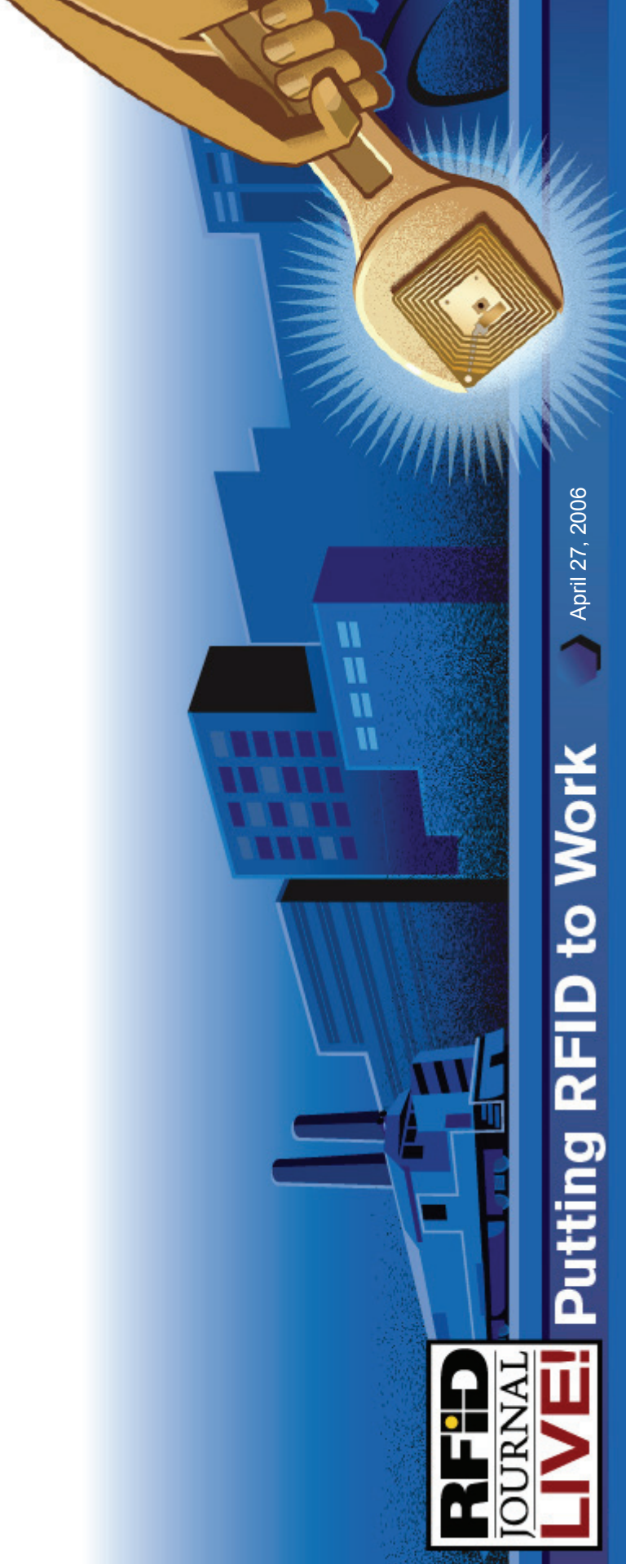


# Legislation and standardisation in RFID

RFID Journal University: Alex C. Y. Wong



# Legislation and standardisation

- Legislation
- Standardisation

# Legislation versus Standards

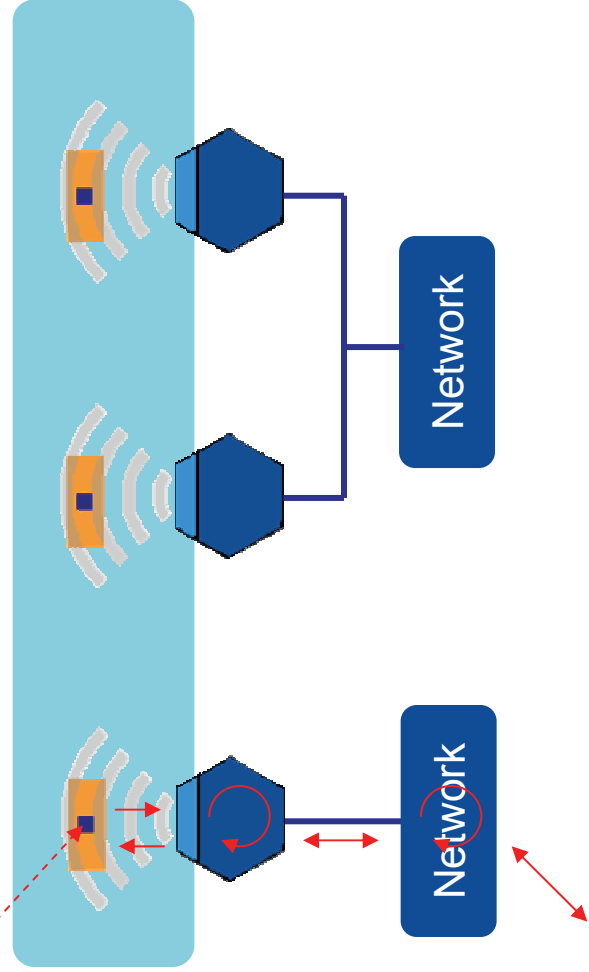
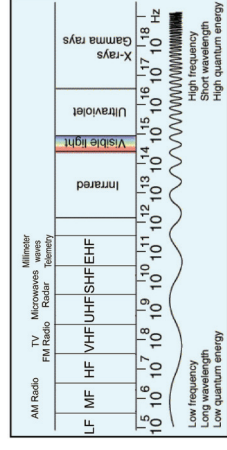
## LEGISLATION

*a law or a set of laws suggested by a government*

## STANDARD

*a required or agreed level of quality or attainment*

# Legislation versus Standards



*Standards*

*Legislation*

## **Radio communication legislation: Why have it?**

- Need to ensure reliable radio communication
  - Interference will always cause problems
  - Governments legislate how spectrum is to be used
  - Variations around the globe, with drive for harmonisation
  - Surprisingly dynamic nature
- Both licensed and licence free bands
  - RFID traditionally uses licence-free bands
  - Shared with other users (mostly low power comms)

## **Radio communication legislation: Why have it?**

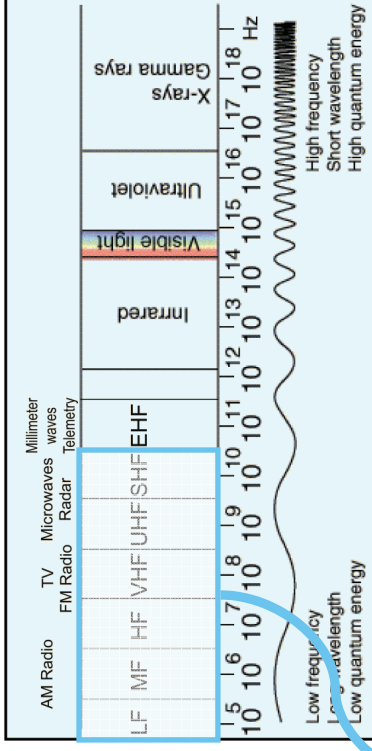
- Other considerations
- Electromagnetic Compatibility
  - Equipment doesn't generate spurious interference
  - Equipment is immune to basic levels of EM disturbance
- Human exposure to radiation
- Adverse effects on medical implants
- Electrical Safety

## **Radio communication legislation: What does it cover?**

- Who can use which frequencies
  - Public, military, commercial
- What the frequencies can be used for
  - Voice, video, telemetry, radio control
- How the spectrum is to be used
  - How long it can be used for
  - How it's shared with others
  - What modulation schemes/air interfaces are possible
  - Power levels allowed
- Equipment or sub-components are often 'type approved'

# Bands available for RFID

- LF, HF and UHF allocations in most regions of the World



Band designation	LF low frequency	MF medium frequency	HF high frequency	VHF very high frequency	UHF ultra high frequency	SHF super high frequency
Frequency	30–300kHz	300kHz–3MHz	3–30MHz	30–300MHz	300MHz–3GHz	3–30GHz
Wavelength	10–1km	1000–100m	100–10m	10m–1m	1m–0.1m	0.1–0.01m

# UHF Band Legislation: Europe versus North America

## North America (FCC Part 15.247)

- 902 - 928 Mhz (4W EIRP)
- 52 channels
- 500khz per channel
- Frequency hopping

## Europe (ETSI 300-220)

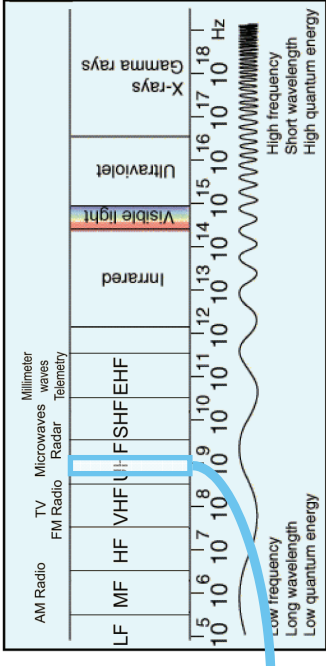
- 869.4 - 869.65 Mhz (0.5W ERP)
- Only 250khz band
- For short-range devices
- 10% duty cycle

## Europe (ETSI 302-208)

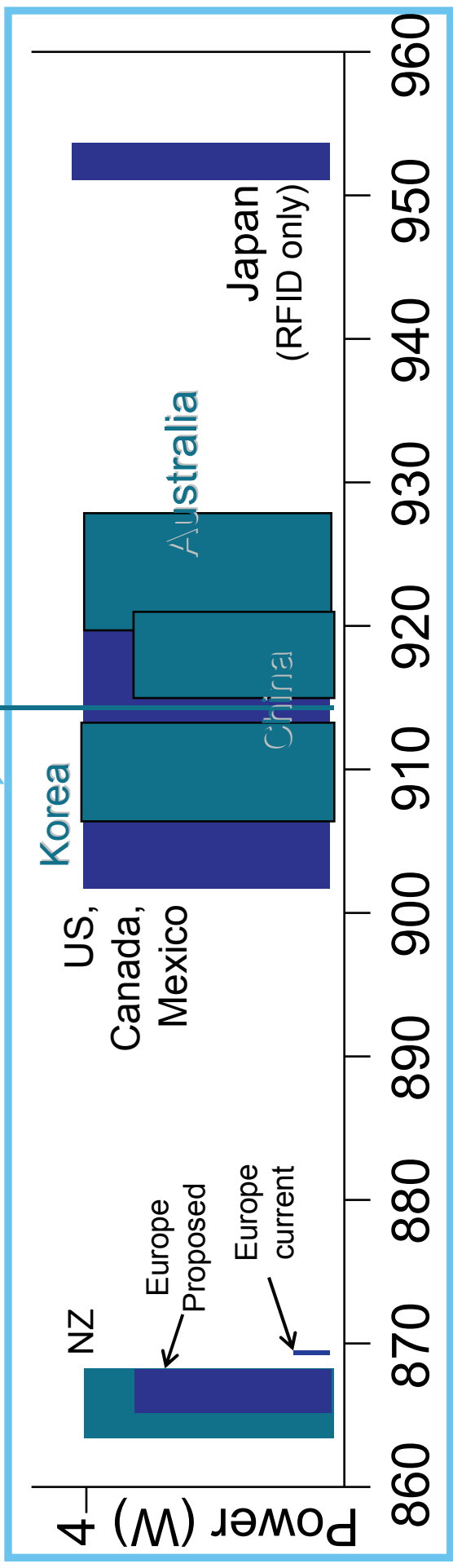
- 865.6 - 867.6 Mhz (2W ERP)
- 10 channels
- 200khz per channel
- Listen-Before-Talk
  - Listen (>5 ms), Use (<4s), Wait (>100ms) or Listen to other channels (>5ms)
  - ERP Threshold < -126 dbW
- Other power levels available

# UHF band legislation: Worldwide

- Need to consider performance
- NB *linear* scales



South Africa (8W)



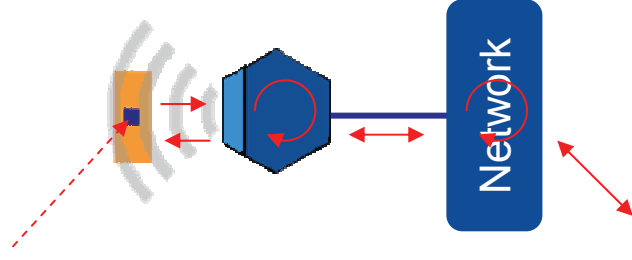
Asia largely follows European regulations  
South and central America largely follow US regulations

# Legislation and standardisation

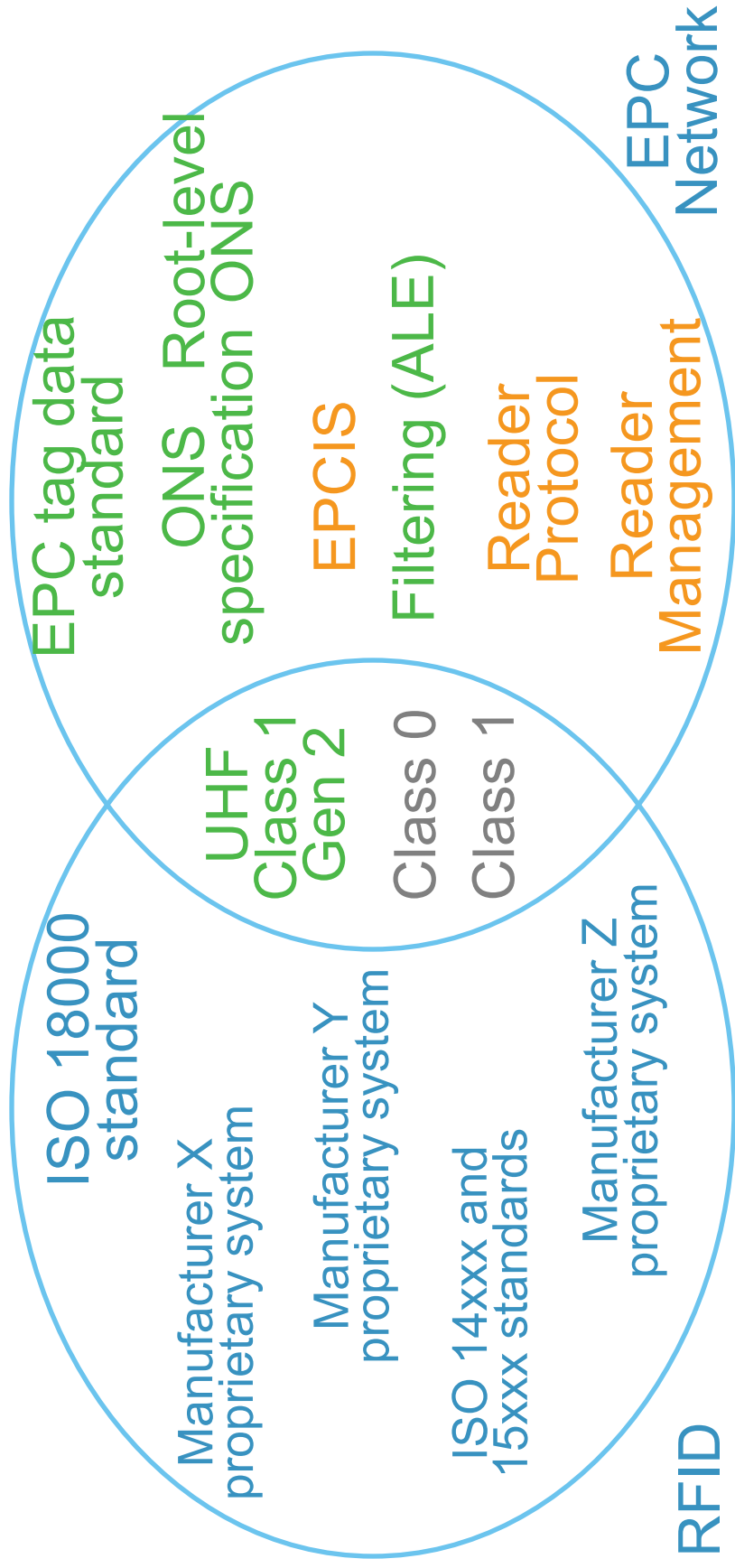
- Legislation
- Standardisation

# RFID & EPC Network Standards

- EPC Network defined by a set of standards specifying
  - What information is programmed into the tags (EPC)
  - Exactly how RFID is to be implemented (air interface)
  - How this information is communicated by RFID readers
  - What additional software is required to process the RFID data
  - How the information is integrated with existing BIS applications
- A number of other RFID specifications exist
  - Many proprietary ones!
  - Also several ISO standards



# RFID & EPC Network Standards



# ISO RFID standards

- International standards organisation (ISO) and International Electrotechnical Commission (IEC) joint technical committees
- ISO/IEC JT1/SC17
  - Identification cards and related devices, HF
  - ISO/IEC 10536 contactless identification cards
  - ISO/IEC 14443 proximity identification cards
  - ISO/IEC 15693 contactless vicinity cards
- ISO/IEC JT1/SC31/WG4
  - ISO/IEC 18000 RFID air interface standards
  - Seven parts in total; part 3 covers HF and part 6 covers 860-930MHz
  - Both parts 3 and 6 have two different modes of operation
- EPCglobal UHF Class 1 Gen 2 is currently being considered for inclusion into ISO 18000-6 as type C

# UHF Class 1 Generation 2

- Class 0 and Class 1 were incompatible with each other
- Two other dominant protocols: ISO 18000-6A, ISO 18000-6B
- End users wanted a single protocol for passive UHF tags which will work globally
- Improvements over previous protocols
  1. Improved performance
  2. Dense Reader Mode
  3. Security Improvements
  4. Supports use of either ISO identifiers or EPC identifiers
- However...

## Gen2: (1) Improved Performance

- Faster and variable Data Rates
  - Up to 128kbps reader → tag  
640kbps tag → reader
  - Variable rates depending on environment
- Reader may selectively filter sets of tags to address based on:
  - header codes – indicates coding scheme
  - fast-filter values – indicates packaging level etc

## Gen2: (1) Improved Performance

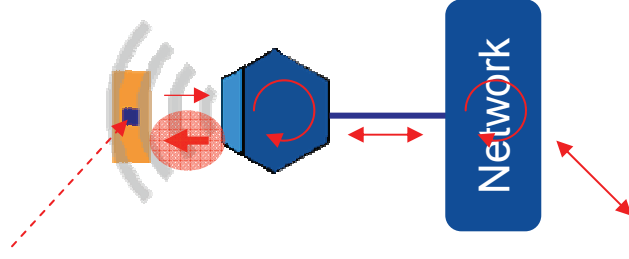
- Eliminate miscounts due to “sleeping tags”
  - Tags will not go to sleep
  - Instead, use flags to count tags from A-> B -> A
- Eliminate reader interruptions
  - 4 sessions of tag reads
- Eliminate ghost reads
  - 8 checks to ensure that tag’s response is valid

## Gen2: (2) Dense Reader Mode

- To enable dense reader deployment (~50 readers per DC)
- Reader requirements:-
  - Reader using even-numbered channels, tag backscatters using odd-numbered channels
  - Sharp reader transmit mask
  - Reduced data rates

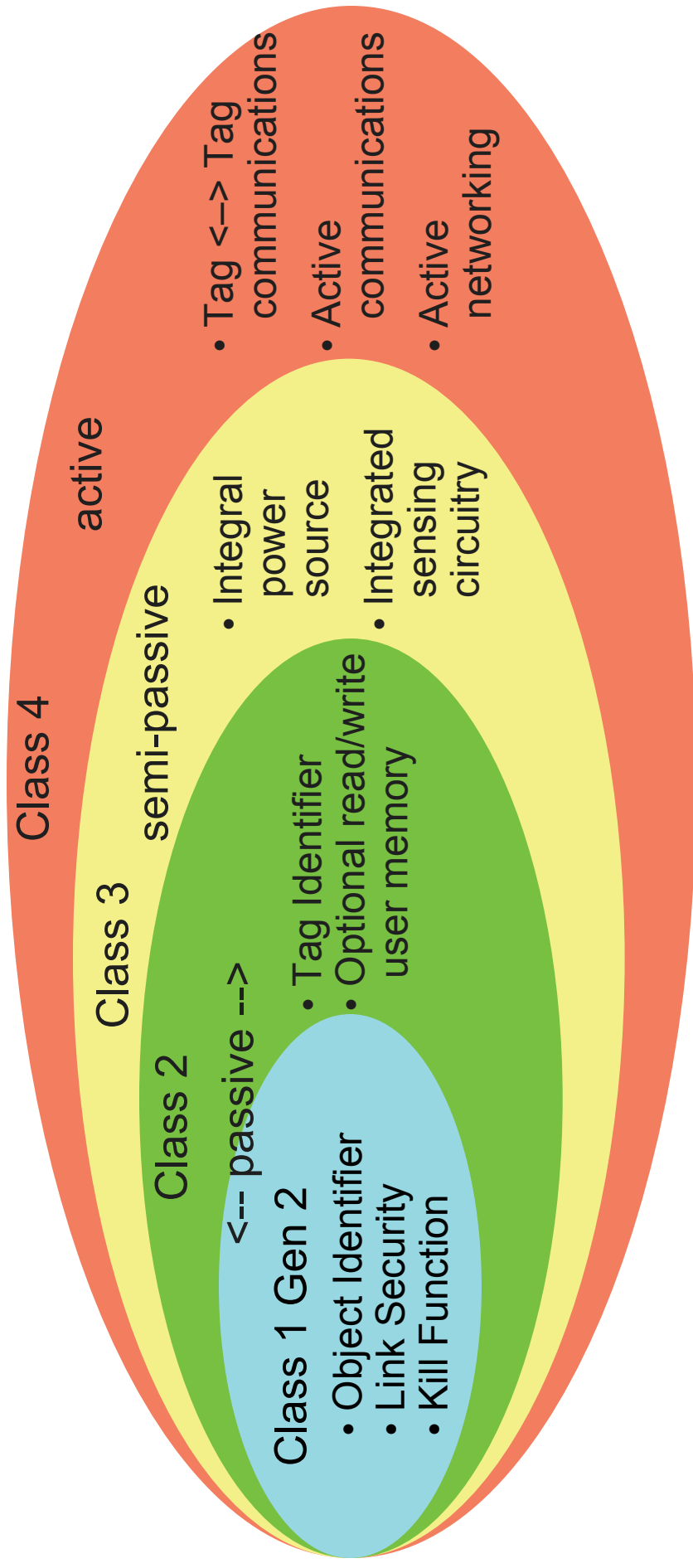
# Gen2: (3) Security Improvements

- **Cover-Coding of the Forward Link**
  - Readers refer to and distinguish between tags via 16-bit random numbers generated by the tags, rather than transmitting the EPC code on the forward channel – better protection against snooping
- **Passwords are never transmitted in clear text - instead they are always sent encrypted based on tag-generated random number**
- **Separate passwords for:**
  - Kill – 32-bit Kill function renders tag permanently inoperable
  - Lock – Tags can be write-locked after programming to avoid over-writing



# UHF class 1 generation 2

the foundation for more functional tags



## However...

- Gen2-certified Readers
  - Readers could be certified if it meets a minimum set of Gen2 features
  - A group of Gen2-certified readers may not be interoperable
- Compliance to Legislation
  - Compliance to standard does not imply compliance to legislation
  - E.g. ETSI listening threshold value

# EPCglobal V1.0 standards

Already Ratified and freely available:

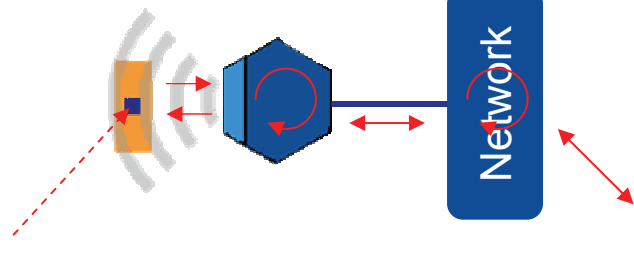
- EPC Tag Data Standards (TDS)
- UHF Class 1 Generation 2 air protocol (tag – reader comms)
- Application Level Events (ALE) (filtering interface)
- Object Name Service (ONS) (lookup service)
- Tag Data Translation (EPC translation, validation, future-proofing)

Expected 2006:

- EPC Information Services (EPCIS) (networked databases)
- Reader Protocol (software interface to the reader)
- Reader Management (remote monitoring, configuration)

Future standards:

- Item-level tagging / HF Generation 2 air protocol
- Discovery Services (secure lookup services across supply chain)



# Obsolete – R.I.P. !

## **X** Physical Markup Language (PML)

- replaced by use of well-defined XML schemas in various new standards - especially in ALE

## **X** Savant

- replaced by Application Level Events (ALE) for outbound (application-facing) interface
- replaced by Reader Protocol for inbound interface