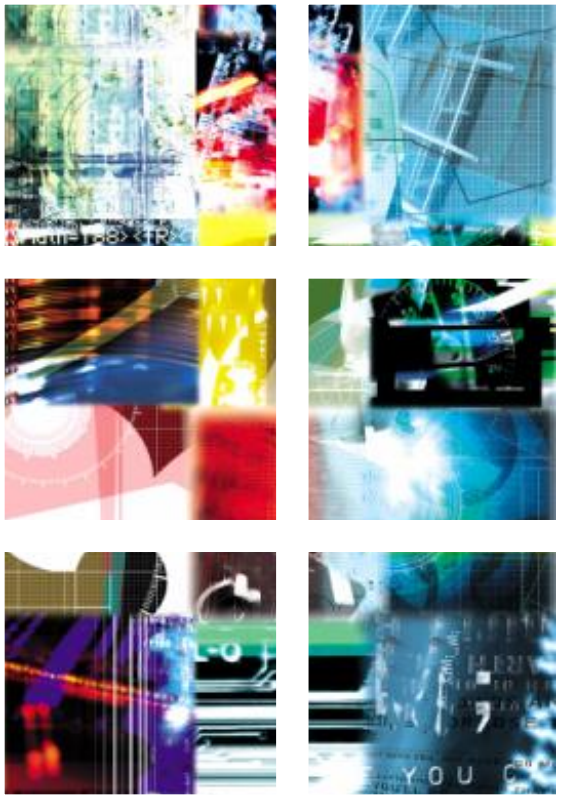

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Use of Open Standards for Smart homes and buildings

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   - application models
5. The HBES RF Medium
   - Overview of the main features
   - Retransmitter technology
   - Bi-directional battery driven devices
   - Recent extensions

Smart Home/Buildings: general advantages

- Scalability – Investment in the future
  - first smart home installation may be limited to one single application
    - Lighting
    - Heating, ventilation, air conditioning
    - Shutters, blinds and sun shading
    - Metering, energy management
- Considerable reduction of energy consumption
  - Examples: presence detectors, window contacts, light intensity sensors
- Increased comfort/security
- Distant monitoring/maintenance of networked devices
- Answer to changing social trends
  - Ageing of people (Ambient Assisted Living)
  - Increase in single person households
  - Both adults in families working
  - Increased urbanization
  - Shrinking resources
    - Anyway requires **increased use of ICT in homes and buildings**

Open Smart Home systems

- What is open?
  - **Internationally standardised** as EN, ISO or IEC and with strong support in industry
    - Guarantee of availability over larger time span
    - Guarantee of backward compatibility of current installations to future extensions
  - Fully available specification for implementation
- Major assets of open smart home system
  - Full **extendibility** of installation
  - Free **choice** of home owner of **material provider**
  - Reduced use of gateways
    - Increased simplicity of installation
      - Increased acceptance of home or building owner

The European Standard EN 50090 (1)

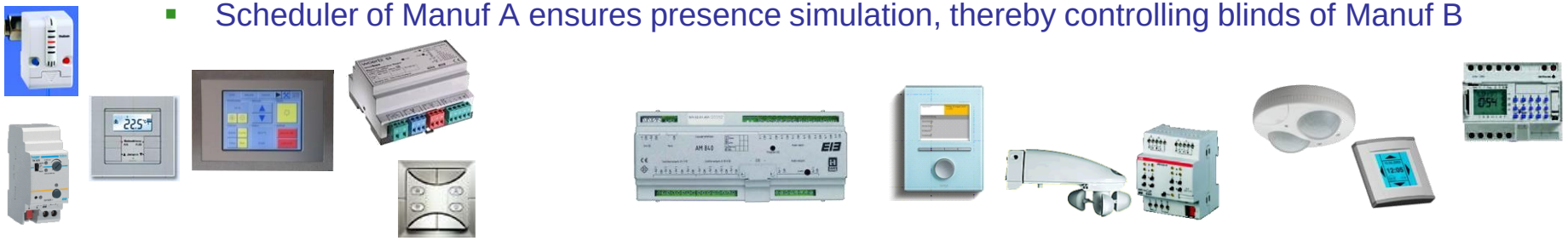
- History
  - Before 1997: 3 major bus associations in Europe
    - **Batibus**: medium originally developed by Schneider Electric – HVAC applications – mainly France/Italy/Spain
    - **EIBA**: association defending EIB protocol – developed by German consortium (a.o. Siemens) – mainly use in German speaking countries
    - **EHSA**: association resulting from European ESPRIT project for networked home appliances – paper standard
  - After 1997: convergence of Batibus, EIBA, EHSA to **KNX**
  - 2003: acceptance of jointly developed protocol as **EN 50090** series, including:
    - 4 media: TP, PL, RF, IP
    - Entire protocol LL, NL, TL, AL
    - configuration procedures including
      - PC tool support
      - Easy installation mechanisms (controller, push button mode)

The European Standard EN 50090

- History
  - 2006
    - Approval of EN 50090 as **ISO/IEC 14543-3**
    - Approval of EN 50090 by CEN as **EN 13321-1 and -2**
  - 2007
    - Approval by SAC (P.R. China) as **GB/Z 20965**
  - 2010
    - Nearly 250 supporting industrial companies offering several thousands of devices
      - compatible to EN
      - certified by third parties
    - Members are SMEs as well as multinationals
    - From all over the world: Europe, US, Asia

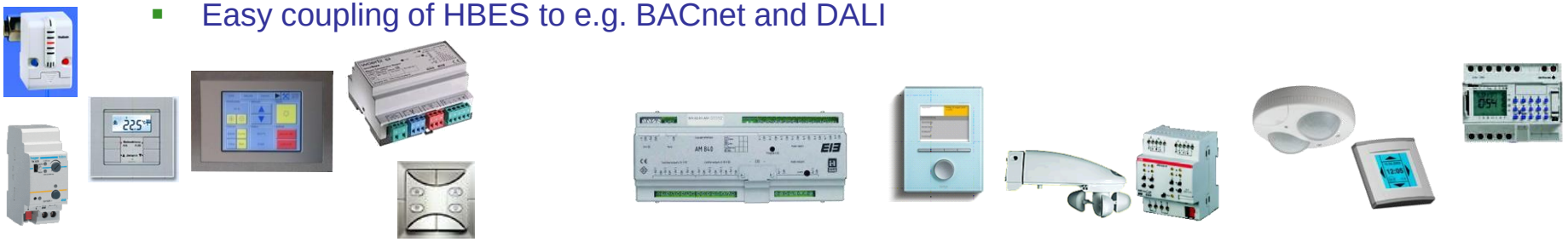
Multi-vendor and cross discipline Interoperability (1)

- **HBES**
  - Next to standardization of system (media, protocol)
  - Standardization of useful data in HBES messages during run-time communication
- **HBES standardized data types for common functions like**
  - Switching, dimming, blinds control, integer and float values, percentage, date/time, HVAC modes, scene control,
  - Data driven instead of command oriented…
- **System as well as data type conformity checked during product Certification**
- **The advantages of HBES only truly become visible in a multi-vendor and cross-discipline environment**
  - Presence detector is part of the alarm system at night
  - Room thermostat of Manuf A sets position of valves of Manuf B
  - “All off” button of Manuf A switches the lights off, controlled by switching actuators of Manuf B, C, D, …
  - Scheduler of Manuf A ensures presence simulation, thereby controlling blinds of Manuf B



Multi-vendor and cross discipline Interoperability (2)

- **Enormous benefit to end users**
  - Product line A is defective but Manuf A has discontinued product line ➔ Find replacement at Manuf B
- **Interworking attracts manufacturers of niche products**
  - One single manufacturer is unable to offer all possible HBES solutions, from lighting to HVAC to Load management, etc.
  - Boosts OEM market: what Manuf A does not produce himself, he can easily find at another HBES manufacturer
- **Thanks to interworking, a common market infrastructure can be established**
  - Common configuration tool
  - Common training schemes
- **Gateways between HBES and proprietary systems are easier to develop**
  - proprietary coding can be easily mapped to common HBES data formats as described in EN 50090-3-3
  - Easy coupling of HBES to e.g. BACnet and DALI



HBES system architecture

Unified Logo

Objects with standardized Data types

‘S’

‘E’

System Mode (PC)

Easy Mode (no PC)

Config. Inteworking

Extended Protocol

Standard Protocol

Supported Media

TP1 ⟺ PL110 ⟺ RF ⟺ IP

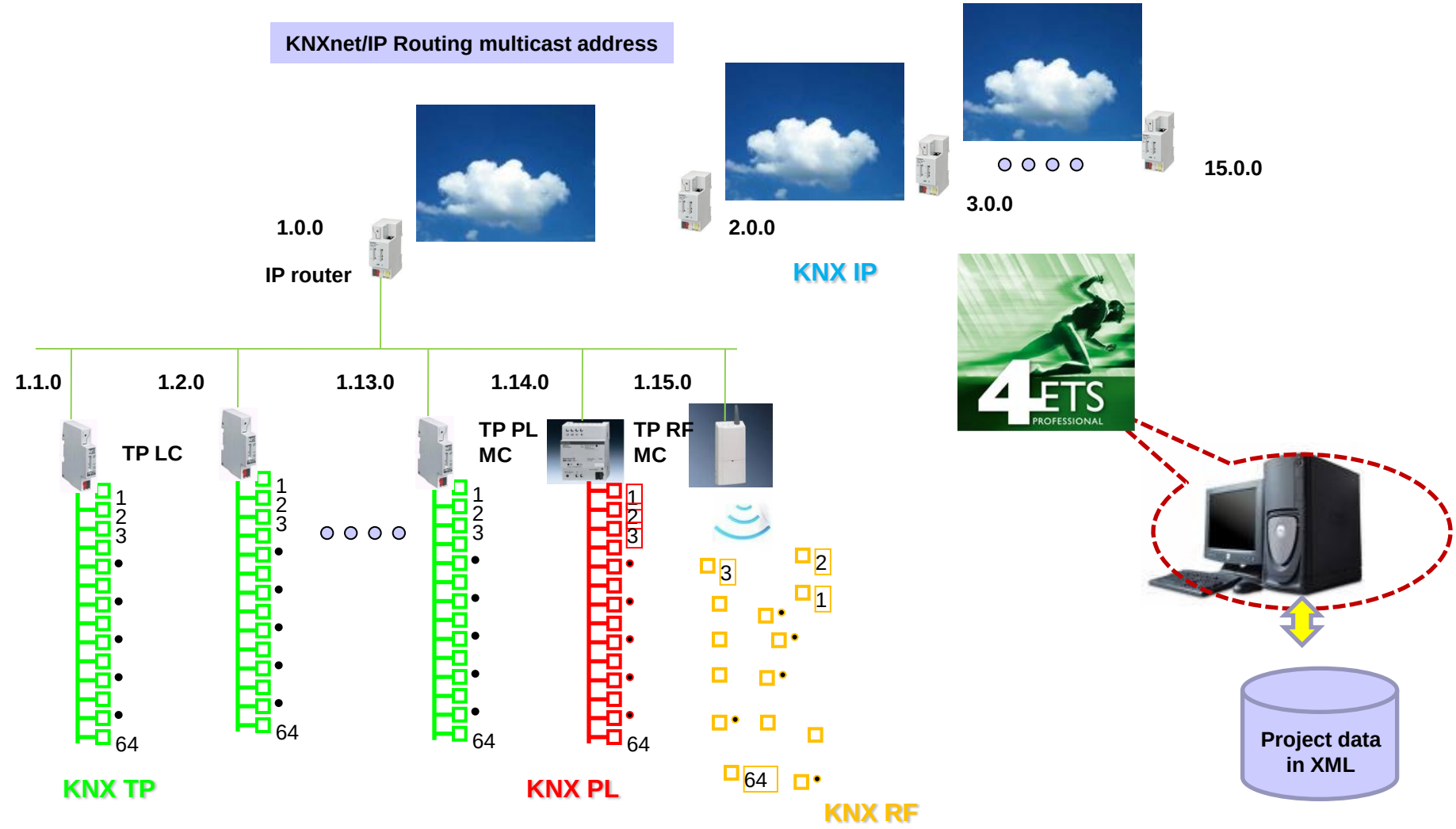
⟺ *Media Coupler*

Controller

Push Button

LTE

HBES – the overall picture!

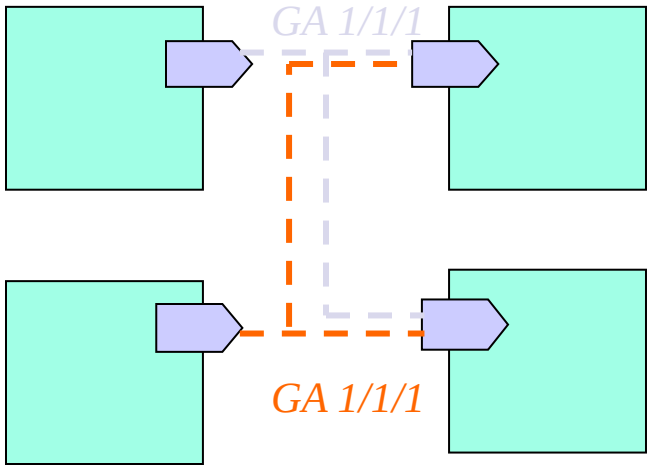


Addressing : Group

- Two basic HBES addressing schemes:

1. Group Addressing
   - In a running installation, main addressing scheme
   - Process information of devices (e.g. state of relay, t°C value, …) reflected in « Group Objects »
   - GO's of same size can be linked via 16 bit group address (64K address space)
   - The value of a GO can be read and written via the bus
   - A GO can only have one sending GA
   - A GO may listen to more than one GA
   - With one message containing GA x, one can address all GO configured to listen to GA x ('multi-cast connectionless')
   - If the message contains GA 0/0, all devices are addressed ('broadcast')
   - Used addresses stored in « Address Table »

Communication Model 1: Group Objects („Shared Variables“)



Group object e.g. DPT_Switch

telegram example:

source address:	destination address:	service:	data:
individual address	group address	read / write	
1.1.40	1/1/1	write	On (1)/Off (0)

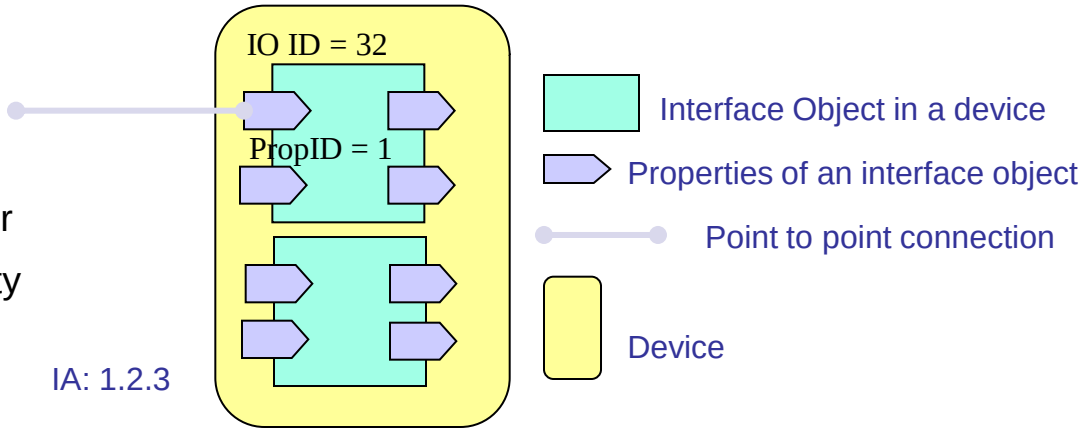
Addressing: Individual

- Two basic HBES addressing schemes:

2. Individual Addressing
   - for point to point communication
   - 16 bit device address (64K address space)
   - On some media (TP): location of device in topology (area.line.device)
   - connection-oriented or connectionless services
   - mainly for configuration, visualisation, diagnostics & remote management
   - Address also stored in « Address table »

Communication Model 2: Properties of Interface Objects

- IO is a Collection of process data („properties“) of a device, typical for its functionality
- Device can have several IOs (max. 256)
- Type of IO is given by 16 bit identifier
- Type of property is given by 8 bit identifier
- Value of GO can be reflected in a property of an IO



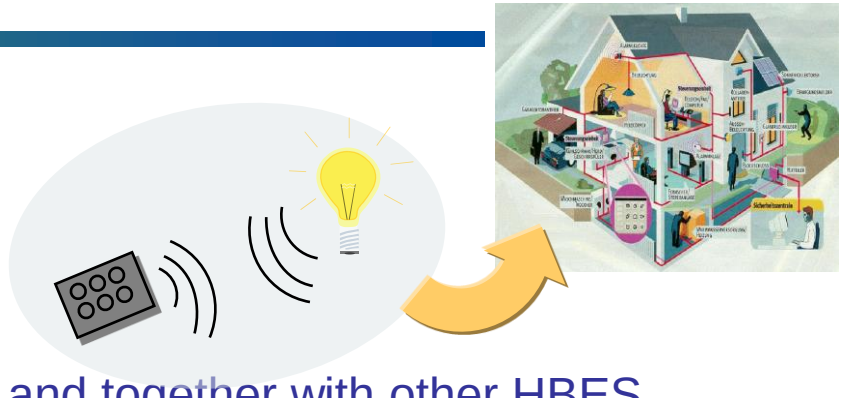
telegram example:

source address:	destination address:	service:	data:
individual address	individual address	read / write	object.property.value
1.1.40	1.2.3	write	Dimming speed= 1 dim step/100 ms

Addressing: separation on open media

- Powerline: 48 bit domain address added to each message
- HBES RF: in view of need for uni-directional senders
  - « Extended Group Address » = GA + Serial number of sender
  - For uni-directional senders: GA = pre-assigned

Features of the HBES RF system

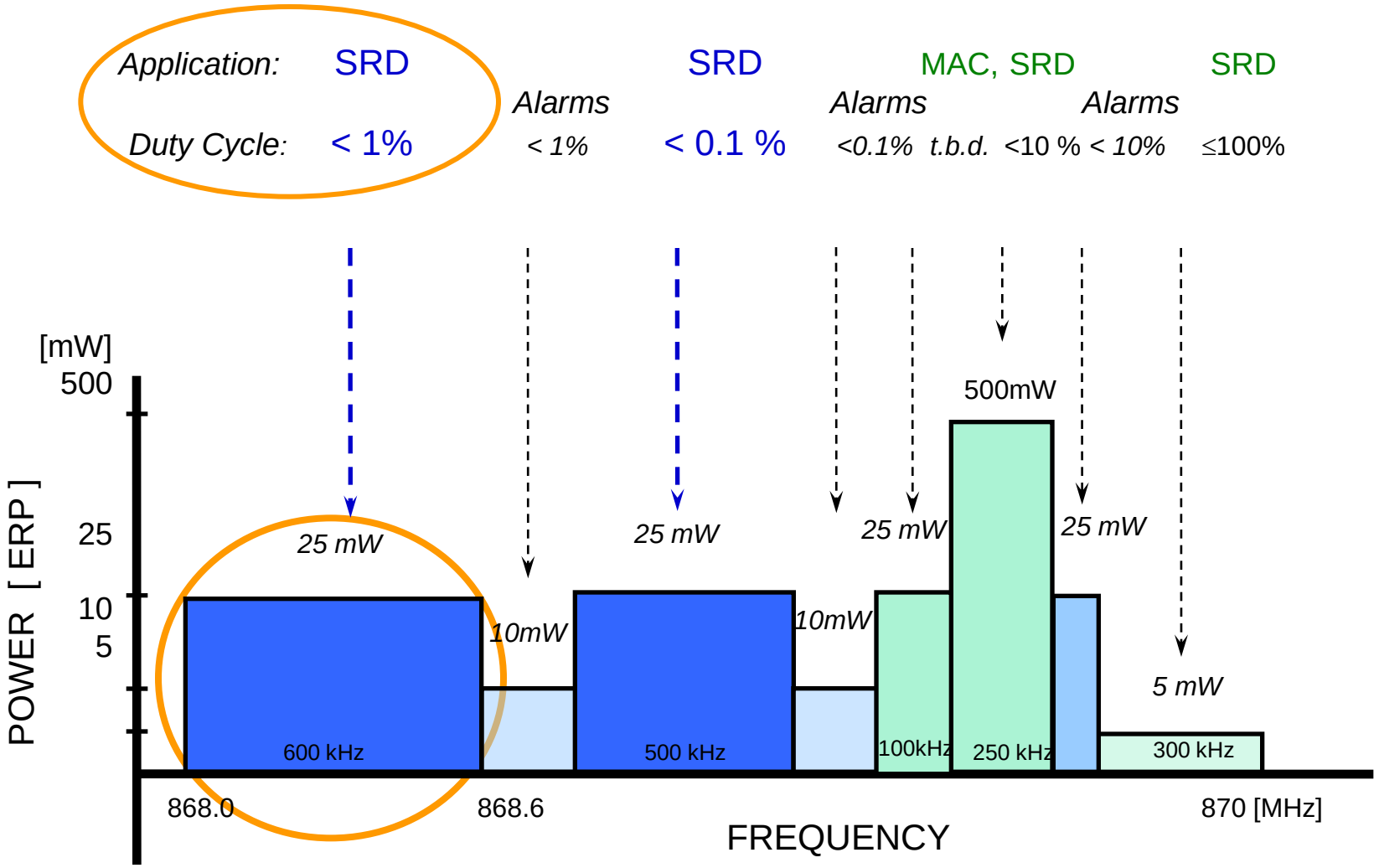


- retrofit market mainly
- home & residential market
- Decentralised (no master) but centralised functions possible
- usable as stand alone solution and together with other HBES media (gateways)
- Implementation on off-the-shelf components, small footprint
- Re-transmitter use only for bigger installations
- Bi- and unidirectional implementations possible
- Low power consumption
- for all application domains of home automation
  - lighting, shutters & blinds, security, HVAC, ..
- HBES RF metering protocol as subsystem to HBES RF
- Non-PC based programming (« Easy installation »), tool support planned

Relevant Standards

- Layers 3-7 = EN 50090-series
- Layers 1-2, approved by CLC/TC 205 as EN 50090-5-3
- common solution with/according to CEN/TC 294
  EN 13757-3/-4 (Metering!)
- RF according to CEPT/ERC 70-03 (868 MHz - Band)
- Data Link Layer according to IEC 870-5-2 (FT3 - Protocol)

HBES RF Physical Layer (1) acc. to CEPT/ERC 70-03



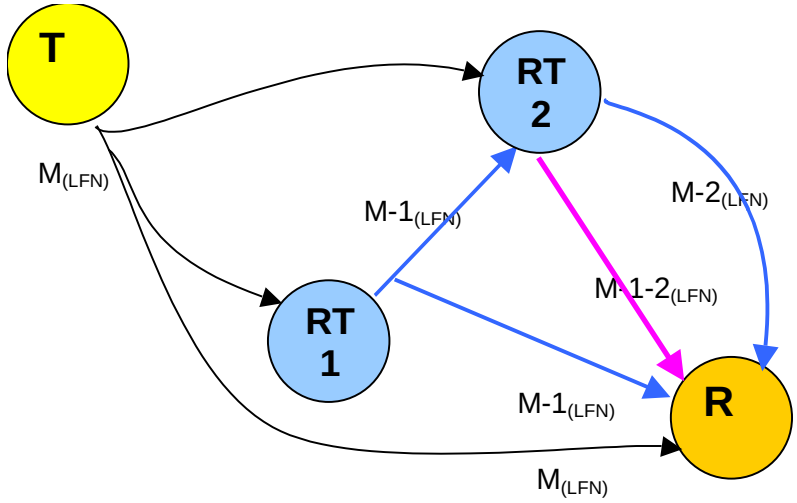
HBES RF general frame structure

IEC870-5-2 (FT3)

- Preamble — max. 15 x 01 chip — preamble for synchronisation
  - Manch. Violation
  - Sync Word
- Block 1 — 10 bytes — fixed length, more info on next slide
- CRC — 2 bytes CRC after each data block
- Further blocks — 16 bytes — details of block 2 on next slides
- Last block — 1 to 16 bytes
- Postamble — 2 to 8 chips — provides defined end of frame

Re-transmitter Technology

- up to 3 Retransmitters are supported
- No need for meshed networking
- *Link Layer Frame Number (LFN) + history list*
  - solution to multipath communication and avoiding message duplication:
- *routing counter*
  - Limitation of number of retransmissions
- *short interframe time + random delay: 0...10 ms*
  - avoiding collisions of retransmitted messages

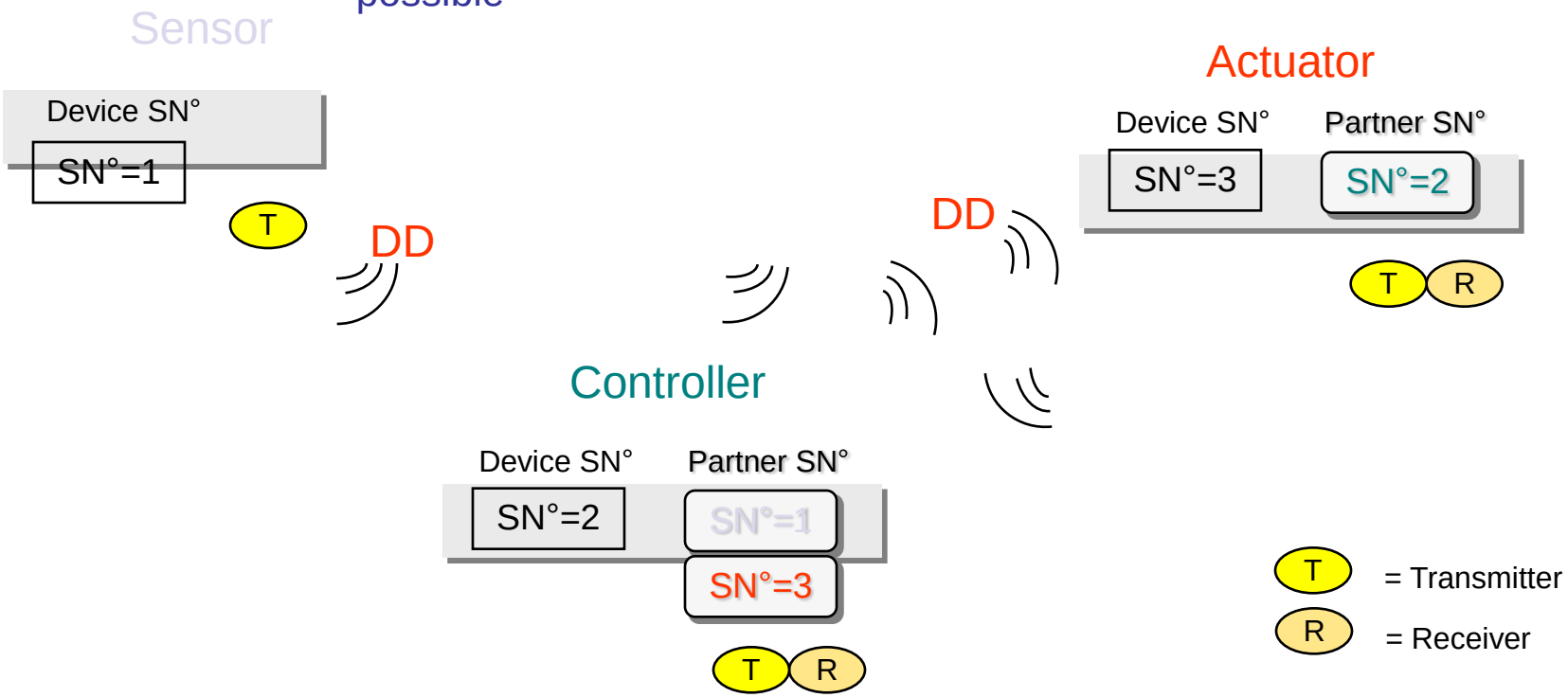


➢ *Dedicated retransmitters avoid complexity and overhead in normal end devices!*

T = Transmitter
R = Receiver
RT = Retransmitter

Device Linking via Serial Number and optional Domain Address

- Controller Based : Devices report Device Descriptor (type of supported standardised easy channels) – controller knows which channels can be linked
- Push button: same approach but partner device decides whether linking is possible



RF extension for bidirectional battery powered devices (BiBat)

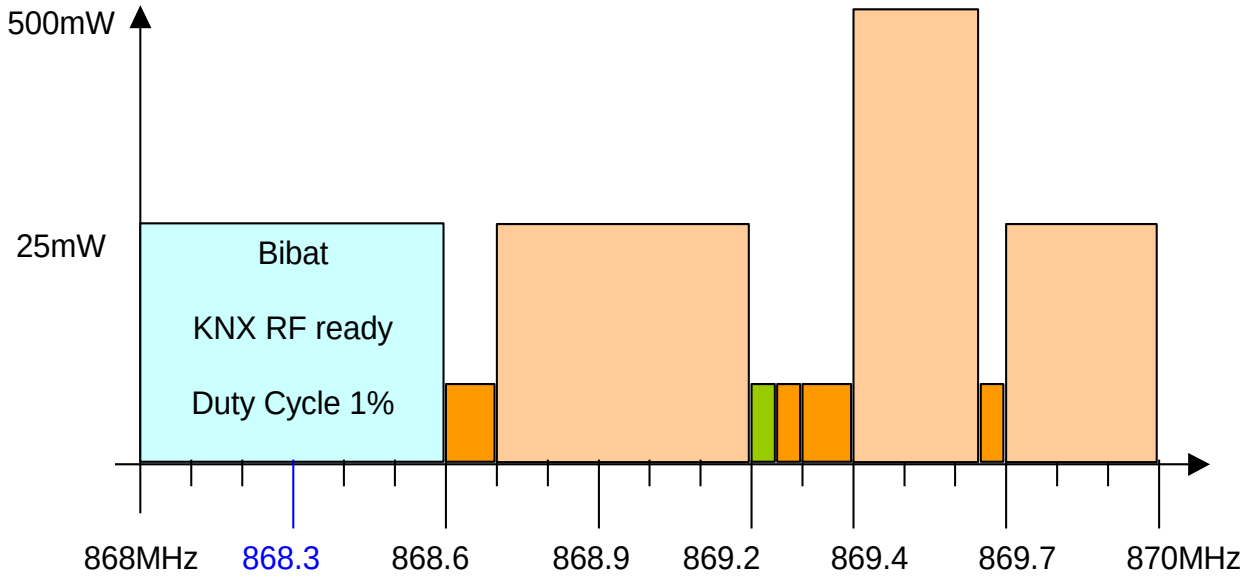
- Bidirectional battery-driven RF devices can't be in receive-mode all the time because of battery-lifetime
- The BiBat extension reduces the active receive windows of battery operated receivers to a minimum *by means of a time slot procedure*
- Application:
  - heating actuators for radiators
  - bidirectional room units
  - fire/smoke sensors remote controls with feedback
- Typical battery life times 1-3 years (with 2-3 AA batteries)

Recent extensions HBES RF

- RF « ready »
  - Single RF channel version – upgrade of version 1 of HBES RF
- RF « multi »
  - 3 fast RF channels and 2 slow RF channels
- Bibat
  - single RF channel version, unchanged compared to version 1 of HBES RF
- Bibat 2
  - 2 RF channels

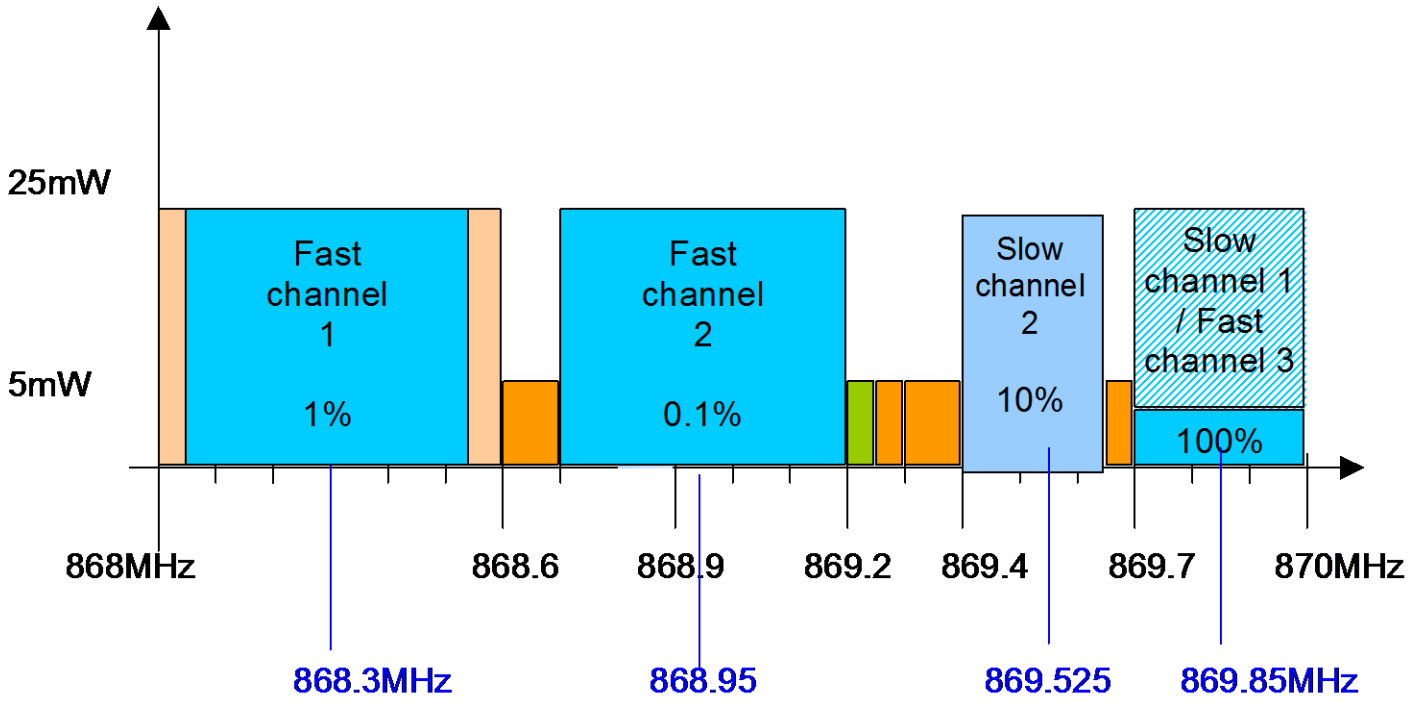
HBES RF Ready

- Single channel, evolution with 4.8ms preamble for Tx
- Rx change to ignore some bits in CTRL field
- The rest of the stack remains the same
- Only a software upgrade of existing products
- *All new developments shall be RF ready*

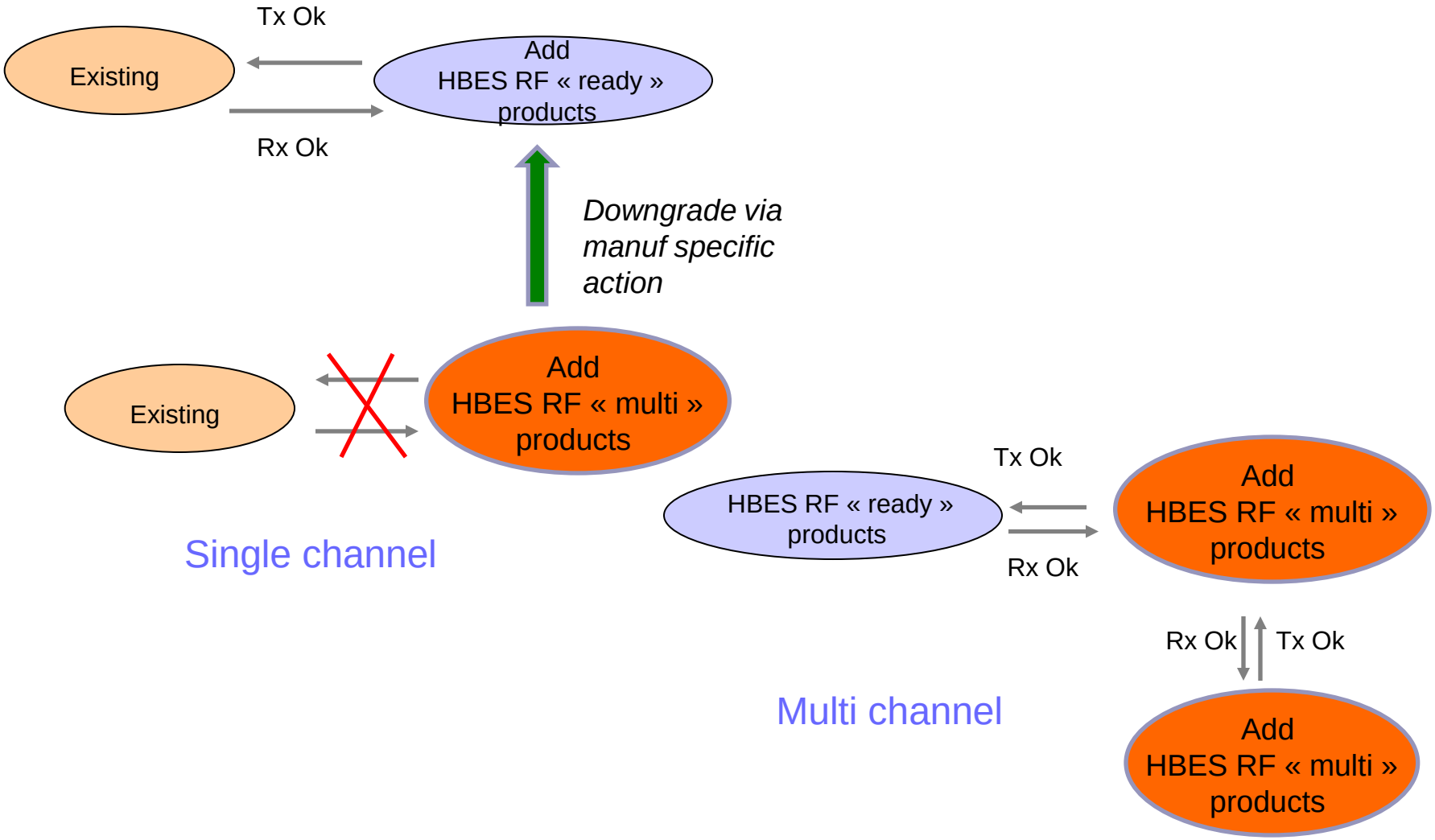


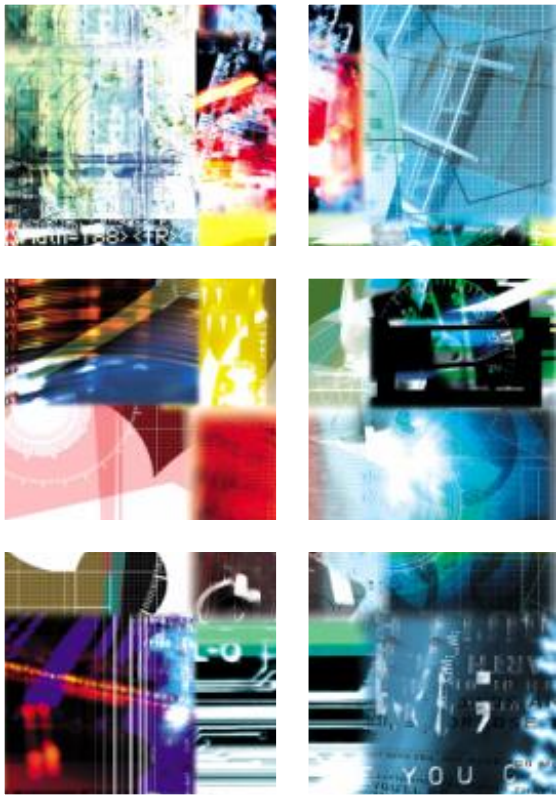
HBES RF multi

- 3 RF fast channels for low latency devices
- 2 RF slow channels for battery powered devices
- F3 optional
- 25mW in F3 is now allowed by regulation
- Energy savings
  - Allow very low power consumption for receivers



Compatibility scheme





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Thank you for your attention!

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