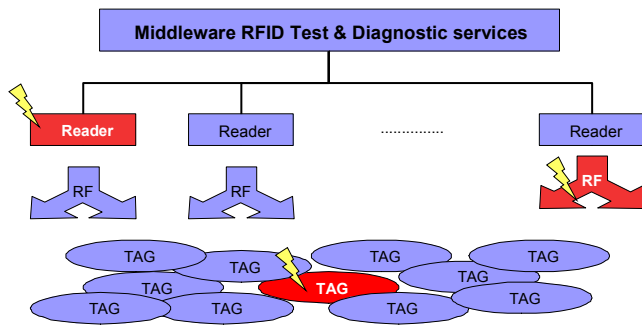


CONTEXT

RFID technologies are often used in critical domains or into harsh environments where the on-line detection of RFID system defects is a must.

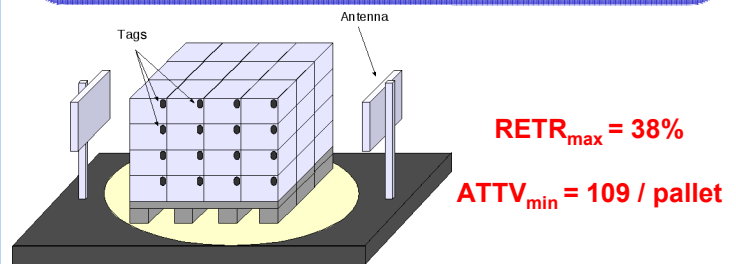
OBJECTIVES

- New on-line monitoring approach detecting reader, RF coupling or tag defects
- Non-intrusive approach: all the information are available from classical RFID system operations



CASE STUDY

- 900MHz UHF RFID System
- EPC Class 1 Gen 2 tags
- Fixed number of tags per pallet: 111 tags
- Configuration detecting almost all the tags:
 - ☒ Optimized reader protocol parameters
 - ☒ Optimized tag location and direction on boxes
 - ☒ Optimized antenna reader types, location and direction



RFID SYSTEMS MONITORING

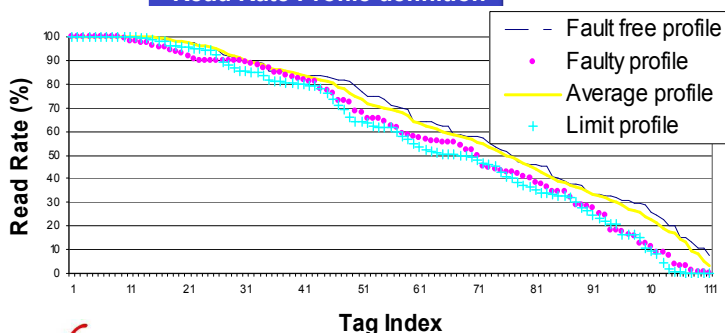
Classical approaches

- Remote monitoring:
 - ☒ Status monitoring
 - ↓ Only detects catastrophic errors: disconnected or power down readers
- Performances monitoring:
 - ☒ « Average Tag Traffic Volume » (ATTV)
 - ↓ Requires a learning phase to create a reference
 - ☒ Global « Read Errors to Total Reads » (RETR)
 - ↓ Does not detect local soft errors
 - ↓ No localization of defects

New approach

- Characterization of a statistical parameter, the tag Read Rate Profile, individually involving each tag
- Learning phase: Each inventory leads to a specific inventory profile, the Read Rate Profile, which is the ordered read rate curve of the entire population
- Limit profile definition: this limit is computed using the average and the standard deviation of each ordered tags (assuming a Normal distribution)

Read Rate Profile definition



EXPERIMENTAL VALIDATION & CONCLUSION

Hardware fault injection

- The following faults have been randomly injected:
 - (1) 5 tags rotated by 90°
 - (2-3-4) 5-15-21 tags misplaced on boxes
 - (5-6) Pallet rotation stopped during 15s-20s

Fault detection

	(1)	(2)	(3)	(4)	(5)	(6)
#Tags detected	108	108	109	107	109	109
RETR (%)	34.9	35.4	37.5	37.3	36.4	38
ATTV monitoring	✓	✓	✗	✓	✗	✗
RETR monitoring	✗	✗	✗	✗	✗	✗
Profile monitoring	✗	✗	✓	✓	✓	✓

✓ : Fault detection ✗ : No fault detection

Software fault injection

- The following faults have been randomly injected:
 - (1) +40% RETR on 5 tags
 - (2) +10% RETR on 20 tags

Fault detection

	(1)	(2)
ATTV monitoring	10%	8%
RETR monitoring	7%	7%
Profile monitoring	69%	97%
Complementarities of the 3 monitoring methods		

Conclusion: ATTV and Profile monitoring methods must be concurrently used to detect the maximum number of faults