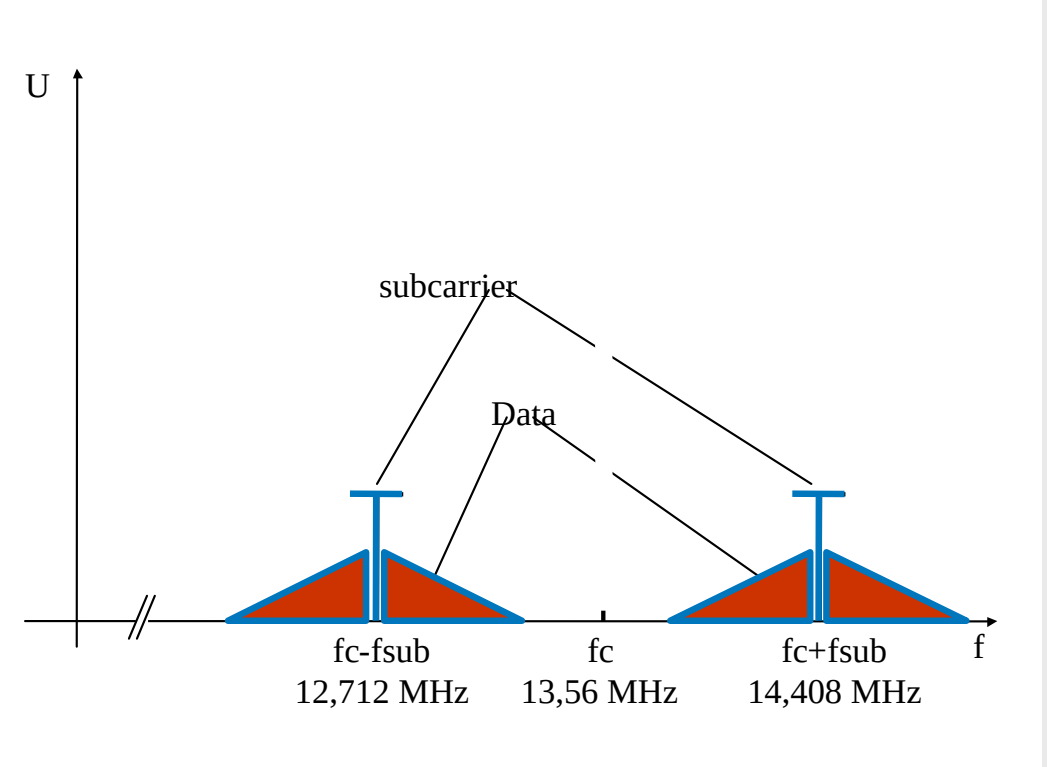


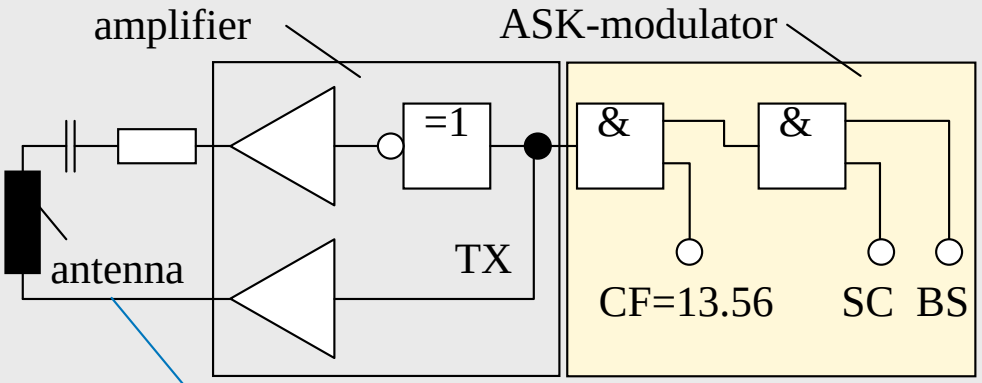
➔ **Modulate carrier frequency with modulated subcarrier signal according to ISO/IEC 14443. Use efficient modulation method (ASK or DSB modulation)**

Generating active load modulation

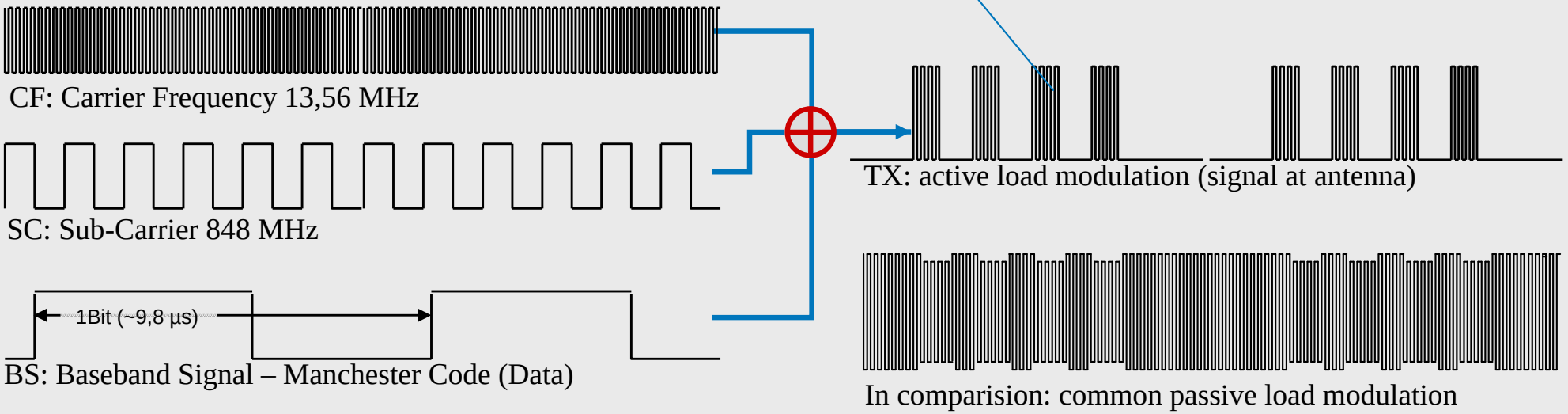
ASK is the most simple approach to generate active load modulation

Most simple modulation: Logical AND

$$CF \wedge SC \wedge BS$$



- Type A, 106 kBit/s



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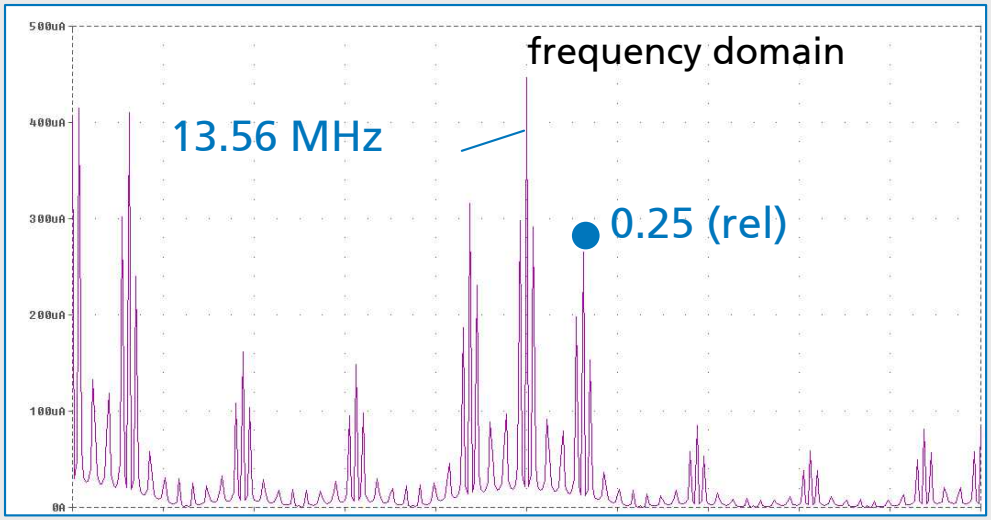
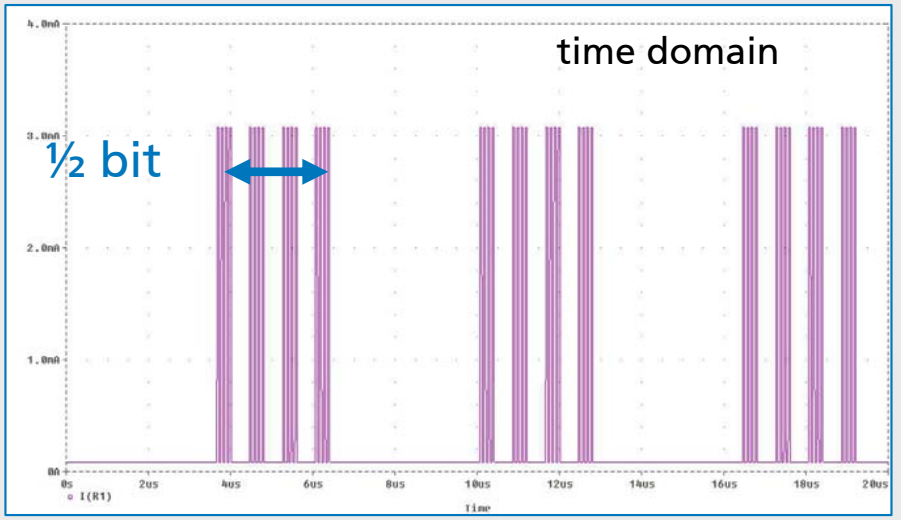
Performance of the ASK Modulator

ASK is the best choice regarding energy efficiency (type A, 106 kBit/s)

- 83% relative read range (compared with ring modulator)
- 25% relative energy consumption (25% time „on air“)

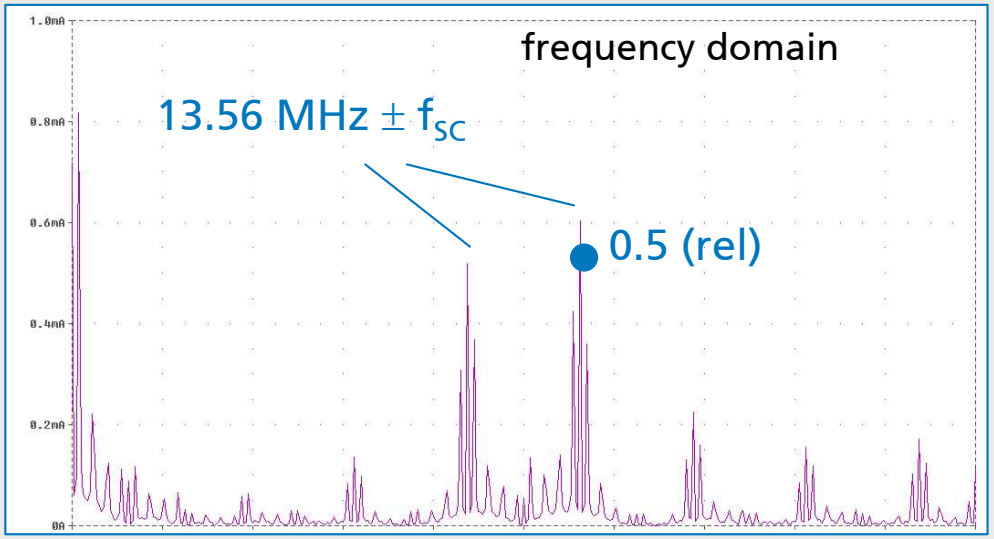


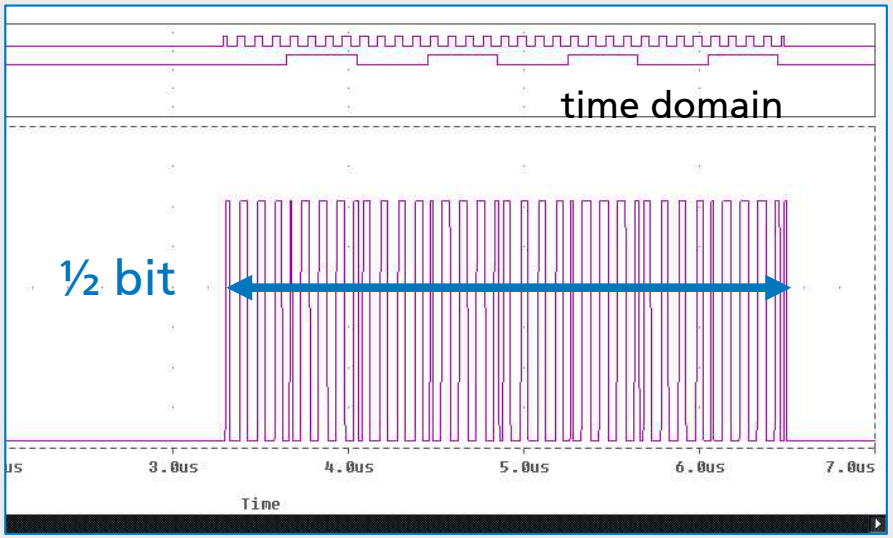


Performance of an Optimised Ring Modulator

The optimized ring modulator is the best choice regarding the reading range (type A, 106 kBit/s)

- 100% relative read range
- 50% relative energy consumpion (50% time „on air“)
- Carrier suppression ➔ +6 dB Gain





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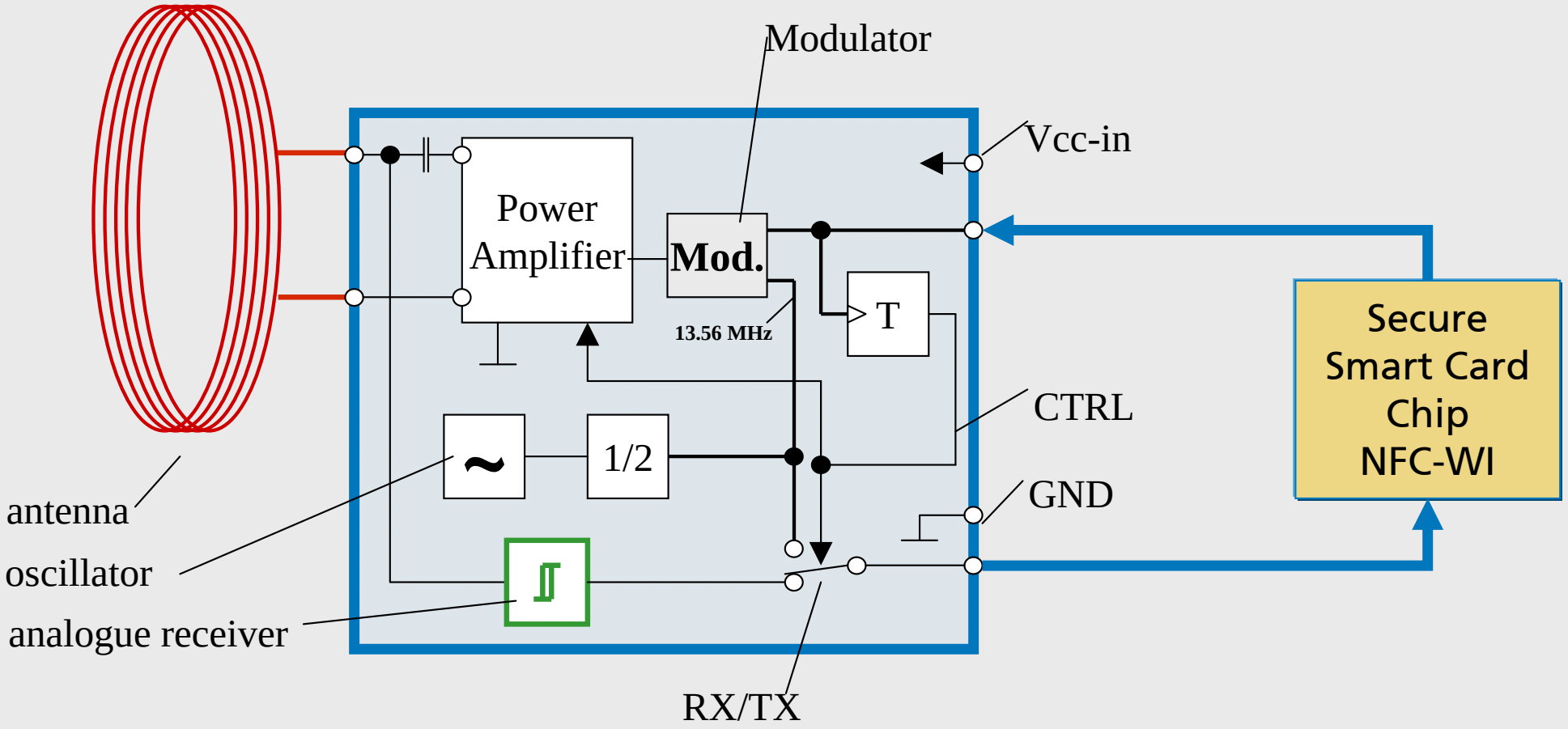
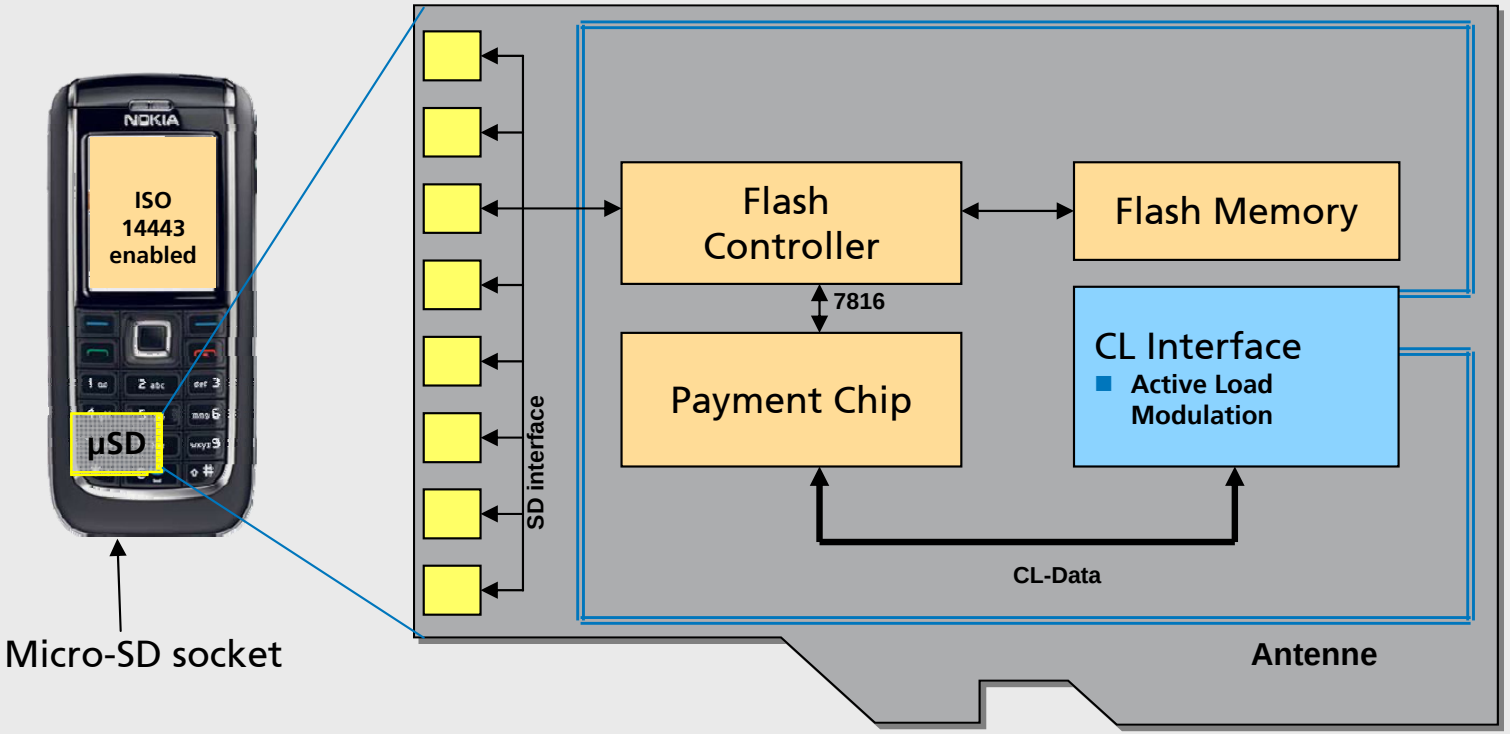
Analoge Front End ASIC

To proof the concept of active load modulation and to supply first products, a special analoge front end ASIC was developed



Sample application – a contactless micro SD card

The contactless micro-SD Card will be a “Plug & Play” NFC extension for mobile phones



- Supports „over the air“ download of applications (GSM interface)
- Card can be operated with common ISO/IEC 14443 compliant readers

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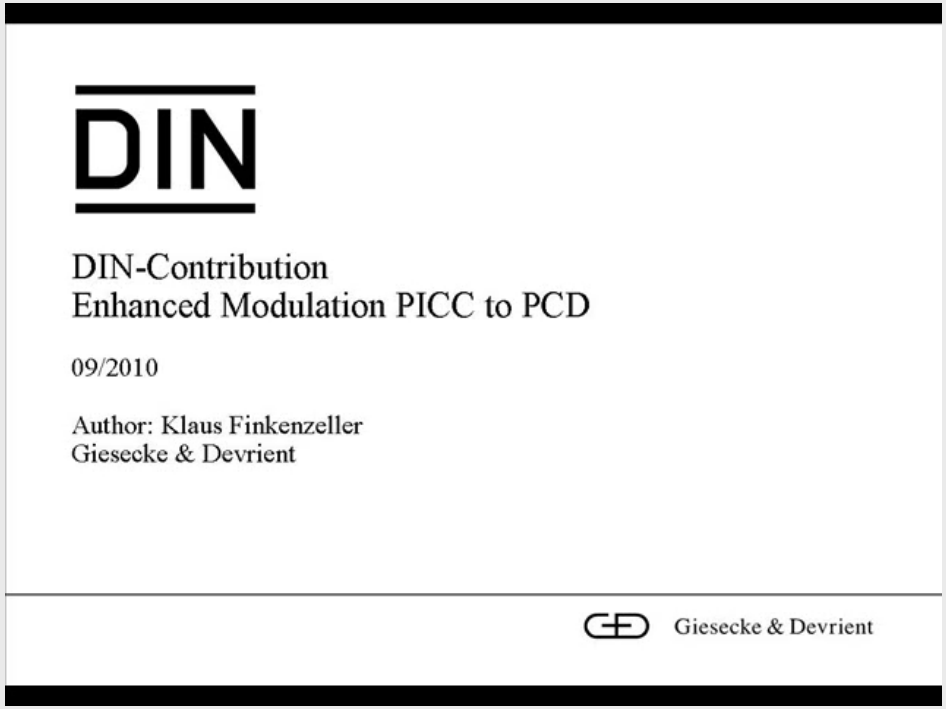
Videopresentation



Definition of Load Modulation in ISO/IEC 14443-2

ISO/IEC 14443-2 currently only permits passive load modulation, so some clauses have to be changed

Clause 7

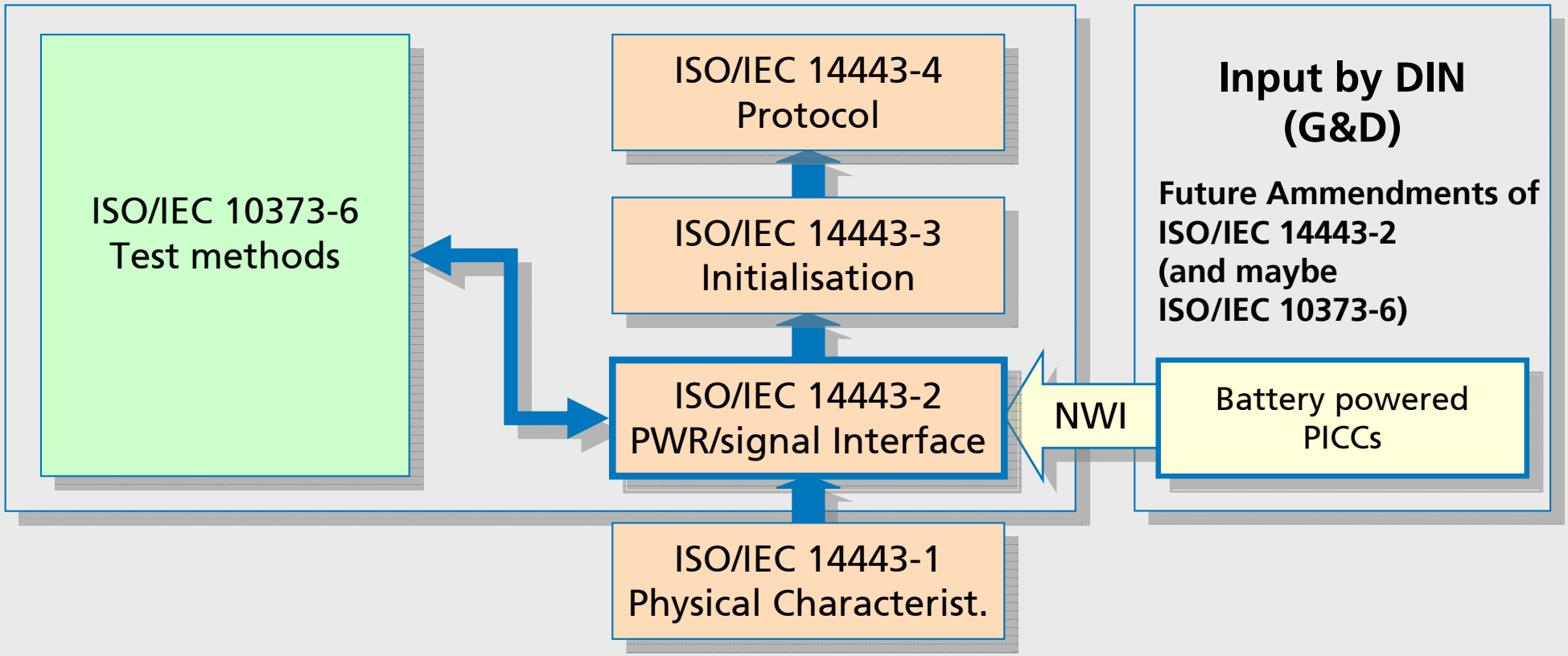
- The PICC loads the alternating magnetic field with a modulated subcarrier signal (load modulation) in order to transmit data from the PICC to the PCD.
- Within manufacturer specified operating volume the PCD shall generate modulation pulses as described in the following clauses and shall be capable of receiving the minimum load modulation amplitude.

Clause 8.2.2

- The PICC shall be capable of communication to the PCD via an inductive coupling area where the carrier frequency is loaded to generate a subcarrier with frequency fs. The subcarrier shall be generated by switching a load in the PICC.

Involved parts of ISO/IEC 14443

To include battery powered tags (PICC), part 2 of ISO/IEC 14443 has to be changed



Thank you!