

KNOWLEDGE IN REALITY

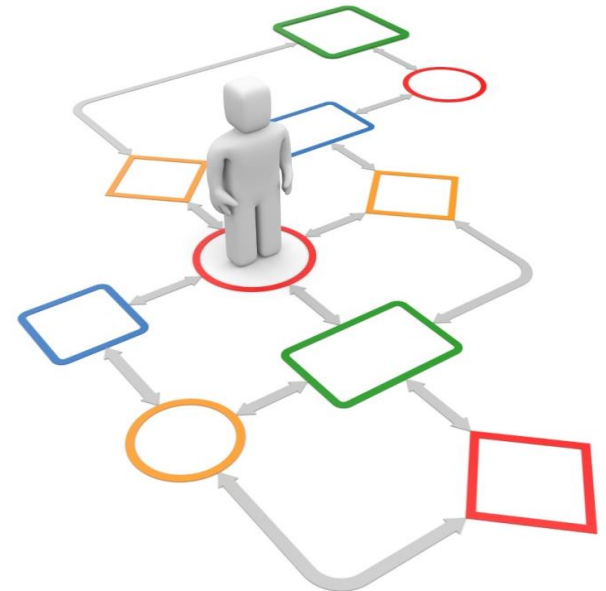


EMC SERVICES

From system to component – allocating EMC requirements Examples from different sectors



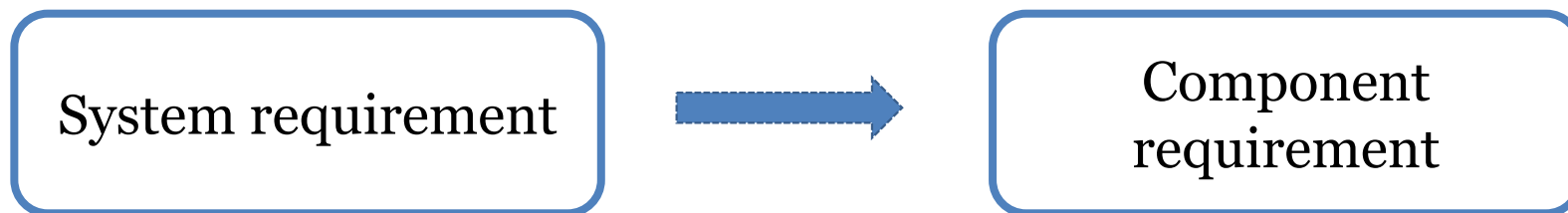
- What is the goal?
- Examples
 - Military
 - Railway
 - Marine
 - Vehicle
- What of Forklifts?
- Discussion



Presentation 20180914 IEEE

What is the goal?

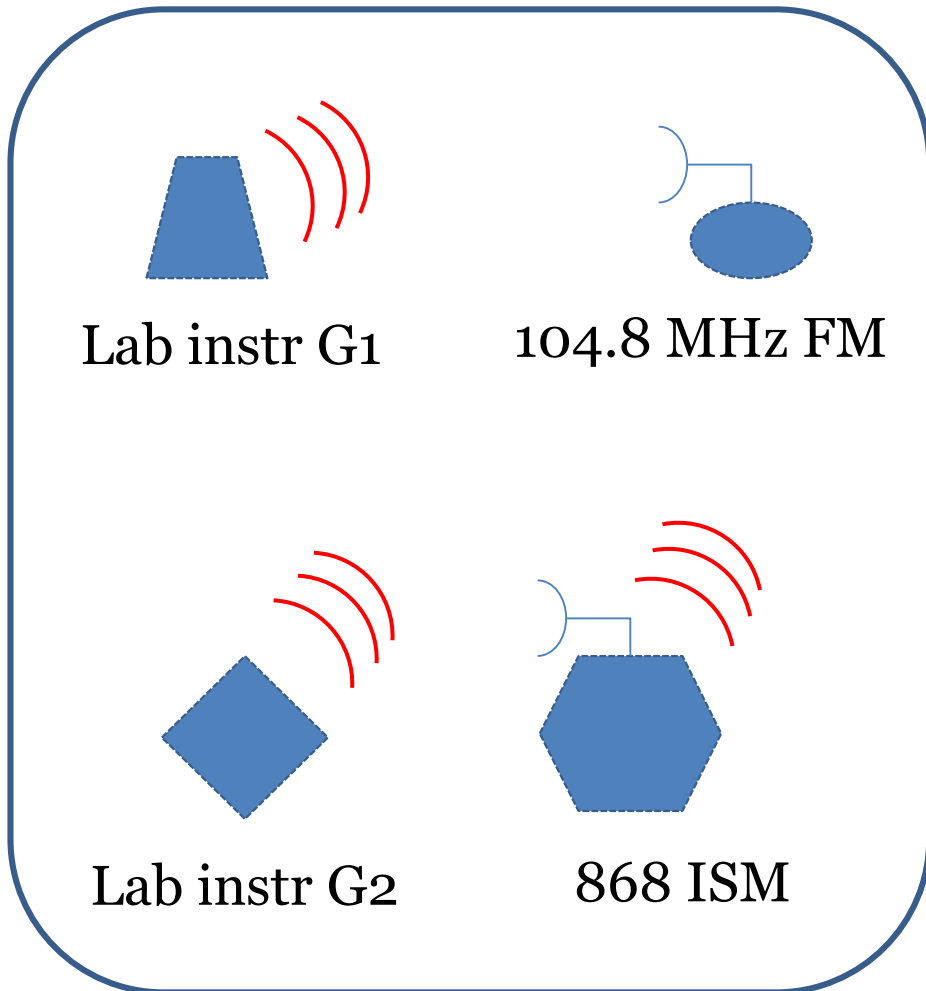
- When installing all components, the complete system shall work within specification
 - Component requirement shall reflect actual environment and installation
 - Adequate requirements – not excessive and not underestimating



Industrial sector

- Components = apparatus
 - Conform to industrial levels
 - Some 100 standards -> standard chaos
 - Same basic tests, usually same levels
- House = installation
 - Conform to *good engineering practice*

Example: one room with multiple equipment – same electromagnetic environment - Industrial



- Technical rationale: same limit due to local EME
- Multiple product standards
 - Mostly same levels
- Some products do not have industrial environment as level
- Assumption: some space between components

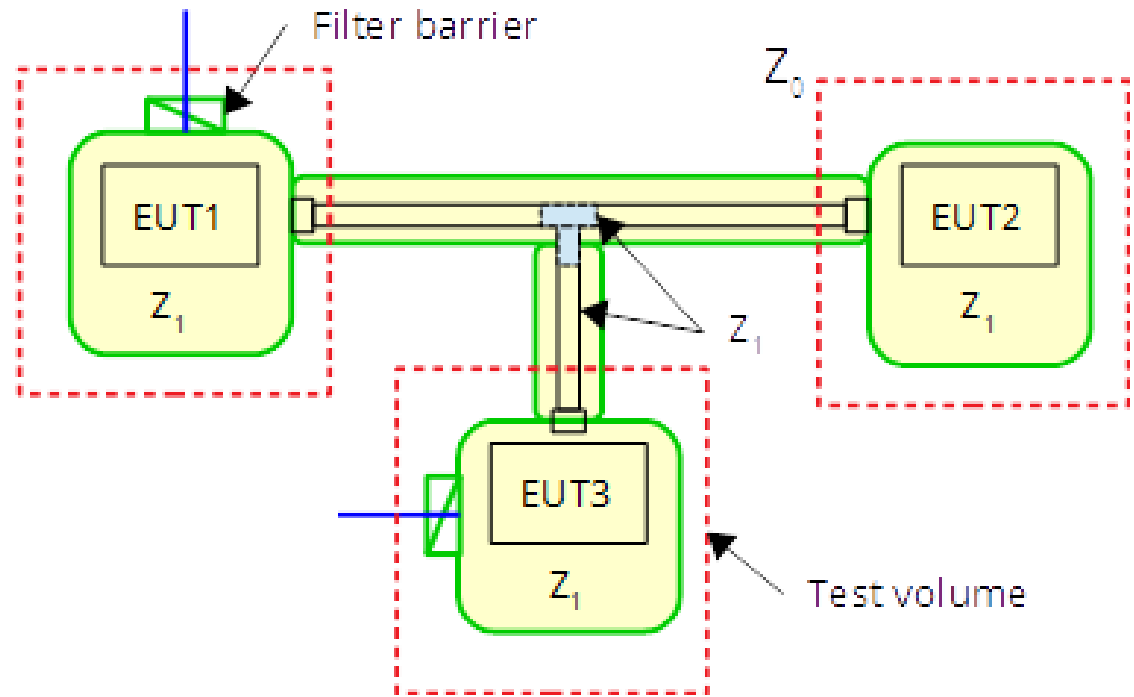
Military sector

- Top level
 - Ships, vehicles, installations
 - E.g. MIL STD 464C: overall environment specification
- Components
 - E.g. MIL STD 461G
 - Tailored limits for each environment (platform)
 - Same basic tests + dedicated tests
- Everything is shielded
 - Assumption: each component = worst case



Military example

- Preconditions:
 - One zone containing multiple components
 - Each component = worst case
 - Same test on each one
 - Assumption: the shield is always continuous



Railway sector

- Specific standard for each environment
- Top level
 - Complete railway emission EN 50121-2
 - Train and complete vehicle EN 50121-3-1
- Components
 - Rolling stock EN 50121-3-2
 - Telecommunication systems EN 50121-4
 - Fixed power installation EN 50121-5
 - Tailored limits for each environment (platform)
 - Same basic tests, EN standard + dedicated tests



Marine sector

- Two environments = 3 zones
 - Bridge and vicinity zone
 - General power distribution zone
 - Accommodation zone
- Ship level
 - IEC 60533 Ships with metallic hull
 - Installation control
- Components
 - Tailored limits for each environment (zone) – IEC 60533
 - Some unique marine requirements
 - Accommodation zone = pick any standard for domestic environment
 - Same basic tests, EN standards

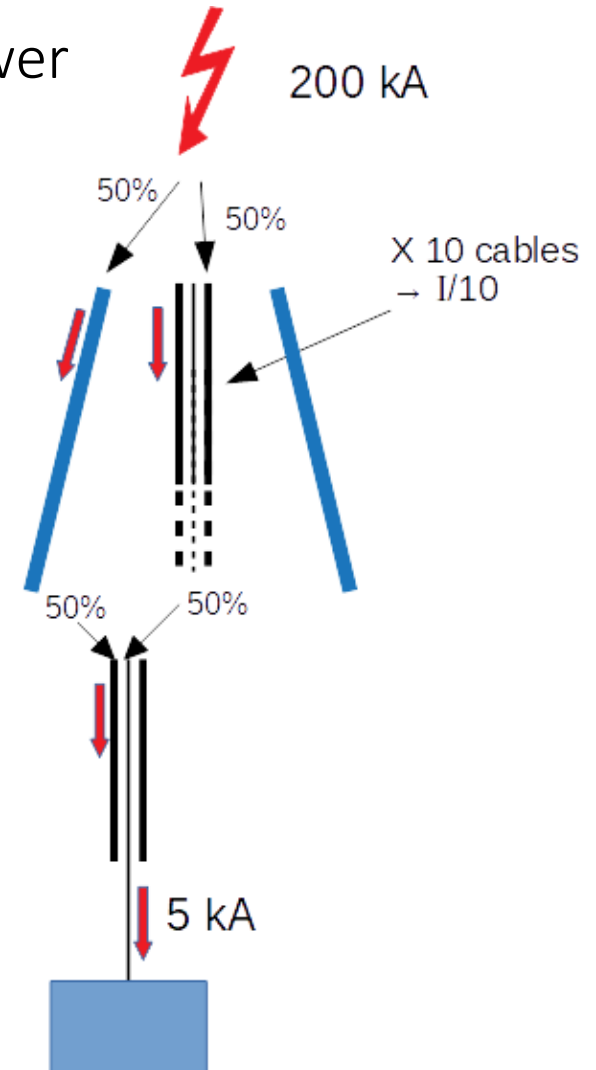


Telecom example: lightning pulse

- Assumption: worst case direct strike 200 kA in tower
 - Low frequency pulse – shielding not very effective
 - Each layer is a shield for the interior
 - Each shield handles 50% of the incident pulse

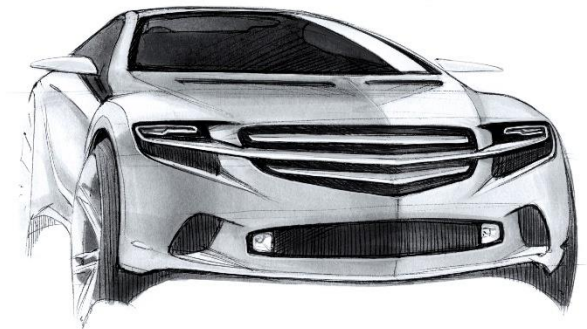


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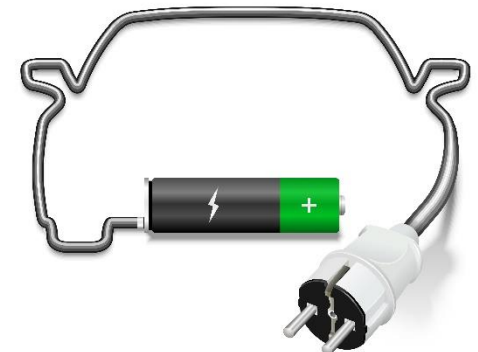
Vehicle sector – standard car (combustion engine)

- Legal requirements – protecting other cars
- Corporate requirements – protecting your own car
 - Tailored limits in detail, revised periodically
 - Added requirements based on risk assessment
- Each component = one zone
- Hidden car level zones
 - ESD for different placements
 - Portable transmitter test depending on installation
- Component tests
 - Setup simulating the car body
 - Import from MIL setups



Vehicle sector – electric car (hybrids etc)

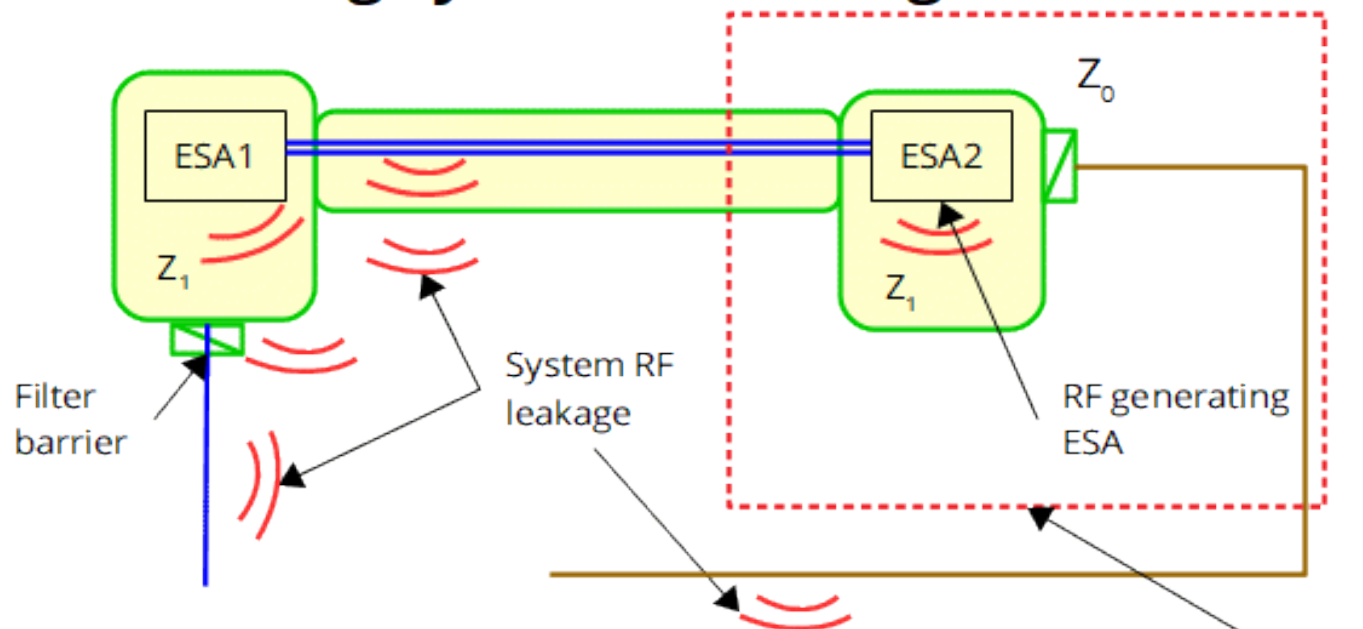
- Legal requirements – including AC/DC charging
 - Component tests modified
- **Several components = one combined zone**
- Corporate requirements – protecting your own car
 - What to do?
- Volvo Car solution – tailored testing
 - Identify the worst case component (power inverter)
 - Simulate the impact of that component with RF current injection
 - Worst threat = RF emission
 - Added to the regular emission tests
 - Future development: shielded signal systems



Volvo Car example: shielded system

Volvo shielding requirement

Risk: Leaking system including cables



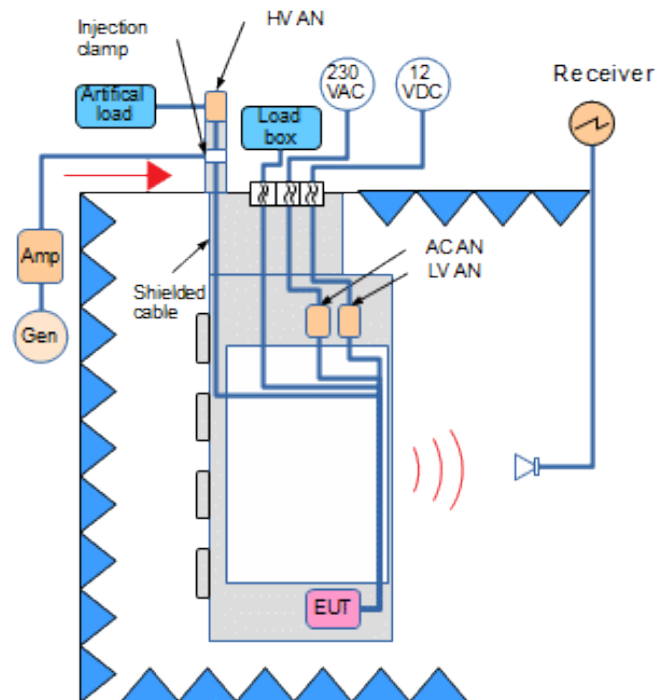
Problem:

- System leakage generated outside ESA1 and ESA2
- How to discover this prior to vehicle test?
- How to verify ESA1?
- What requirement?

Volvo Car example: test method

CMA shielding requirement

Option 2: Injection on ESA1 during emission measurement



Pros:

- All interfaces, connectors and cables are included
- Measurement is integrated into regular test setup
- No tailored test items (EUT)

Cons:

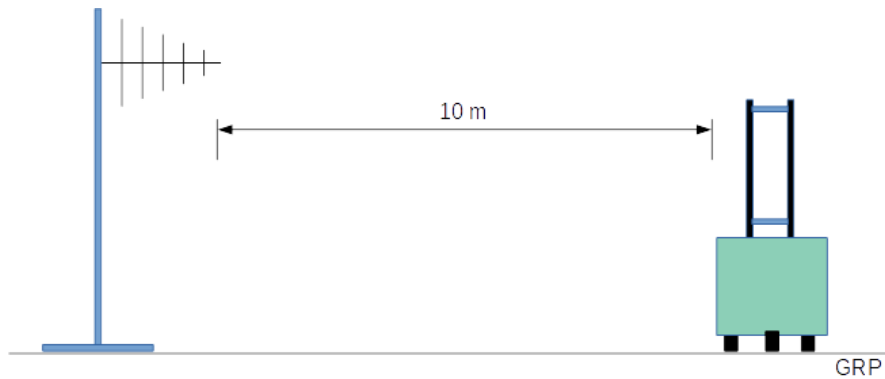
- How to specify the injection
- The major source must be known
- Pulse generator is complicated
- The laboratory must be prepared!

Forklifts

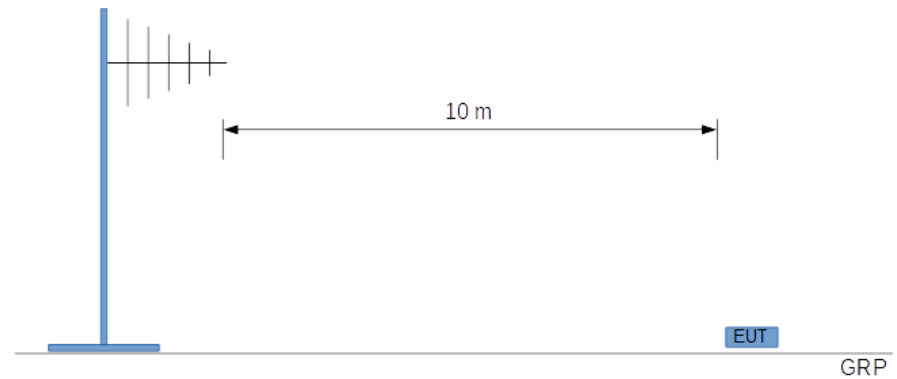
- EU: one standard – EN 12895:2015
 - Complete forklift
 - Component/system test
 - Same test methods and levels for all
 - LF H-field test (DC, 50 Hz) on component only
 - EN standards as test methods
 - Only external threats considered
 - AC charging handled separately, outside scope
- The 2015 version of the standard
 - Enhanced immunity requirements
 - Buying commercial industrial components off the shelf is harder
 - Why did they choose the EN 61000-4-8 for H-field immunity?
 - Is DC and 50 Hz the only threat?

Forklift test example

- Complete forklift radiated emission



- Component radiated emission



Forklifts – future component requirements

- What do we actually need?
 - Tests relevant to the installation
 - Reuse of existing standards
 - Tests relevant to the real threats
 - External and internal
- What is a forklift?
 - 3/4 wheels
 - Metal body
 - Isolated electrical system 24/48 VDC
 - IoT base unit



Forklifts –component ideas

Regard the forklift as a regular vehicle variant

- Adaptation of existing standards
 - Do not make new method standards!!!
- CISPR25 emission
- ISO immunity
- ISO 16750-2 power quality?
 - Everything is not relevant

Forklifts discussion



Comments?