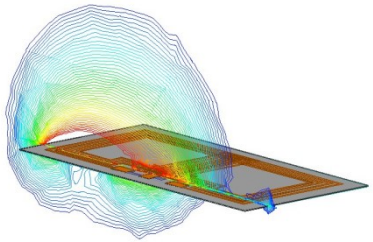
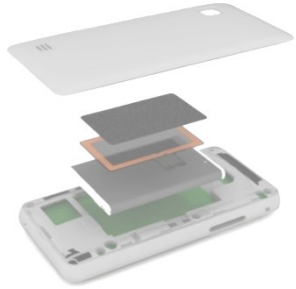
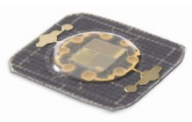
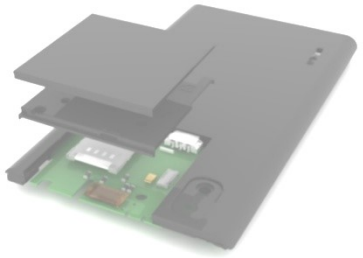






02 Standards and Regulation

2nd unit in course 451.417, *RFID Systems, TU Graz*

Dipl.-Ing. Dr. Michael Gebhart, MSc

RFID Systems, Graz University of Technology
SS 2023, March 07th

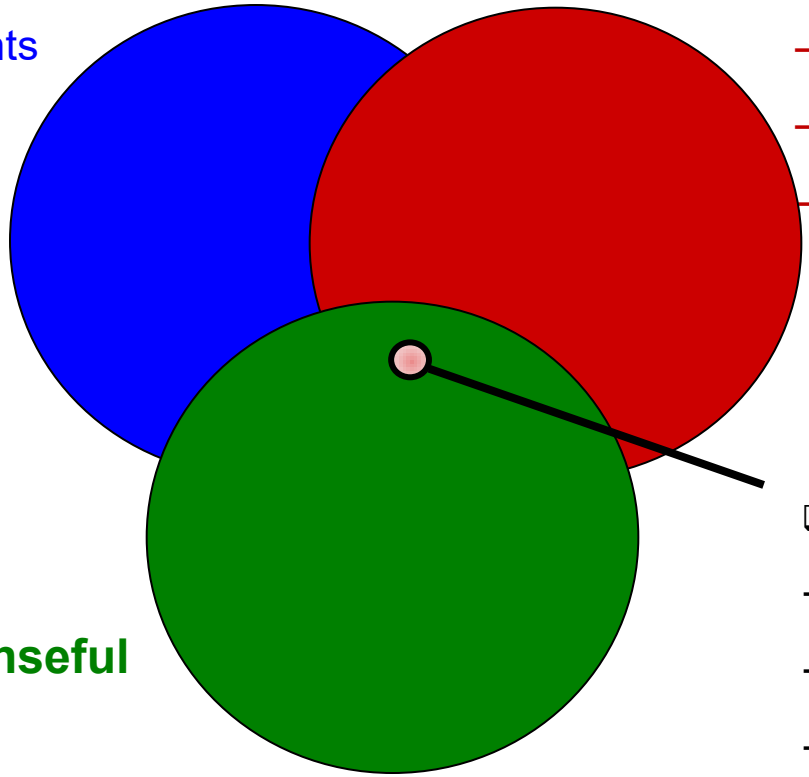
Content

- Overview
- Frequency Regulation (focus on HF)
- Product Standards and Standardisation
- Application related Standards

A general consideration for RF products

- **Physically / Technically doable**
  - functional requirements
  - power restrictions
  - analogue functions
  - digital functions

- **Legally allowed**
  - Frequency Regulation
  - Safety (e.g. CE)
  - Function / Compliance

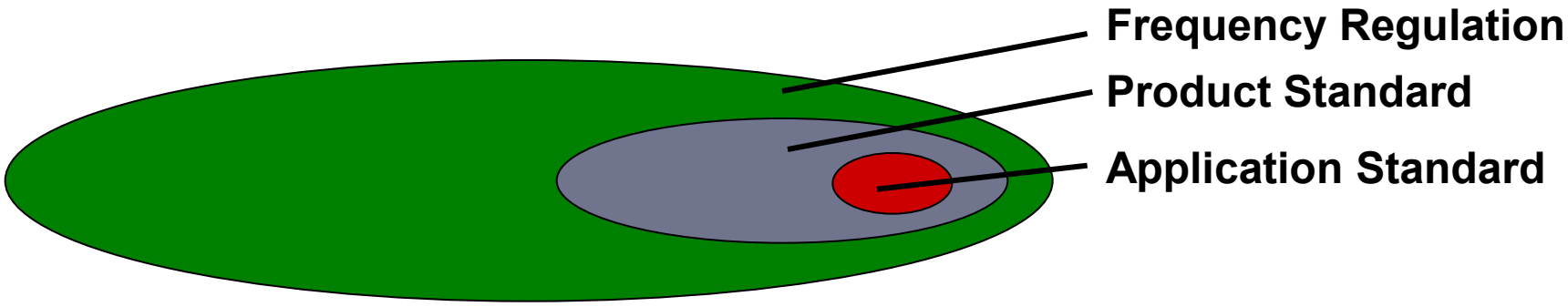


- **Economically senseful**
  - desired by people
  - use-case / benefit

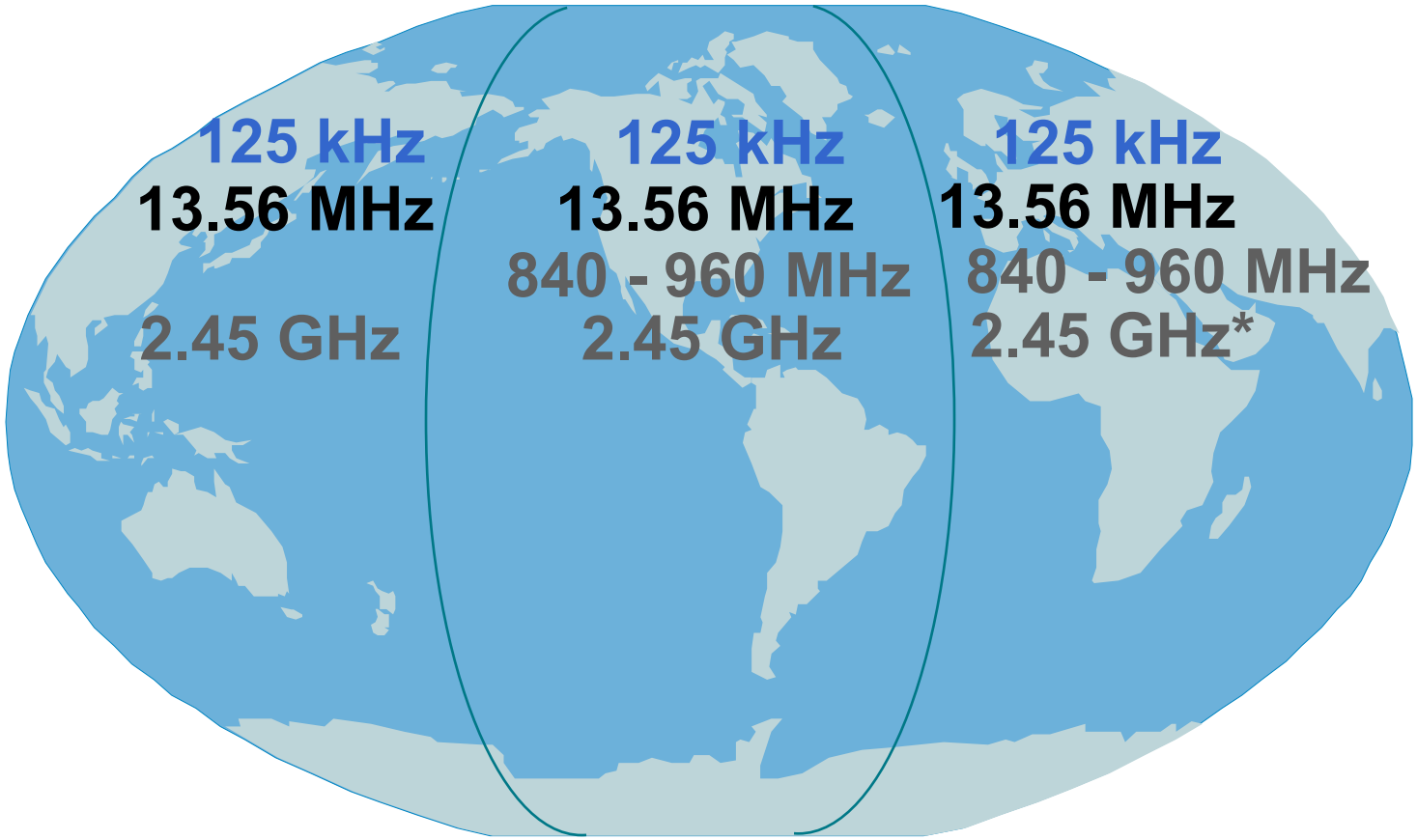
- **Senseful products**
  - Contactless Cards,
  - NFC,
  - UHF Labels…

RFID Standards and Frequency Regulation

- Dealing with Radio Frequency Identification, we need to differentiate 3 types of Standards:
- Frequency Regulation gives a general permission to emit radiation for certain applications by Short Range Devices (SRD) in specified frequency bands, for industrial, scientific, medical (ISM) use. Measurement methods, and emission limits, are specified.
- Product Standards specify, in the frame of a general operating permission, how an RFID-System or how contactless communication technology works.
- Application Standards specify everything for a certain application, e.g. e-Government, Payment, etc.

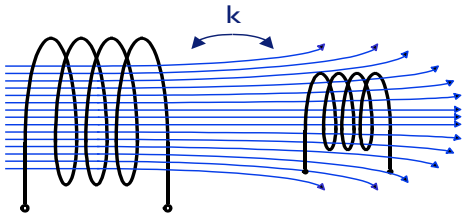
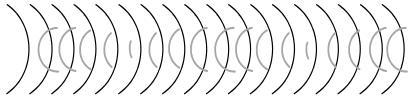
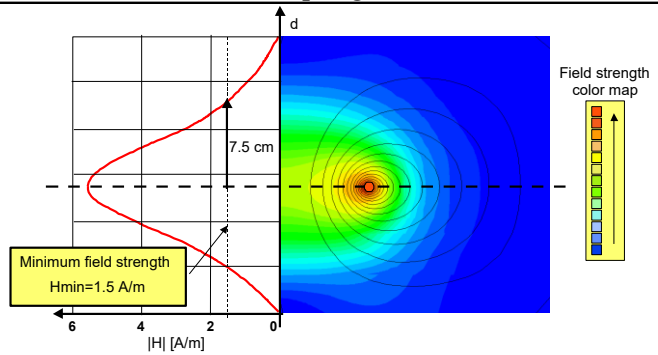
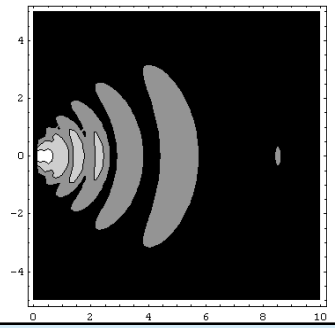
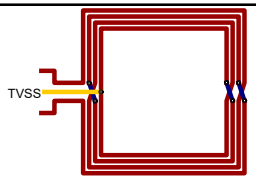
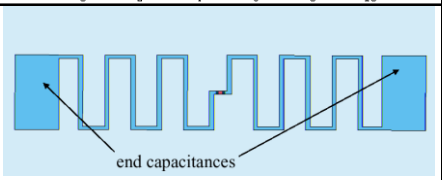


Regional differences in Frequency Regulation



*UHF with Limits due to Frequency Regulation

Frequencies for passive RFID-Systems

	LF (125 kHz)	HF (13.56 MHz)	UHF EU 866 MHz, USA 915 MHz
Principle	 Inductive coupling in near-field		 Wave propagation and reflexion
Field			
Transponder-Antenna	 *H*-field loop antenna		 *E*-field diplole antenna
Environment Water Metal	**No problem** **low attenuation**	**low attenuation** **critical**	**critical** **less critical**
max. range	**~ 0.8 m**	**~ 1.8 m**	**USA ~ 7m, EU ~ 7m**

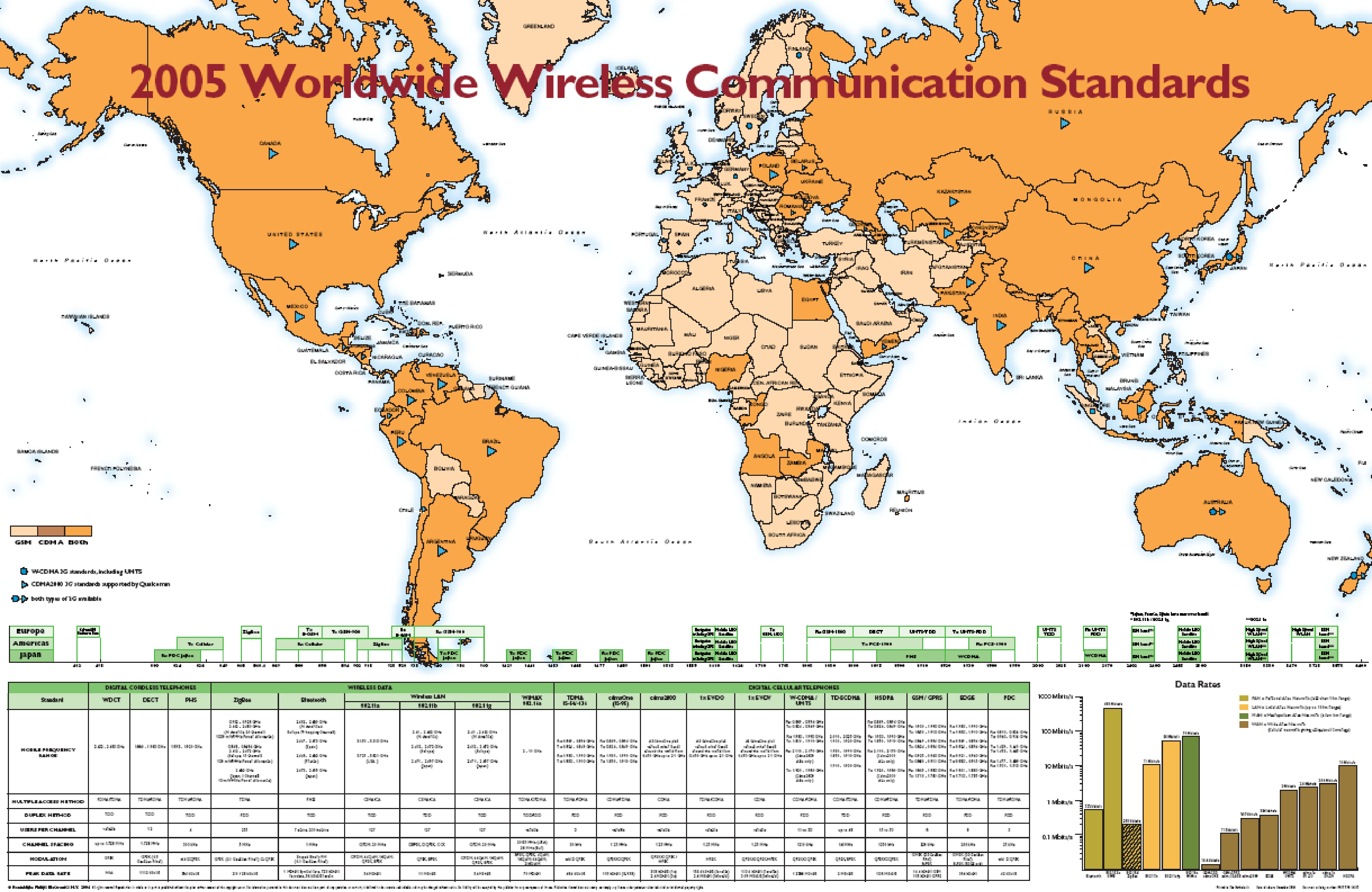
Frequency bands for RFID world-wide

- 125 kHz – LF
  - World-wide harmonized
  - No limitations of transmission time (100 % duty cycle)
  - (battery-less) Transponders: Emission is not considered
- Frequency Regulation13.56 MHz - HF
  - World-wide harmonized with minor national limitations
  - No limitations of the transmission time (100 % duty cycle)
  - (battery-less) Transponders: Emission is not considered
- 860 – 956 MHz – UHF
  - Europe: 0.5 W or 2 W ERP, 250 kHz band width, 10 % duty cycle
  - USA: 4 W EIRP, 26 MHz bandwidth, 100 % duty cycle
  - Japan: 950 – 956 MHz
  - (battery-less) Transponders: both, Readers and Transponders need to be certified
- 2.45 GHz (rarely for battery-less RFID, often for active Transponders
  - Europe: 0.5 W EIRP, 100 % duty cycle
  - USA: 4 W EIRP, 100 % duty cycle
  - Japan: 10 mW …. 1 W EIRP
  - (battery-less) Transponders: Readers and Transponders considered

Frequency bands and applications

- Within CEPT, ECC uses the following abbreviations for frequency ranges:

Symbols	Frequency range (lower limit exclusive, upper limit inclusive	Services
VLF	9 to 30 kHz	Induction heating
LF	30 to 300 kHz	Industrial induction heating, AM broadcasting, clock transmitters
MF	300 to 3 000 kHz	AM radio, industrial induction heating
HF	3 to 30 MHz	Broadcasting, Radio-amateurs, Armed Forces
VHF	30 to 300 MHz	PMR, TV, Armed Forces, Radio-amateurs, FM broadcasting, Aeronautical services
UHF	300 MHz to 3 000 MHz	TV, GSM, DCS, DECT, UMTS, Bluetooth, earth station, Radars
SHF	3 to 30 GHz	Radars, Earth stations, Microwave links
EHF	30 to 300 GHz	Radars, microwave links

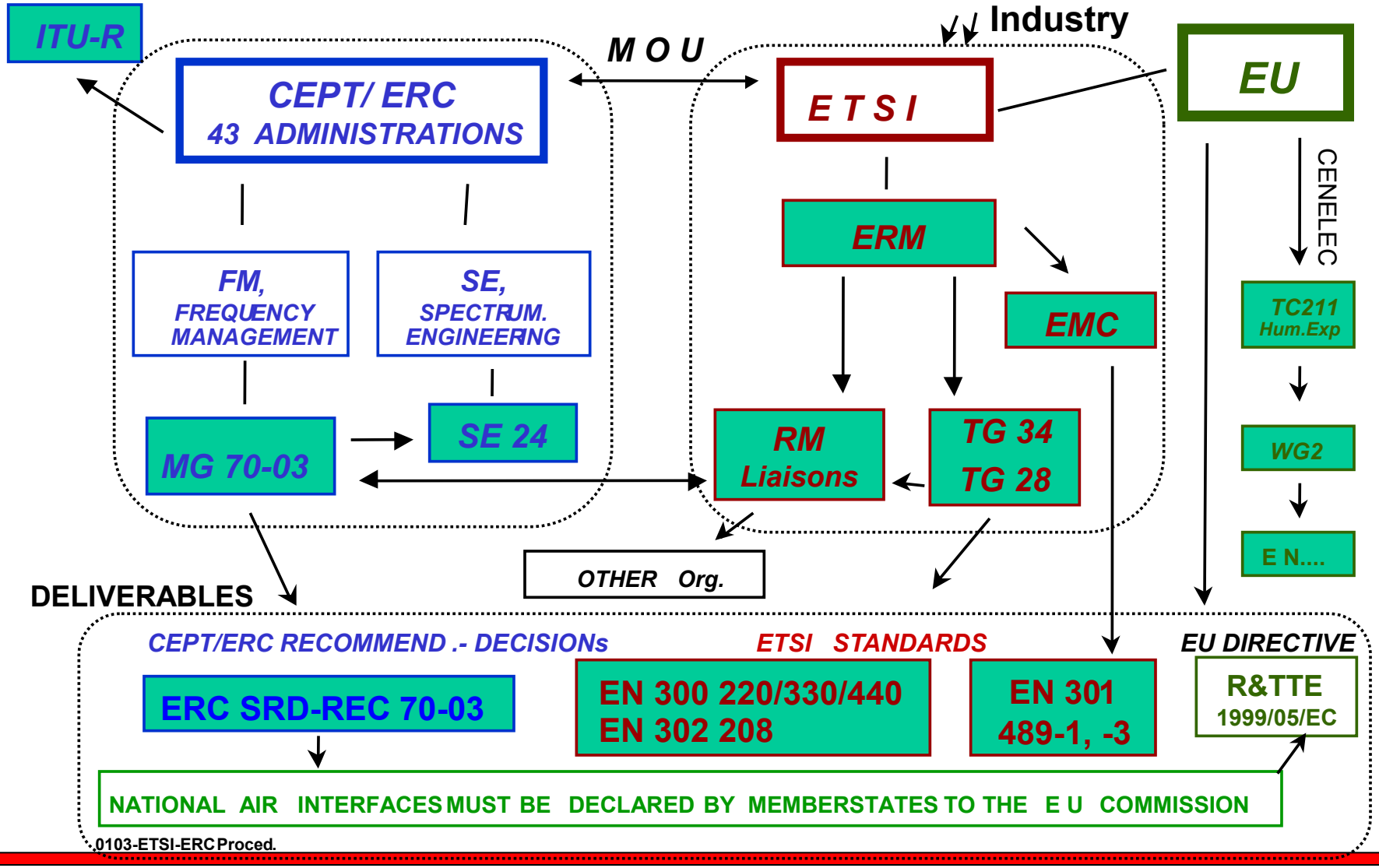


RFID Systems

Frequency Regulation

European Frequency Regulation

SRD Radio Regulation Organizations, EU



Some Abbreviations

- CEPT……Conference Europeenne des Administration des Postes et des Telecommunications (European Conference of Postal and Telecommunications Administrations)
- ECC.....Electronic Communications Committee
- EIRP.....Equivalent Isotropically Radiated Power (related to sphere)
- EN.....European Norm
- ERC.....European Radio Commission
- ERO.....European Radiocommunications Office
- ERP.....Effective Radiated Power (related to dipole)
- ETSI.....European Telecommunications Standards Institute
- ICAO..... International Civil Aviation Organisation
- ITU.....International Telecommunication Union
- LBT.....Listen before Talk
- R&TTE.....Radio Equipment & Telecommunications Terminal Equipment

European Frequency Regulation

- Since the mid 1990ies in Europe a harmonized frequency regulation for Short Range Devices (SRD) is in place. The documents are split up between Measurement Methods and Emission Limits. Main Norms are:

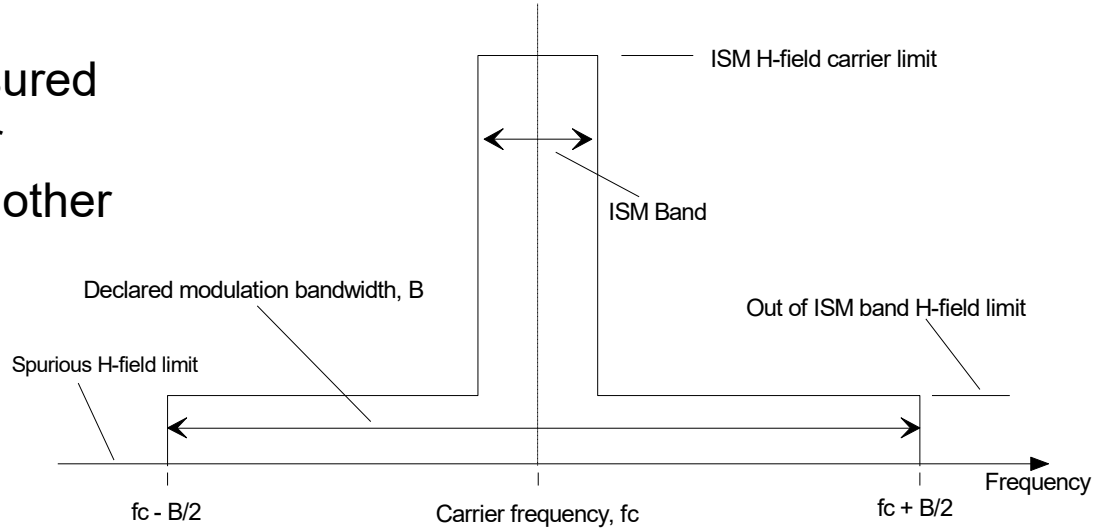
	Norm	Frequency range	Body	Concern
-	EN 300 220	25 MHz - 1 GHz, < 500 mW	ETSI	Measurement
-	EN 300 330	9 kHz - 30 MHz	ETSI	Measurement
-	EN 300 440	1 GHz - 25 GHz	ETSI	Measurement
-	EN 302 208	865 - 868 MHz, < 2 W	ETSI	Measurement
-	TR 70-03	Use of SRDs	ECC (CEPT/ERC)	Limits

Concept for emission limits

- The *H*-field mag. is usually measured in 10 m distance in free field. For information, values measured at other distances can be re-calculated
- Field strength is measured
  - In the carrier
  - In the modulation bandwidth
  - Unwanted emission (out band)
- Measurement receiver (Spectrum Analyzer) uses Quasi-Peak detector

Frequency: (f)	Detector type:	Bandwidth:
9 kHz ≤ f < 150 kHz	Quasi Peak	200 to 300 Hz
150 kHz ≤ f < 30 MHz	Quasi Peak	9 to 10 kHz
30 MHz ≤ f ≤ 1 000 MHz	Quasi Peak	100 to 120 kHz

- Noise level must be > 6 dB below signal

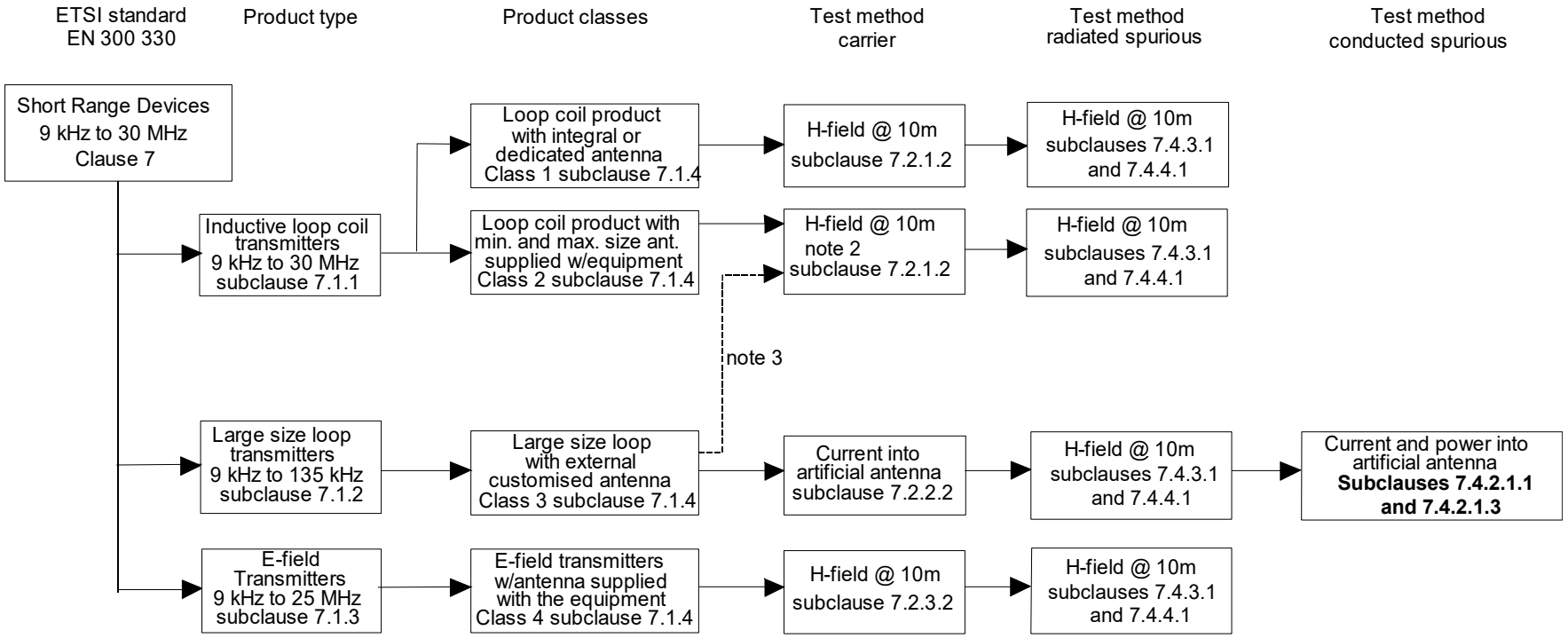


where B is the declared modulation bandwidth

- Allowed measurement tolerance
  - HF frequency +/- $1*10^{-7}$
  - HF power, cable +/- 1 dB
  - HF power, radiated +/- 6 dB
  - temperature +/- 1°C
  - humidity +/- 5 %

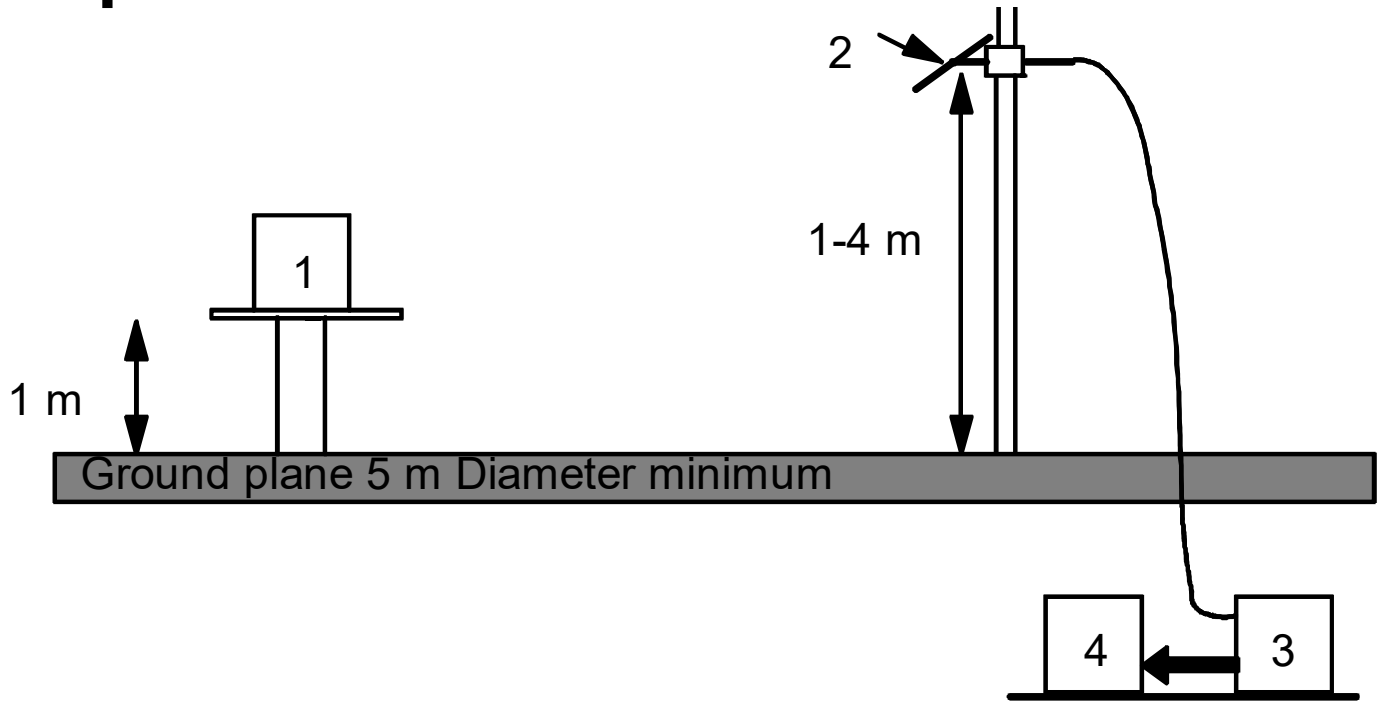
Selection of appropriate measurement method

- Overview for selection of measurement methods acc. to ETSI/EN300330

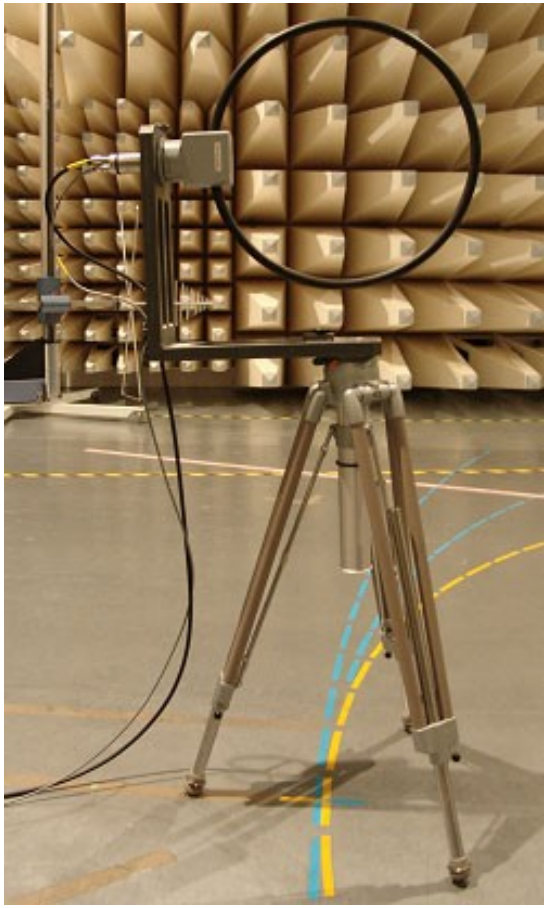


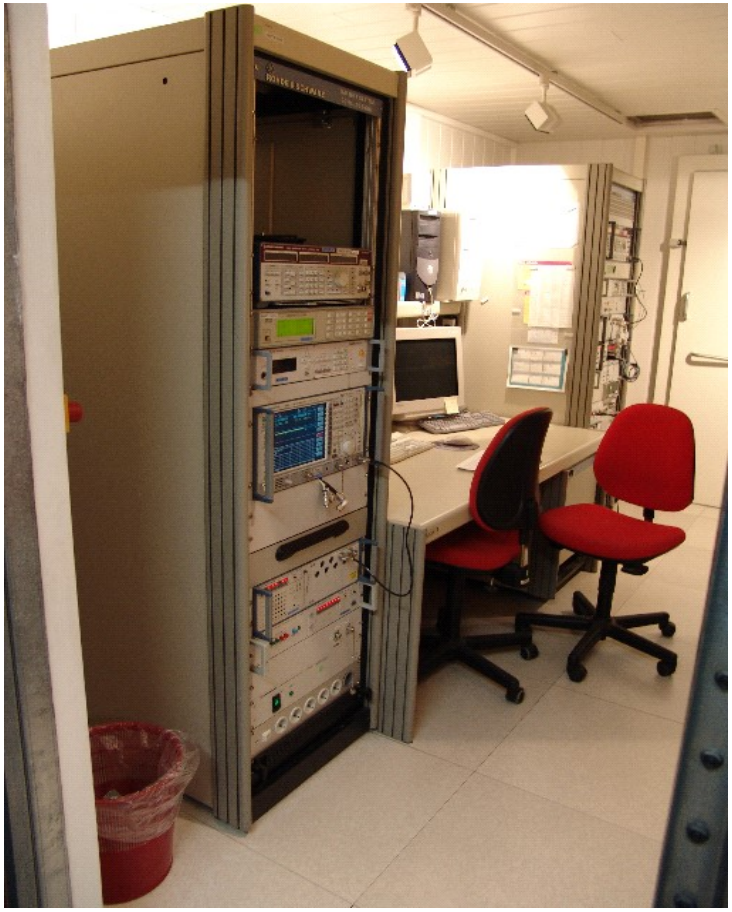
- There are classes for applications and radiated power differentiated, which determine the method for measurement.

Free space measurement



Measurement in an-echoic chamber





Technical Report 70-03 – Emission Limits

- The harmonized Standard TR 70-03 is available since 1997 and defines Frequency Bands, Power Levels, Channel Grids and Duty Cycles (duration for emission) of Short Range Devices. In CEPT member states, which apply the R&TTE guidelines (Article 12 and 7.2), it is allowed to operate SRDs with CE without the need for further permission, if national limitations of the regulation are not violated.

Technical Report 70-03 – Application classes

- Application classes which are of interest for RFID are marked green:

Class	Application
1	Non specific SRD
2	Devices to detect avalanche victims
3	LANs, RLANS und HIPERLANs
4	Automated vehicle identification for rail road (e.g. Eurobalise)
5	Road Transport and Traffic Telematics (RTTT)
6	Movement detectors and alert equipment
7	Safety Equipment
8	Remote Controls
9	Inductive Applications
10	Radio Microphones
11	RF Identifikation Systems
12	Active medical implants at low power
13	Audio Radio Applications

- Frequency bands and further specifications are assigned to each class.

TR 70-03 – Frequency bands for Class 1

- Usable for all SRDs (including RFID)

Band	Frequency range	Power, field strength	Duty cycle	Channel grid	Measurement
	MHz		per hour		
A	6,765 – 6,795	42 dBµA/m (10 m)	unlimited	none	EN 300 330
B	13,553 – 13,567	42 dBµA/m (10 m)	unlimited	none	EN 300 330
C	26,957 – 27,283	42 dBµA/m (10 m)	unlimited	none	EN 300 220
D	40,660 – 40,700	10 mW (ERP)	unlimited	none	EN 300 220
E	433,05 – 434,79	10 mW (ERP)	< 10 %	none	EN 300 220
E1	433,05 – 434,79	1 mW (ERP)	unlimited	none	EN 300 220
E2	434,04 – 434,79	10 mW (ERP)	unlimited	up to 25 kHz	EN 300 220
F	868,00 – 868,60	25 mW (ERP)	< 1 %	none	EN 300 220
G	868,70 – 869,20	25 mW (ERP)	< 0,1 %	none	EN 300 220
H	869,30 – 869,40	10 mW (ERP)	unlimited	25 kHz	EN 300 220
I	869,40 – 869,65	500 mW (ERP)	< 10 %	25 kHz	EN 300 220
K	869,70 – 870,00	5 mW (ERP)	unlimited	none	EN 300 220
L	2400 – 2483,5	10 mW (EIRP)	unlimited	none	EN 300 440
M	5725 - 5875	25 mW (EIRP)	unlimited	none	EN 300 440
N	24000 – 24250	100 mW (EIRP)	unlimited	none	EN 300 440
O	61000 – 61500	100 mW (EIRP)	unlimited	none	EN 300 440
P	122000 – 123000	100 mW (EIRP)	unlimited	none	EN 300 440
Q	244000 – 246000	100 mW (EIRP)	unlimited	none	EN 300 440
R	138,20 – 138,45	10 mW (ERP)	unlimited	none	EN 300 330

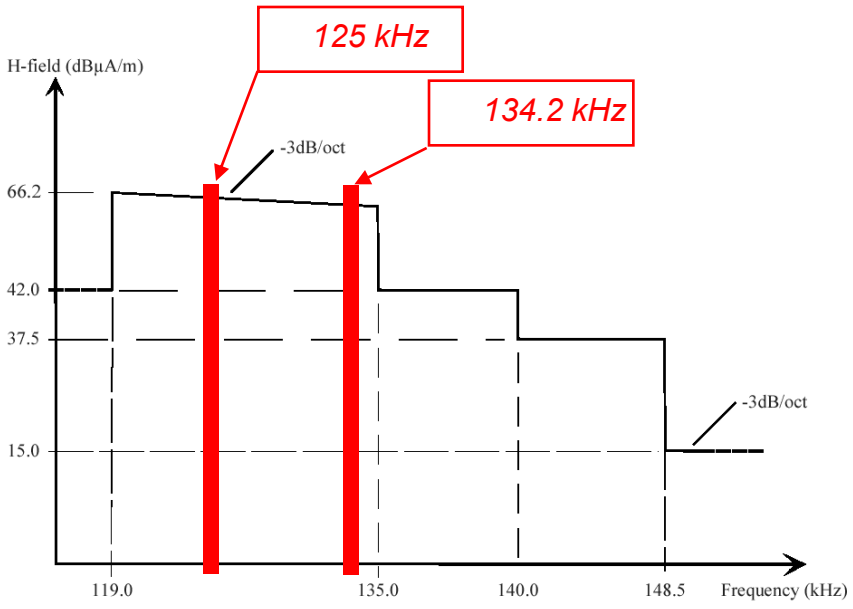
TR 70-03 – Frequency bands for Class 9

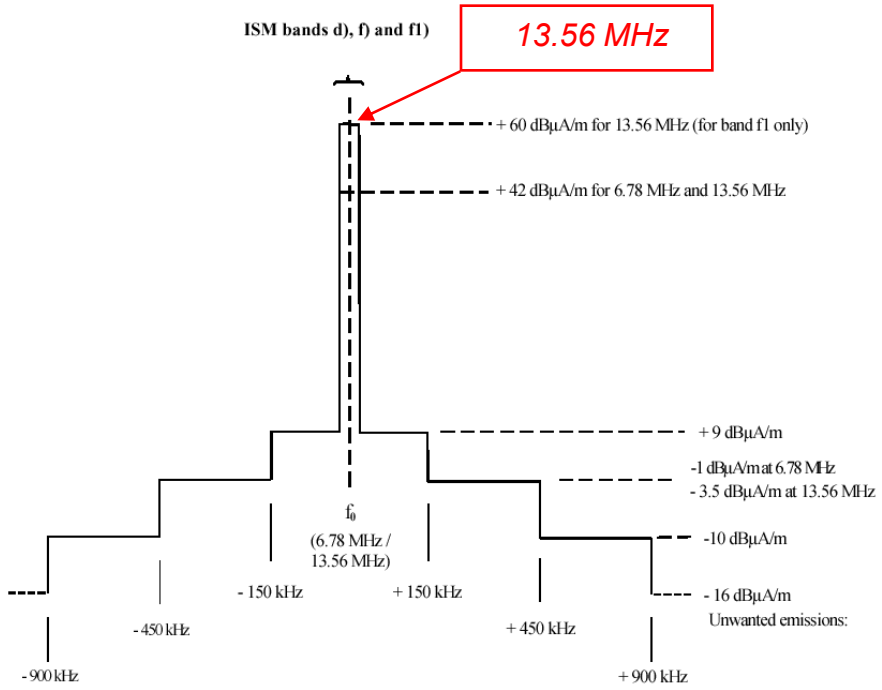
- Typical application for inductive coupled LF and HF RFID (Cards, Labels, NFC)

Band	Frequenzbereich	Leistung, Feldstärke	Duty cycle	Kanalraster	Messung
	MHz		pro Stunde		
AA	0,009 – 0,05975	72 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
AB	0,05975 – 0,06025	42 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
AC	0,06025 – 0,0700	69 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
B	0,07 – 0,119	42 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
C	0,119 – 0,135	66 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
C1	0,135 – 0,140	42 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
C2	0,1400 – 0,1485	37,7 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
D	6,765 – 6,795	42 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
E	7,400 – 8,800	9 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
F	13,553 – 13,567	42 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
F1	13,553 – 13,567	60 dBµA/m (10 m)	RFID und EAS		EN 300 330
G	26,957 – 27,283	42 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
H	10,2 – 11,0	9 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330
M	3,155 – 3,400	13,5 dBµA/m (10 m)	unbegrenzt	keines	EN 300 330

Frequency emission masks – LF, HF

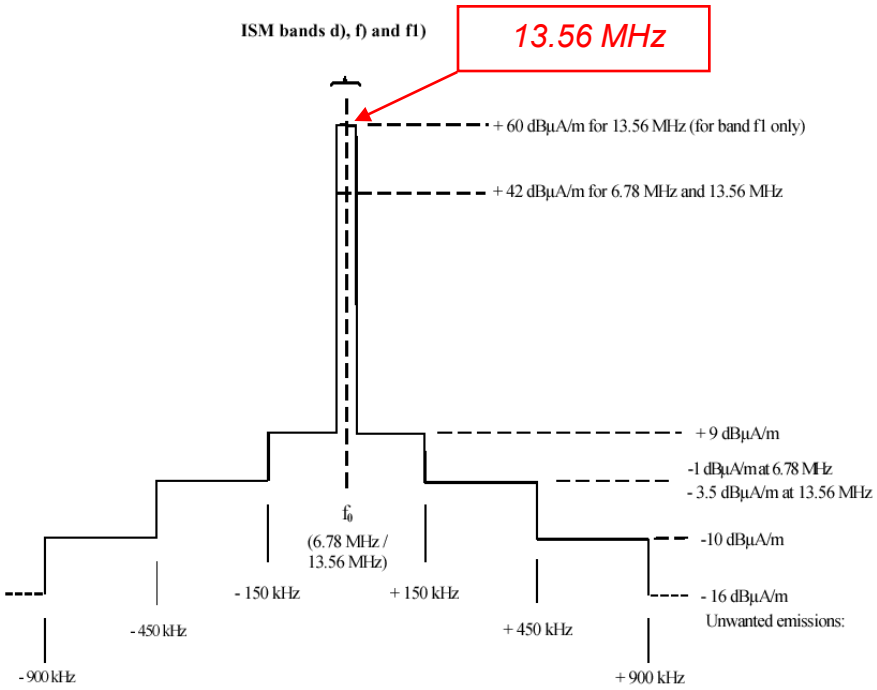
- Typical RFID applications in the LF and HF band (Terminals for Card systems, Readers for Tags, NFC Interfaces)

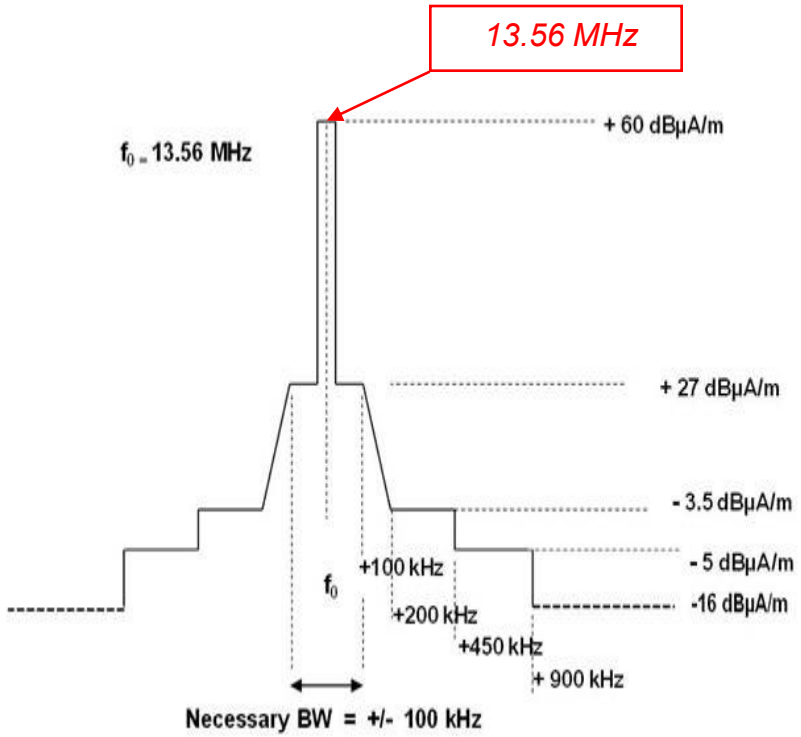




- Emission Limits for LF frequency range
- Emission limits for HF frequency range

New HF Emission Limits for Europe



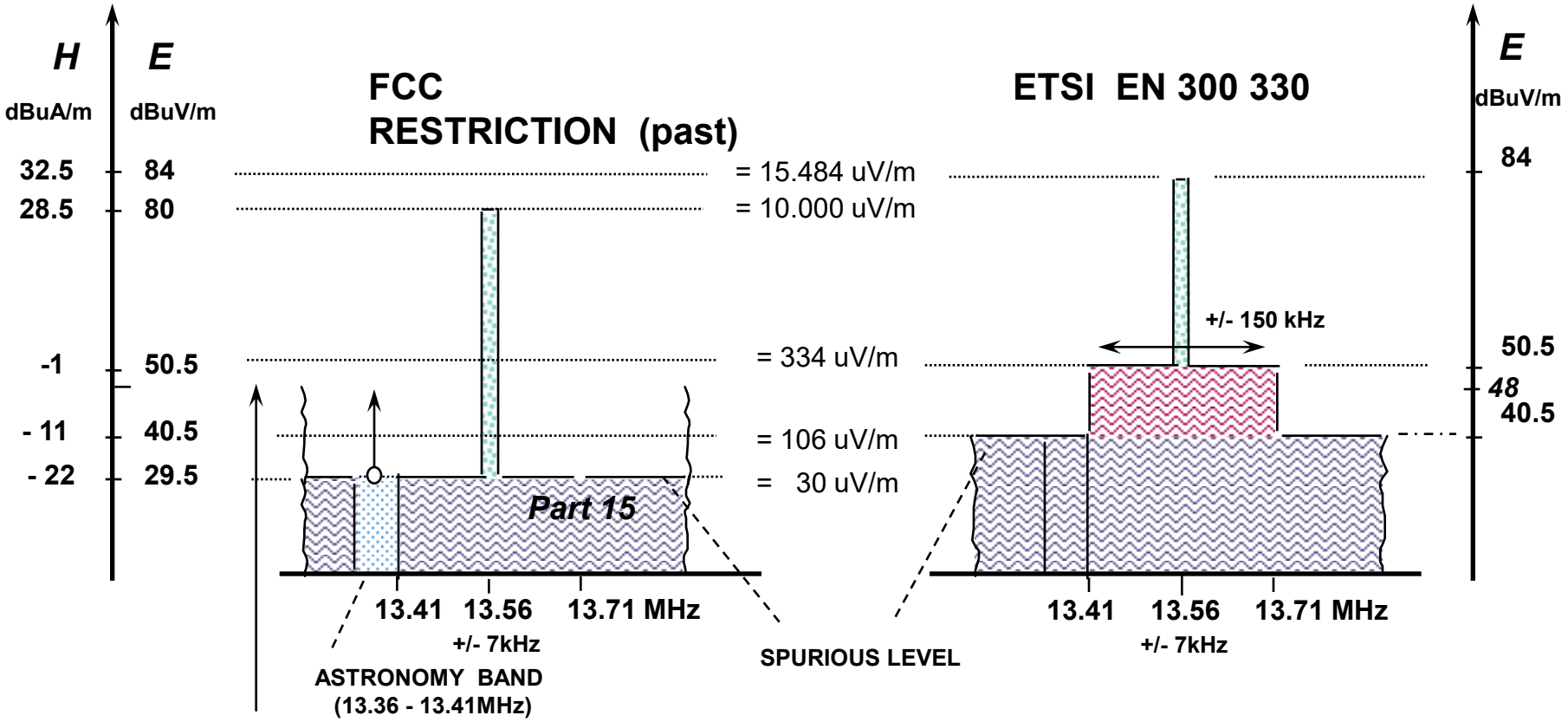


- Spectral mask for narrow-band systems, e.g. ISO/IEC18000-x, ISO/IEC15693
- Spectral mask for wide-band systems, e.g. ISO/IEC14443, NFC

US Regulation: FCC part 15

E-field strength

@ D = 30 METER



SOURCE: ANSI NCITS, B 10.5	**PURPOSE:** International Harmonization of Radio
REFER.: ISO/IEC JTC1/SC17/WG8/TF2,TF3 ISO14443, 15693	Regulation with ETSI EN 300 330

- Typical application for RFID in the UHF range.

Band	Frequency range	Power	Duty cycle	Channel grid	Measurement
	MHz		per 200 ms		
A	2446 – 2454	500 mW (EIRP)	unlimited	none	EN 300 440
A	2446 – 2454	4 W (EIRP)	< 15 %	none	EN 300 440
B1	865 – 868	100 mW (EIRP)	LBT*	200 kHz	EN 302 208
B2	865,6 – 867,6	2 W (ERP)	LBT*	200 kHz	EN 302 208
B3	865,6 – 868	500 mW (ERP)	LBT*	200 kHz	EN 302 208

*) LBT…… Listen before Talk, means the channel must be free (up to a certain signal threshold). Use of frequency agility is preferred.

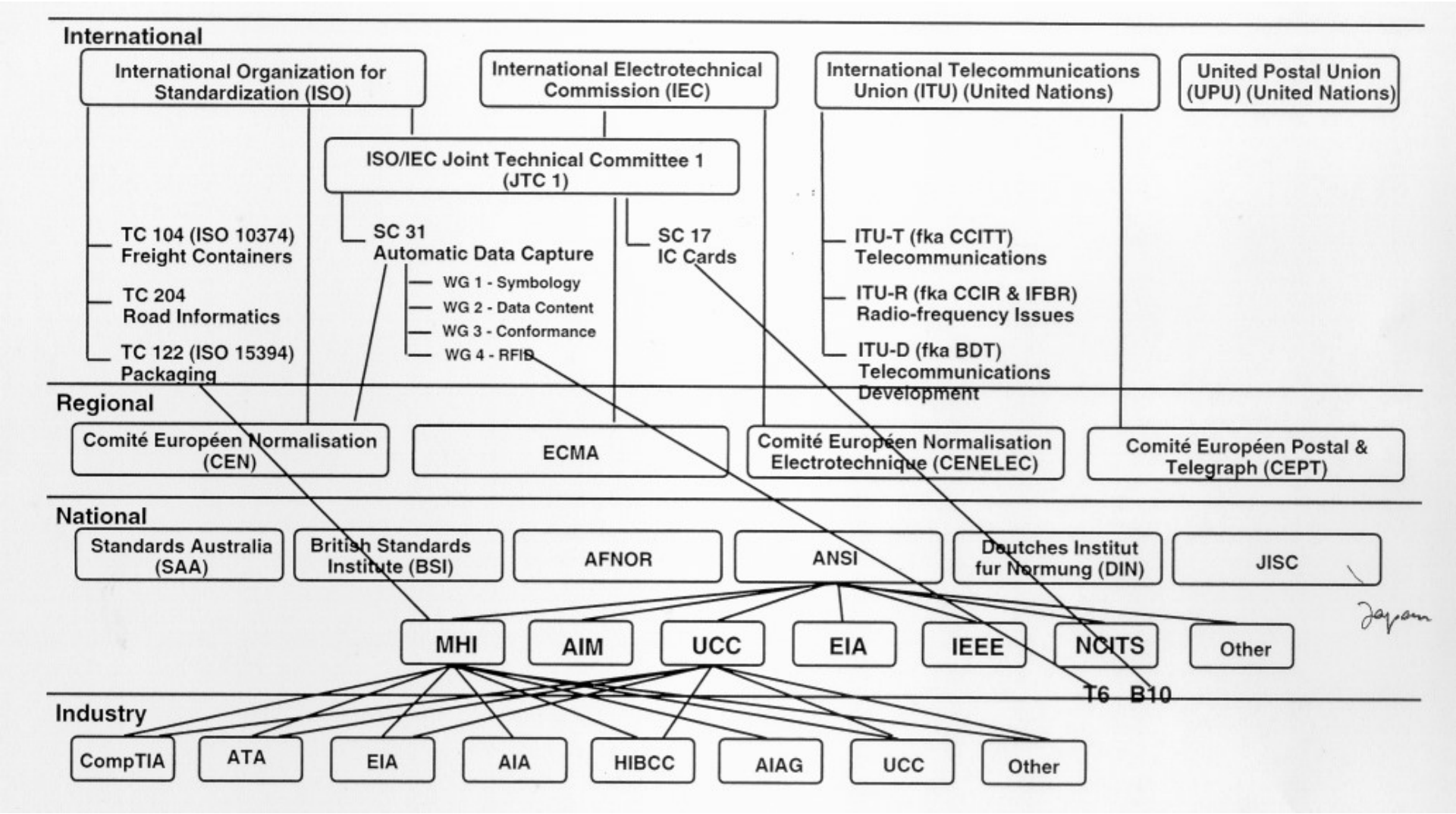
Product Standards

ISO/IEC Standards, Development & Life cycle

RFID Product Standardisation at ISO

- ISO (International Organisation for Standardisation) and IEC (International Electrotechnical Commission) form the specialized system for world-wide Standardisation. National bodies, which are members of ISO or IEC, can participate in the development of International Standards in technical committees, which can be formed for their specific fields of interest.
- Standardisation of Information Technology is driven by ISO and IEC, by the Joint Technical Committee ISO/IEC JTC1. This committee develops and governs its own procedures.
- JTC1 consists of 19 Sub-Committees (SC), which cover all Info Technologies.
- Product Standards are developed in sub-committees (SC), and these delegate the work to Working Groups (WG), which delegate the more technical work to Task Forces (TF).
- WG and TF delegates (called “experts” in ISO) usually are represenatives of industry and organisations which have a relation and interests in these topics. Experts participate as national delegation (one person can vote for one state), elected by the national ISO member organisation for the state.

RFID Product Standardisation world-wide

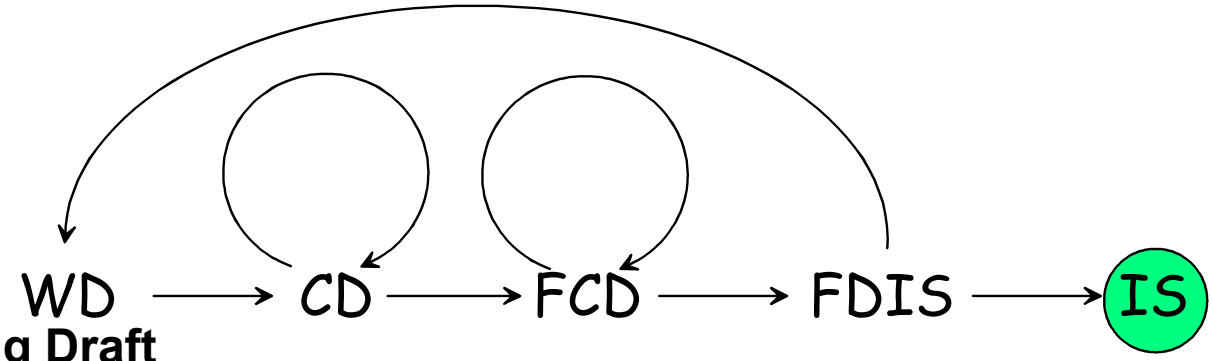


RFID Product Standardisation at ISO

- Experts participate as national delegation (one person can vote for one state), elected by the national ISO member organisation for the state.
- According to ISO rules it is expected that the national delegation already has consolidated the opinions of individual participants (div. companies) and has one opinion in the technical committee. So there are “mirror committees” of the WG on national level, which take up members contributions, discuss and conclude by majority a common view, which is contributed to the ISO/IEC WG. (e.g. ÖNORM or DIN contribution, has more impact than the opinion of one company).
- Each Working Group has officers, like the Convenor, Secretary or Project Editors. All these appointments are honorary, as ISO/IEC offers no funding.
- A WG typically has 3 meetings per year, which may take 3 days and are hosted by one member, so the location varies.
- Technical contributions can typically be posted / uploaded to the official homepage of the WG up to 1 month before the meeting. This allows other members to know in advance and react to the content. In the meeting contributions are discussed according to an agenda prepared by the secretary.

Life-cycle of an International Standard at ISO/IEC

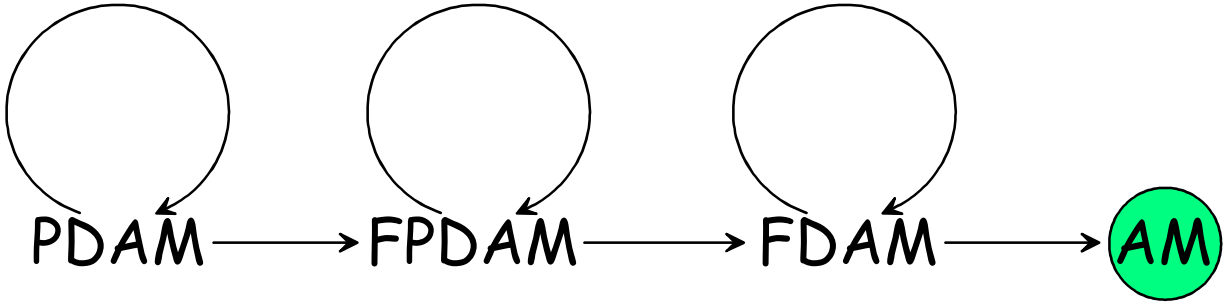
- The development of an International Standard at ISO/IEC has following steps:



- **WD……Working Draft**
  - Working document, an elected editor re-works accepted contributions into a structured document.
- **CD……Committee Draft**
  - Consolidated document, containing all parts. Techn. and editorial comments allowed.
- **FCD… .Final Committee Draft**
  - Only editorial comments are allowed at this status.
- **FDIS….Final Draft International Standard**
  - Word-by-word equal version of final standard for ballot (accept / refuse).
- **IS……. International Standard**
  - Valid specification, available via ISO/IEC secretary (costs)

Life-cycle of an International Standard at ISO/IEC

- During lifetime the Standard can be extended by Amendments, which are part of the valid specification. The Amendment development cycle is:



- **PDAM……Preliminary Draft Amendment**
  - Working document, an elected editor re-works accepted contributions into a structured document.
- **FPDAM……Final Preliminary Draft Amendment**
  - Consolidated document, containing all parts. Techn. and editorial comments allowed.
- **FDAM… .Final Draft Amendment**
  - Word-by-word equal version for ballot (accept / refuse).
- **AM……. Amendment**
  - Valid part of specification, available via ISO/IEC secretary (costs)

Life-cycle of an International Standard at ISO/IEC

- The content of a contribution can lead to a Technical Report, which can be starting point for a new part of a Standard.
- Valid Standards are documents entitled “International Standard” and are exclusively available (sold) by Standardization Institutes. They are continuously amended.
- Approx. every 5 years an “active” Standard shall undergo a Revision. The document is completely re-worked, all Amendments are included.
- Essential for the Standard is not easy readability, but un-ambiguity of the content. To avoid double specifications (especially in the context of revisions), a specification is only made once, and it is referenced, if needed elsewhere. In practice, the text can get un-understandable for non-members of the Working Groups, which may be a political aim.
- To speed up the time frame for the constitution of a Standard, a “fast track” was established for industry standards. For already as industry standard available technologies an ISO/IEC Standard can be completed within 1 – 2 years.

How to read an International Standard

- ISO/IEC Standards are published exclusively in english language (while numbers are written with comma as decimal separator).
- To provide un-ambiguity, there are also specific rules for text formulation:

Grade	**positive form**	**negative form**
Absolute MUST	*shall*	*shall not*
Recommendation	*should*	*should not*
Permission	*may*	*need not*
Option	*can*	*can not*

- Moreover, pictures and illustrations only have informative meaning. Only the description in text is valid specification.

ISO/IEC JTC1 SC17 Working Groups (N1416)

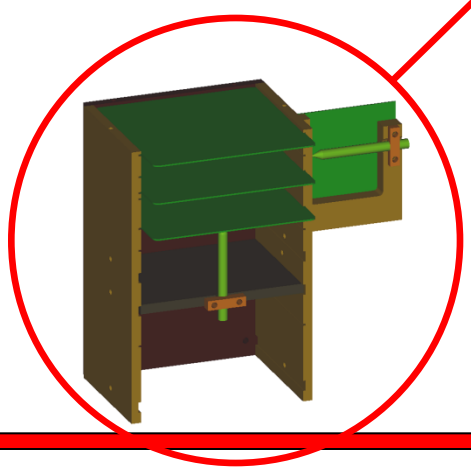
Working group	*Name* **Short description of scope of work**	Convenor
WG1	*Physical Characteristics and Test Methods* Physical characteristics, embossing, magnetic stripe, and test methods for conformance and card durability	David May
WG3	*Machine Readable Travel Documents* To prepare a revised text of ISO 7501; monitor the standards referenced; consider and define standards for machine readable travel documents and related machine readable cards (see Recommendation 3 of N 379); co-ordination of JTC1 liaison with ICAO for maintenance of ICAO 9303, machine readable passports and related ICAO documents	Joel Shaw
WG4	*Integrated Circuit Cards with Contacts* To define specifications related to the Integrated Circuits Card with Contacts within the area of SC17	Rene Beltrando
WG5	*Issuer Identification Numbers (IINs)/Application Provider Identifiers (RIDs)* To serve as the RMG for ISO/IEC 7812 Parts 1 & 2 and ISO/IEC 7816-5. Responsibility for maintenance of ISO/IEC 7812 Parts 1 & 2. Responsible for Registration of Application providers under ISO/IEC 7816-5. To liaise, when necessary with Working Group 4 on matters relating to ISO/IEC 7816-5.	Freda Bennett
WG7	*Financial Transaction Cards* To revise ISO/IEC 7813 and its amendment 1 in accordance with SC17 resolution 365 and to carry out any further revisions as necessary	Jim Riddell
WG8	*Contactless Integrated Circuit(s) cards* cards The scope of WG8 is to develop standards for the Contactless Integrated Circuit(s) Card which do not preclude the incorporation of other Standard technologies on the card.	Michael Hegenbarth
WG9	*Optical Memory Cards* Enhanced OMC technologies enabling more data capacity, fast access and high reliability based on existing standard technologies or new technologies. Software or programming interface for accessing OMC data contents. (Host application program will be able to use this interface for easier implementation. Access method software of OMCs application program.) Physical assignment and /or logical assignment for OMC media use. Logical data structures in OMCs data (file structure etc).	Ron Field
WG10	*Motor Vehicle Drivers Licence and Related Documents* Draft Terms of Reference: Standardization in the filed of Motor vehicle driver licences.	Geoffrey G. Slagle
WG11	*Biometrics* Interoperability for interindustry and government applications using personal identification technologies, e.g. biometrics. Excludes generic biometrics as undertaken by SC37.	Michael Hegenbarth

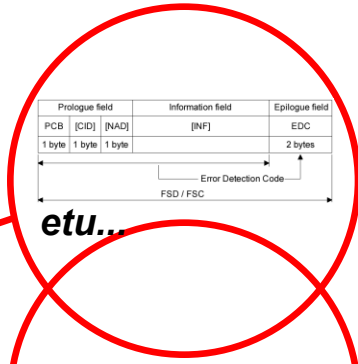
The Proximity Card Standard (14443)

Definitions in the **Proximity-Base Standard** (ISO/IEC)

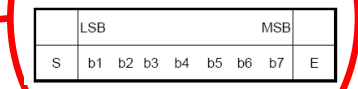
14443-4	Protocol 2 (state diagrams, error correction)
14443-3	Protocol 1 (data frame, initialization and anticollision)
14443-2	Air Interface (power and signal transmission, modulation)
14443-1	Physical Layer (Card geometry, limits)
10373-6	Measurement set-up and test methods for Proximity-Cards

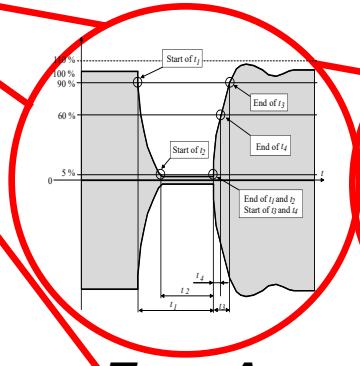
Measurement of properties in Test Standard / Lab Standard (ISO/IEC)



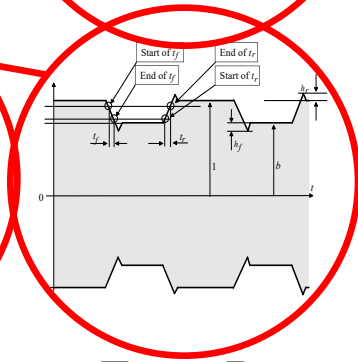


etu...

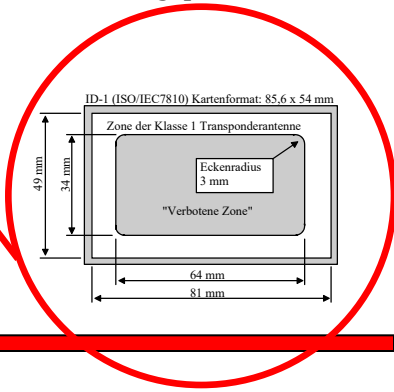




Type A



Type B



NFC: A chance for world-wide interoperability in contactless HF communication

NFC combines all relevant Contactless Communication (protocol) Standards

- ECMA 340: NFCIP-1
  + ECMA 356: RF Test Methods
  = ISO/IEC 18092

  ISO/IEC14443 Type A (106 kbit/s)
  FeliCa (212 / 424 kbit/s)
  „Active mode“ (0.847 … 6.78 Mbit/s ASK)

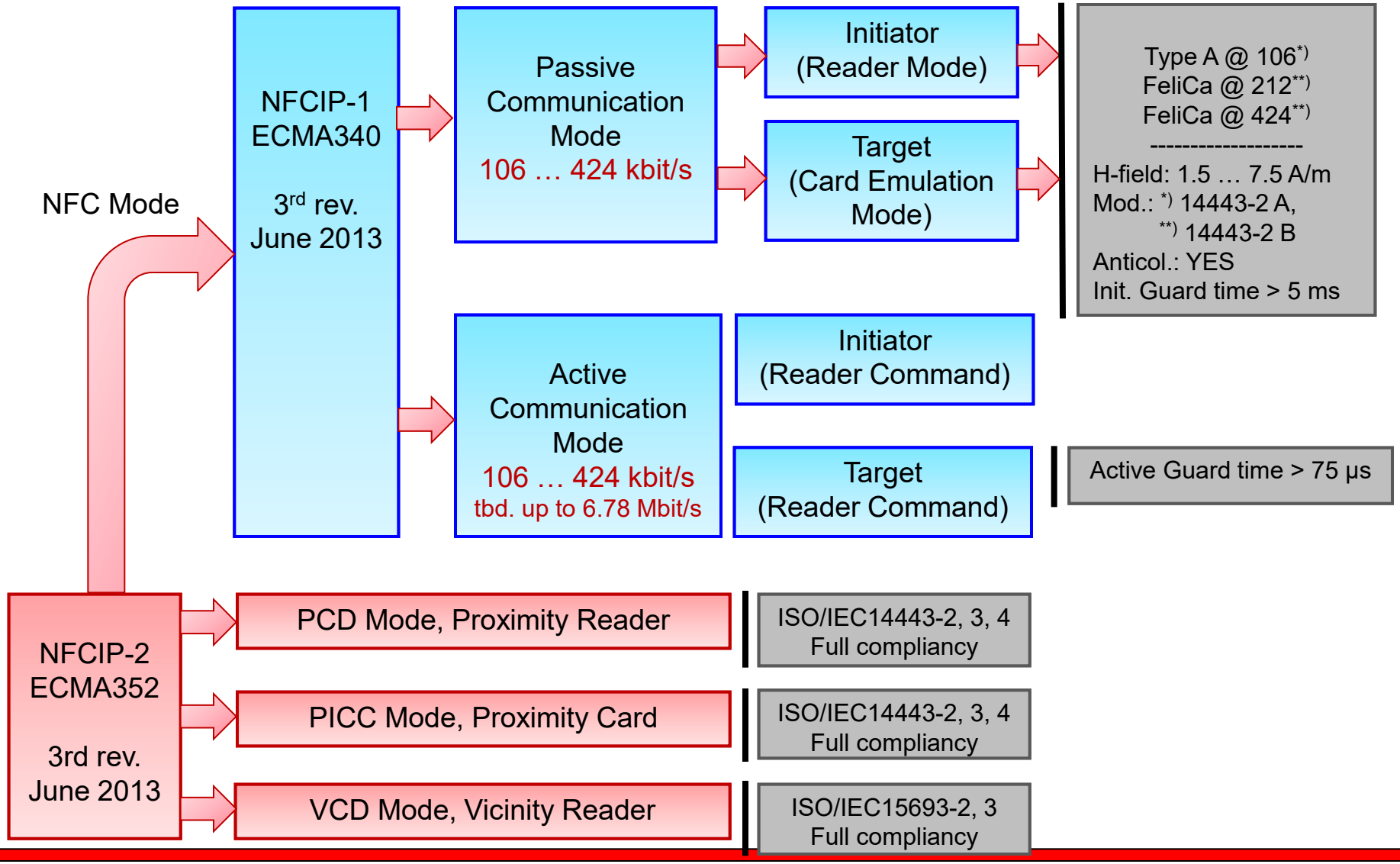
- ECMA 352: NFCIP-2
  + ECMA 356: RF Test Methods

  „NFC mode“ = NFCIP-1
  + Reader ISO/IEC14443 A+B (106 … 847 kbit/s)
  + Reader ISO/IEC15693

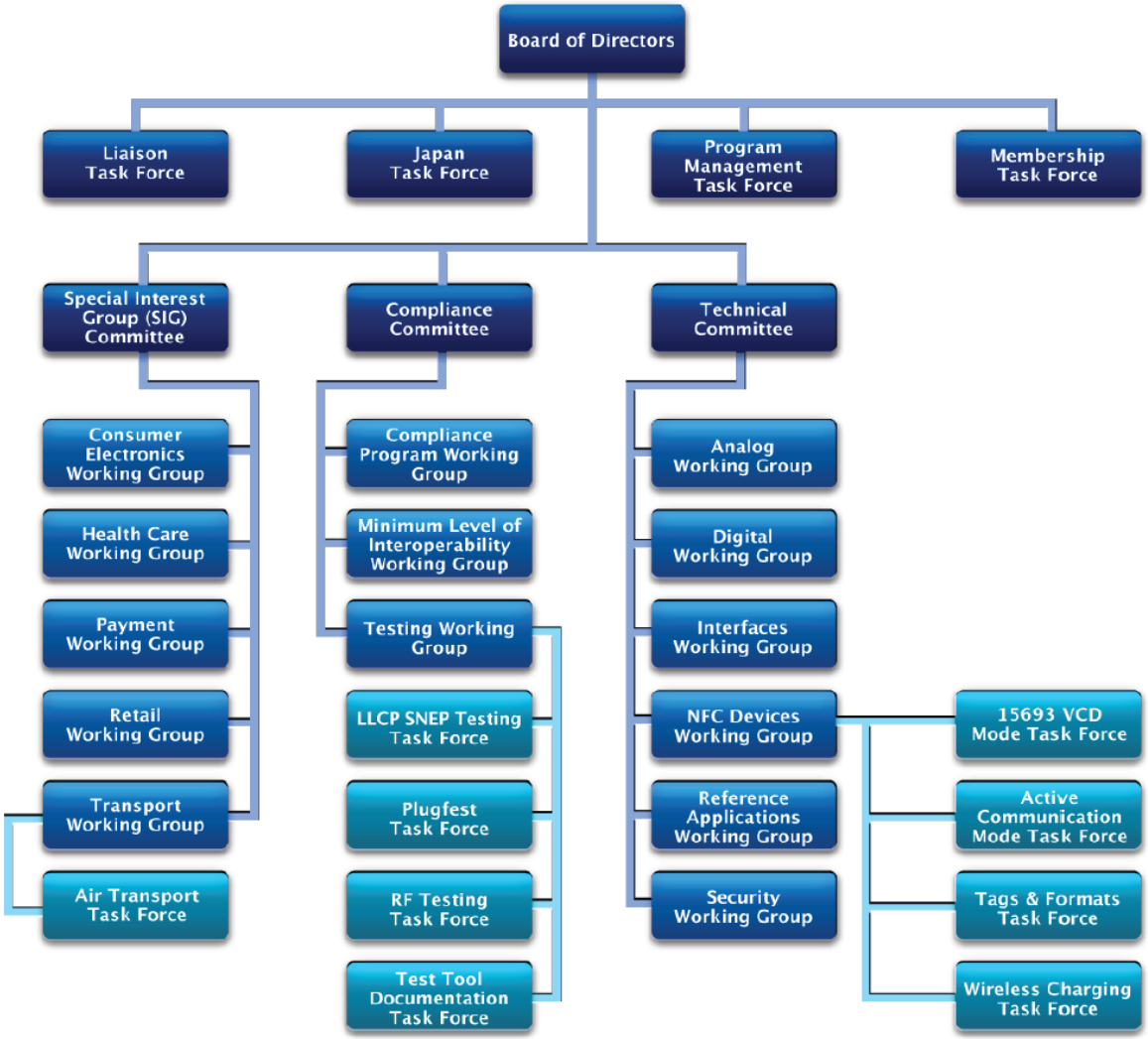
- NFC Forum
  Analogue Specification

  NFC-A = ISO/IEC14443 A (106 kbit/s)
  NFC-B = ISO/IEC14443 B (106 kbit/s)
  NFC-F = FeliCa (212 / 424 kbit/s)
  ISO/IEC15693

ECMA NFC Standards brief Overview



NFC Forum Organisation



http://nfc-forum.org/about-us/the-nfc-forum/committees-working-groups/

Overview of RFID Product Standards

- SC17: Cards and Personal Identification
  - ISO/IEC 7816, IC Cards with Contacts — WG4
  - ISO/IEC 10536, Close Coupling Cards (2 mm) — WG8/TF1 => outdated
  - ISO/IEC 14443, Proximity Cards (10 cm) — WG8/TF2/4=> 13.56 MHz, ~ 20 mW, µC Cards
  - ISO/IEC 15693, Vicinity Cards (1.5 m) — WG8/TF3 => 13.56 MHz, ~ 10 µW, State Machines
  - ISO/IEC 10373, Test Methods (Laboratory Standard)
- SC19: Animal Identification
  - ISO/IEC 11784/5, => 125 kHz
  - ISO/IEC 14223 => 125 kHz
- SC31: Item Management
  - ISO/IEC 18000-X => 125 kHz, 13.56 MHz, UHF, 2.45 GHz
- MIT (Auto-ID Center): EPC Global
  - EPC Gen 2 => UHF
  - ILT (Item Level Tagging) => 13.56 MHz
- ECMA TC47
  - Near Field Communication NFC => 13.56 MHz, Reader & Card function
- NFC Forum

Application related Standards

ICAO, EMVCo

ICAO – Electronic Travel Documents (Doc 9303)

Unter dem Eindruck der Anschläge vom 11. 9. 2001 hat es die Internationale Zivilluftfahrtbehörde ICAO (International Civil Aviation Organization), eine Unterorganisation der UN, übernommen, Richtlinien für maschinenlesbare Reisedokumente (MRTD) voranzutreiben. Richtlinien für internationale Pässe waren erstmals auf einer Konferenz 1920 erarbeitet worden, seit der Gründung der ICAO 1946 liegt diese Aufgabe dort. Der Beginn der Arbeit an MRTD datiert auf 1968.

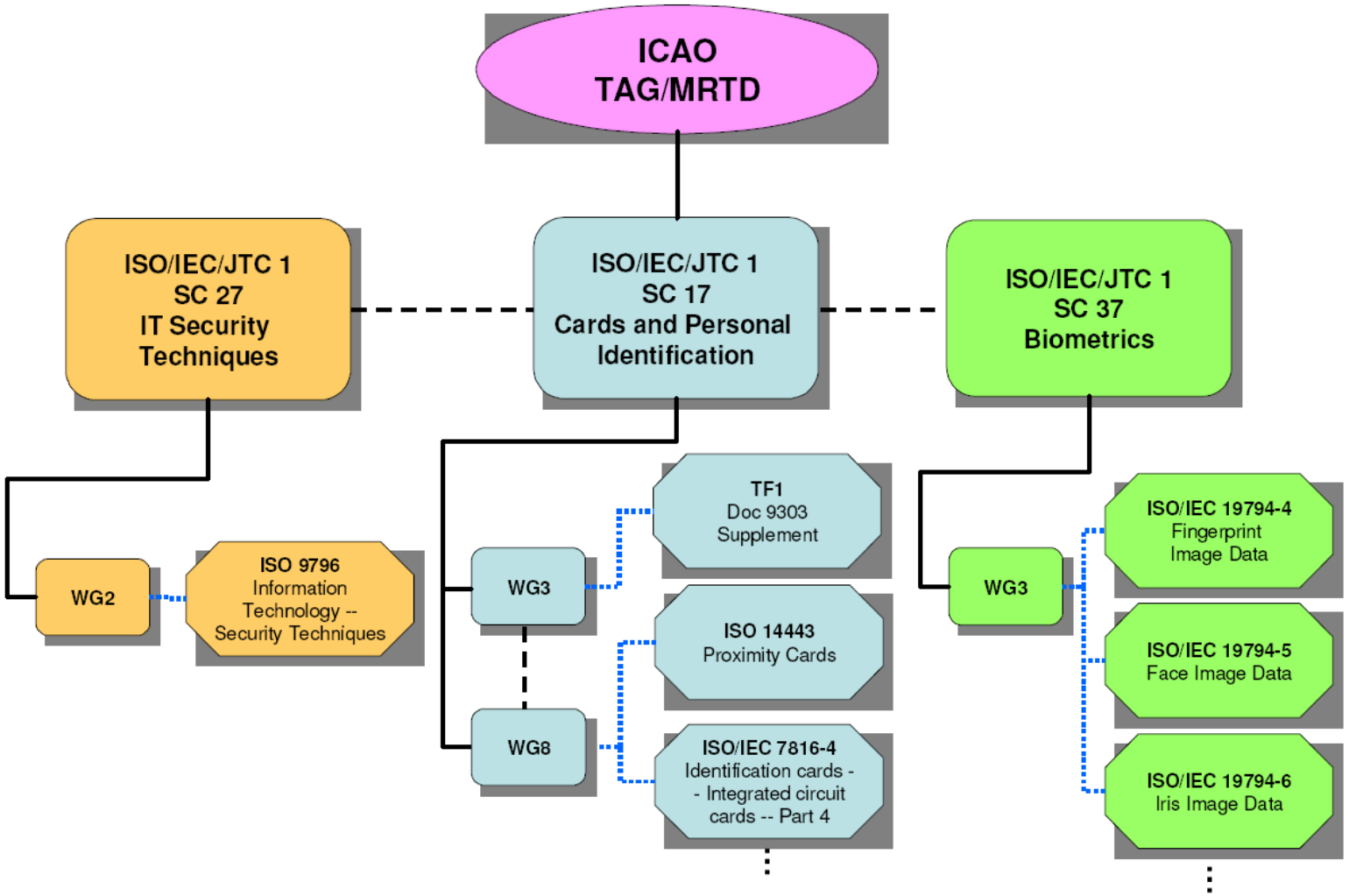
MRTDs beinhalten zunächst als Technische Reports Fragen zu biometrischen Personaldaten, welche Möglichkeiten es gibt (Gesichtserkennung, Fingerabdrücke, ...), und wie diese gespeichert und auch gegen unbefugten Zugriff geschützt werden können.

Neben der schriftlichen Aufzeichnung im Passport sind die Daten auch auf einem integrierten Chip gespeichert. Weil es sich um eine international standardisierte Technik handelt, was größtmögliche Transparenz und Unabhängigkeit von einem Hersteller garantieren soll, wurde dafür der ISO/IEC14443 Proximity-Standard (Typ A und Typ B) ausgewählt.

Besonders wesentlich war, zuvor die Interoperabilität der MRTD-Komponenten sicherzustellen (Passport-Reader-Infrastruktur zu e-PP Chips verschiedener Hersteller). Es wurden daher ICAO-Compliance-Testprozeduren definiert, die von akkreditierten Testhäusern im Auftrag der jeweiligen staatlichen Behörden bescheinigt werden müssen, bevor ein Inlay-Hersteller sein Produkt einer Staatsdruckerei anbieten darf.

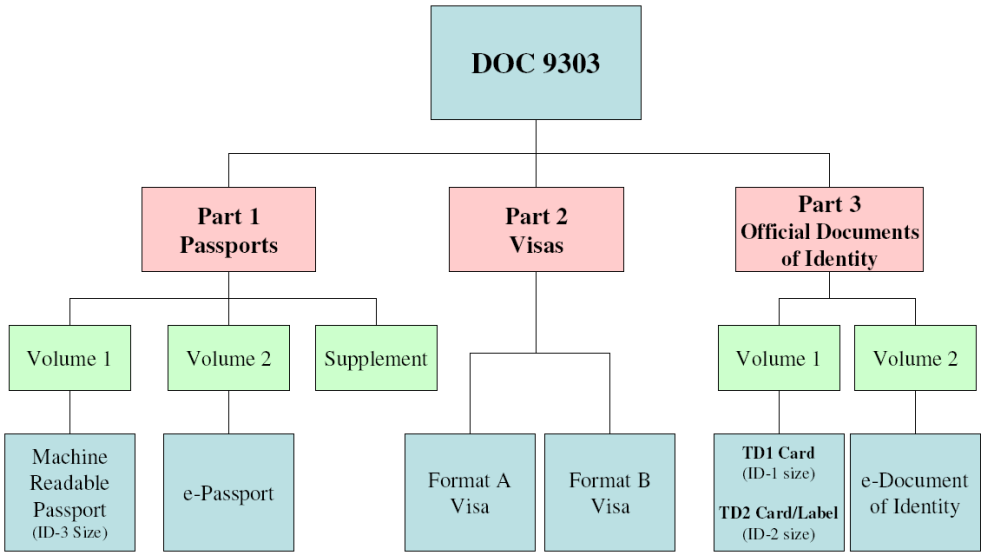
Ein Pilotprojekt war der deutsche Reisepass. Hierfür wurden mit dem BSI 2005 vorab Testprozeduren festgelegt, die mit Beratung durch Anbieter-Firmen zustande gekommen sind. Diese wurden später weiter konsolidiert als ICAO-Dokumente übernommen und gelangen derzeit wieder in den in Revision befindlichen ISO/IEC10373-6 Teststandard zurück.

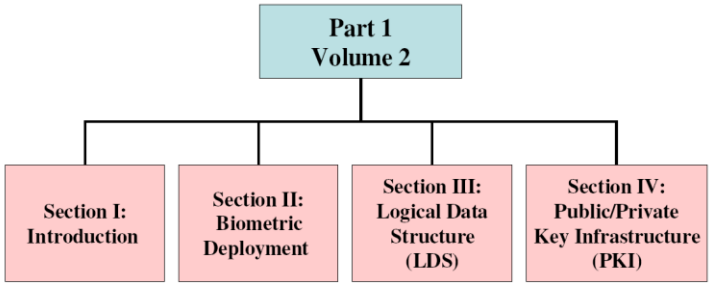
ICAO – Electronic Travel Documents (Doc 9303)



- Structure of the MRTD working groups and Standardisation [3].

ICAO – Electronic Travel Documents (Doc 9303)





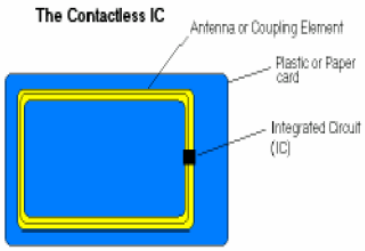
Structure of machine-readable travel documents [3].

Doc 9303 is sub-divided in parts:

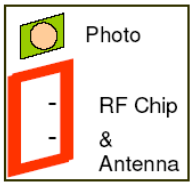
- *Part 1 describes machine-readable Passports (2005)*
  - *Vol. 1: Without additional memory,*
  - *Vol. 2 describes specifications for e-Passport with options for biometric identification,*
- *Part 2 describes machine-readable Identity Documents (2006)*
  - *Vol. 1: Without additional memory,*
  - *Vol. 2: With options for biometric identification*

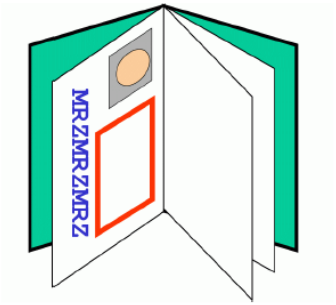
ICAO - elektronischer Reisepass (Doc 9303)

e-Passport

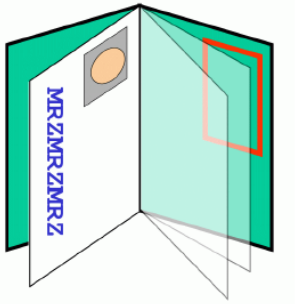


Chip may be located anywhere along antenna loop





Geometry I:
Chip and data page on same side of fold



Geometry II:
Chip and data page on other side of fold

- A symbol on the passport indicates it is a document with chip. It is up to the national body, where in the document the so-called Inlay (chip + antenna on plastic or paper substrate) is located.
- Memory formats, data volume of the biometric personal data is defined in detail. Access to data content is secured by cryptography. 2 OCR lines are required for decoding data (= the passport must be open, so it can be read by a scanner). Moreover, the typical UID (required for anti-collision loop in Type A Proximity) is replaced by a random number (pseudo-unique personal identifer, PUPI) to avoid unauthorized tracking of passports.

EMVCo - Kontaktlos-Kreditkarten

Das EMVCo LLC Consortium wurde 1999 durch Europay, MasterCard und Visa ins Leben gerufen, um Spezifikationen für eine gemeinsame Infrastruktur für Kreditkarten mit integrierten Chips zu erarbeiten. In diesem Rahmen werden auch Kreditkarten mit Kontaktlos-Transpondertechnik behandelt. Bezeichnung dafür ist

- *PayPass (MasterCard), M-Chip (Datenstrukturen)*
- *Visa-Go (Visa)*

Es wird dafür auf den Proximity-Standard ISO/IEC14443 zurückgegriffen. Um jedoch auf die speziellen Bedürfnisse bei Kreditkarten besser eingehen zu können, und um die eigene Infrastruktur von Änderungen des Standards zu entkoppeln, wurde von Teams technischer Experten (insbesondere bei MasterCard) eine eigene Spezifikation erarbeitet, die "ISO/IEC14443 Implementation Specification". (Dokumente zum freien Download auf der EMVCo Homepage).

Um die Interoperabilität zu garantieren, wurden im Auftrag der Kreditkartenfirmen von einem Testhaus auch eigene Test-Setups und Testmethoden entwickelt, welche die Konformität zu den Spezifikationen im Dokument nachweisen. In diesem mehrjährigen Prozess hatten ausgewählte Chip-Hersteller, Reader-Hersteller und Systemintegratoren eine beratende Funktion.

In der derzeitigen Phase der Implementierung ist die Zertifizierung auf zwei ausgewählte Labors beschränkt, dies sind FIME (Caen, Frankreich) für MasterCard und RFI (London, UK) für Visa. Mit Inkrafttreten der neuen, konsolidierten Spezifikation V 2.0 werden auch andere Testhäuser die Möglichkeit bekommen, Zertifizierungen auf Basis der spezifizierten Labor-Testbench und Methoden anzubieten.

HF Product Standards Overview

Proximity, FeliCa, Vicinity, NFC, EPC Gen2 HF

ISO/IEC14443 (Proximity) (formerly Philips, Motorola, Infineon,...)

Carrier frequency:	13.56 MHz	(+/- 7 kHz)	
H-field strength:	1.5 – 7.5 A/m(rms)		
Distance:	~ < 10 cm	(depends on reader / transponder, not specified)	
Data transmission:	Data frames (start-bit and stop-bit)		
Protokol principle:	Reader Talks First		
Antikollision:	Mandatory. UID and Binary Search Tree.		
Comm. Interface:	Typ A (Licence Philips)	Typ B (License Novatron et al.)	
Data link Reader ➔ Transponder (Reader supports both Interfaces)			
Modulation	ASK, 100 % (106), < 60 % high bit rates	ASK, 10 % (8 - 14 %)	
Channel coding	Modified Miller	NRZ	
Datenrate	~ 106 kbit/s (fc/128), 212, 424, 848 kbit/s		
Data link Transponder ➔ Reader (Reader supports both Interfaces)			
Subcarrier	847.5 kHz (fc/16)	847.5 kHz	
Modulation	Load modulation (external AM/PM)		
Channel coding	Manchester (106), BPSK (212-848)	NRZ-L (106), BPSK (212-848)	
Data rate	~ 106 kbit/s, 212, 424, 848 kbit/s		

ISO/IEC15693 (Vicinity) (formerly Philips Semiconductors & Texas Instruments)

Carrier frequency:	13.56 MHz	(+/- 7 kHz)
H-Field strength:	150 mA/m - 5 A/m(rms)	
Distance:	~ < 150 cm	(depends on Reader / Transponder, not spec.!)
Data format:	Data frames (Start-bit and Stop-bit)	
Anticollision:	Mandatory. Polling and Response with UID in Time-Slots	
Protocol principle:	Reader Talks First, the transponder replies to a reader request.	

Communication link Reader => Transponder (Transponder supports both Interface options)

Modulation	ASK, 10 % oder 100 %	
Coding	256PPM, 4PPM (Pulse Position Modulation), pulse in 2nd half-bit	
Data rate	~ 1.65 kbit/s, ~ 26.48 kbit/s	

Communication link Transponder => Reader (Transponder supports both Interface options)

Subcarrier	423,75 kHz (fc/32)	or 424 / 484 kHz
Modulation	Load modulation (external AM/PM)	
Coding	Manchester (single Subcarrier)	FSK (dual Subcarrier)
Data rate	6.62 kbit/s, 26.48 kbit/s	or 6.67 kbit/s and 26.69 kbit/s

FeliCa

(formerly Sony, Panasonic,)

Carrier frequency:	13.56 MHz	
H-field strength:	~ 0.15 A/m ... 12 A/m(rms)	(depends on reader, not specified!)
Distance:	~ < 15 cm	(not specified!)
Data format:	Data packets (preamble, sync., length, data content, CRC)	
Anti-collision:	Mandatory implemented. Polling and response with UID in time-slots	
Protocol principle:	Reader Talks First	

Communication link Reader => Transponder

Modulation	ASK, 10 % (8 - 14 %)
Channel coding	Manchester (each polarity permitted – reader selects)
Data rate	212 kbit/s, 424 kbit/s

Communication link Transponder => Reader

Subcarrier	**No**
Modulation	Load modulation (external AM/PM)
Channel coding	Manchester (each polarity supported)
Data rate	212 kbit/s, 424 kbit/s

ISO/IEC 18092 (NFC)

(formerly Philips, Sony)

Carrier frequency:	13.56 MHz	
H-Field strength:	1.5 A/m – 7.5 A/m(rms)	RF-Detektion threshold 0.1875 A/m
Distance:	~ few cm	
Protokol principle:	Initiator to Target (active - passive), Peer to Peer (active - active)	
Protocols:	14443 Type A, FeliCa	

Communication link Reader => Transponder

Modulation	ASK, 100 % (106)
Coding	Modified Miller
Data rate	106 kbit/s (14443A), 212, 424 kbit/s (FeliCa), up to 6.78 Mbit/s (active-active)

Communication link Transponder => Reader

Sub-Carrier	847.5 kHz / none (for FeliCa)
Modulation	Load modulation (external AM/PM)
Channel Coding	
Data rate	106 kbit/s, 212, 424 kbit/s

EPC Gen2 HF-Interface

(Item Level Tagging, Philips, Magellan,...)

Carrier frequency:	13.56 MHz	
H-Field strength:	150 mA/m - 5 A/m(rms)	(depends on Reader / Transponder, not specified)
Distance:	~ 150 cm	(depends on Reader / Transponder, not specified)
Protocol principle:	Reader Talks First	
Operating mode:	ASK (mandatory)	PJM (optional)

Communication link Reader => Transponder

Modulation	m = 10 ... 30 %,	+/- 3 ° ..... +/- 6 °
Coding	Pulse Interval Encoding (PIE)	Change at beginning und mid of bits
Data rate	53 ... 848 kbit/s (Matrix)	212 kbit/s (PJM)

Communication link Transponder => Reader

Sub-carrier	Base band (FM0), 423 or 847 kHz	8 possible sub-carrier frequencies
Modulation	Load modulation (external AM/PM)	
Channel Coding	FM0, Miller, Manchester	BPSK
Datea rate	424, 848 (FM0), 53 ... 212 kbit/s (sub-carrier)	106 kbit/s

Thank you for your Audience!

Please feel free to ask questions...

Appendix: Links to Frequency Regulation

- CEPT www.cept.org
  - 70-03 www.erodocdb.dk/Docs/doc98/official/pdf/Rec7003e.PDF
- ITU www.itu.int/en/Pages/default.aspx
  - ITU-R (Radiocommunication Sector)
- ETSI www.etsi.org
  - EN 300 330, etc…. (free download)
  - www.etsi.org/standards/looking-for-an-etsi-standard/list-of-harmonized-standards
- .

Appendix: Links to Product (base) Standards

- ISO/IEC JTC1 (Contactless Card Standards, Proximity, Vicinity, NFC, …) www.iso.org/iso/jtc1_home.html
- ECMA (Industry Standards, TC 47 NFC) www.ecma-international.org
- NFC Forum www.nfc-forum.org
- EPC Global (GS1) www.epcglobalinc.org/home
- .

Appendix: Links to Application Standards

- EMVCo (Contactless Payment) www.emvco.com

Some further References

[1] http://www.sc17.com/

[2] ISO/IEC JTC1/SC17 WG1 N1416

[3] Machine Readable Travel Documents, Hiostory, Interoperability and Implementation, ISO/IEC JTC1 SC17 WG3/TF1 for ICAONTWG, Release 1 Draft 1.4, 23. 3. 2004

[4] http://www.ecma-international.org

[5] http://www.emvco.com

[6] http://www.erodokdb.dk/docs/docs98/Official/PDF/Rec7003e.pdf

[7] http://www.epcglobalinc.org/home

[8] RFID-Handbuch, Klaus Finkenzeller, 3. Auflage Carl Hanser Verlag München Wien 2002, ISBN 3-446-22071-2

Questions for self-evaluation

- Explain the difference between Frequency Regulation, Product Standard and Application Standard. Give examples for European Standards in RFID context.
- Which organisations and bodies deal with RFID Standards? Explain the steps in development of an ISO Standard and an Amendment!
- Which 3 topics are considered for emission limits, in frequency regulation? What is a free space measurement, and a measurement in an an-echoic chamber?
- If I buy a Contactless Card or RFID Label (containing a contactless transponder), do I need to take care of emission limits? Explain for LF, HF and UHF RFID!
- For ISO/IEC Standardisation: Is everybody allowed to propose contributions to a Product Standard? How is the procedure, which bodies are the right contact to bring in contributions? Can everybody get the (currently valid) Standards to read them, and how to get them?
- Give an overview of specified technical properties for HF Product Standards!