Mission Reliability

The operating scenario is increasingly close to our territory

An effective military instrument is mandatory

It is increasingly important to know the operational availability of the weapon system when the mission starts

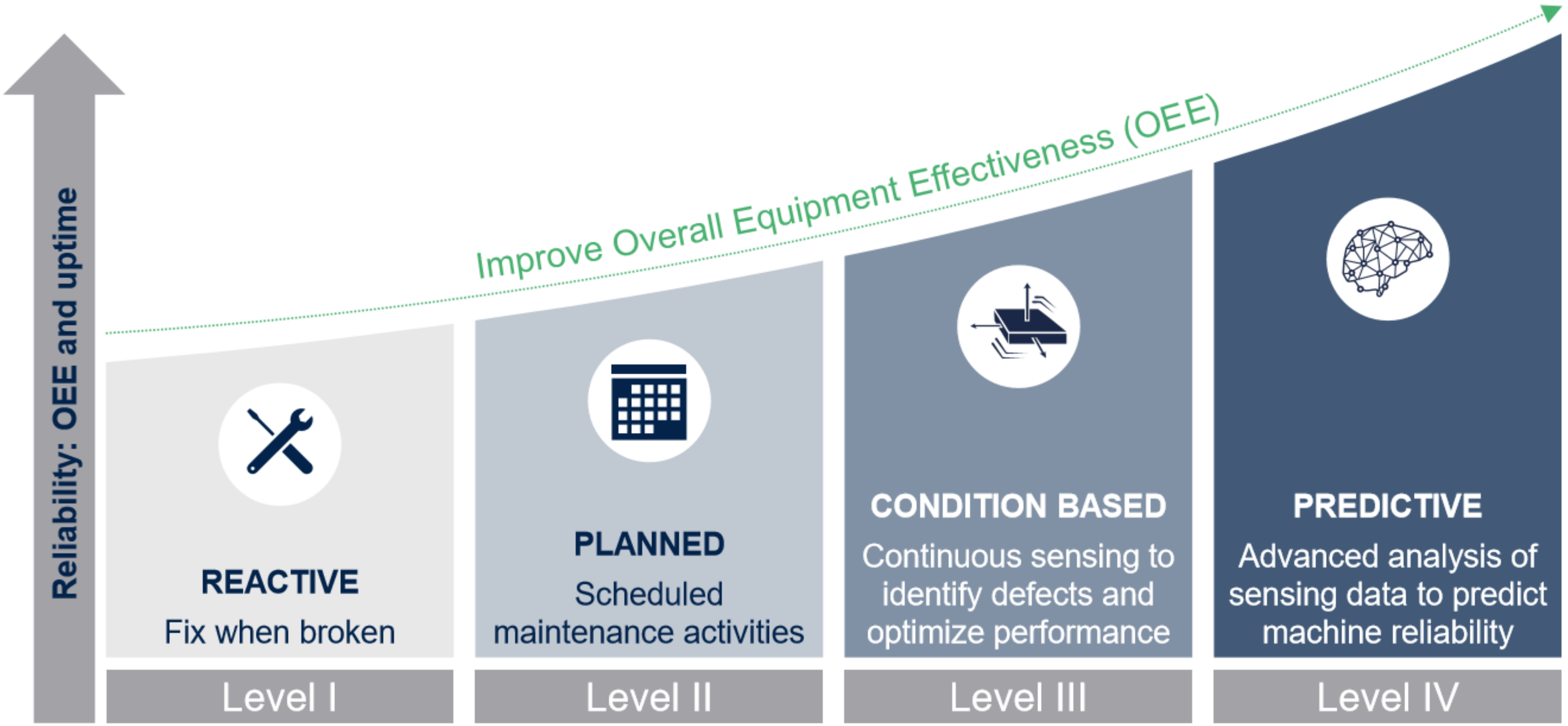
From reliability to mission reliability - the role of edge processsing

From reliability to mission reliability - the role of edge processsing

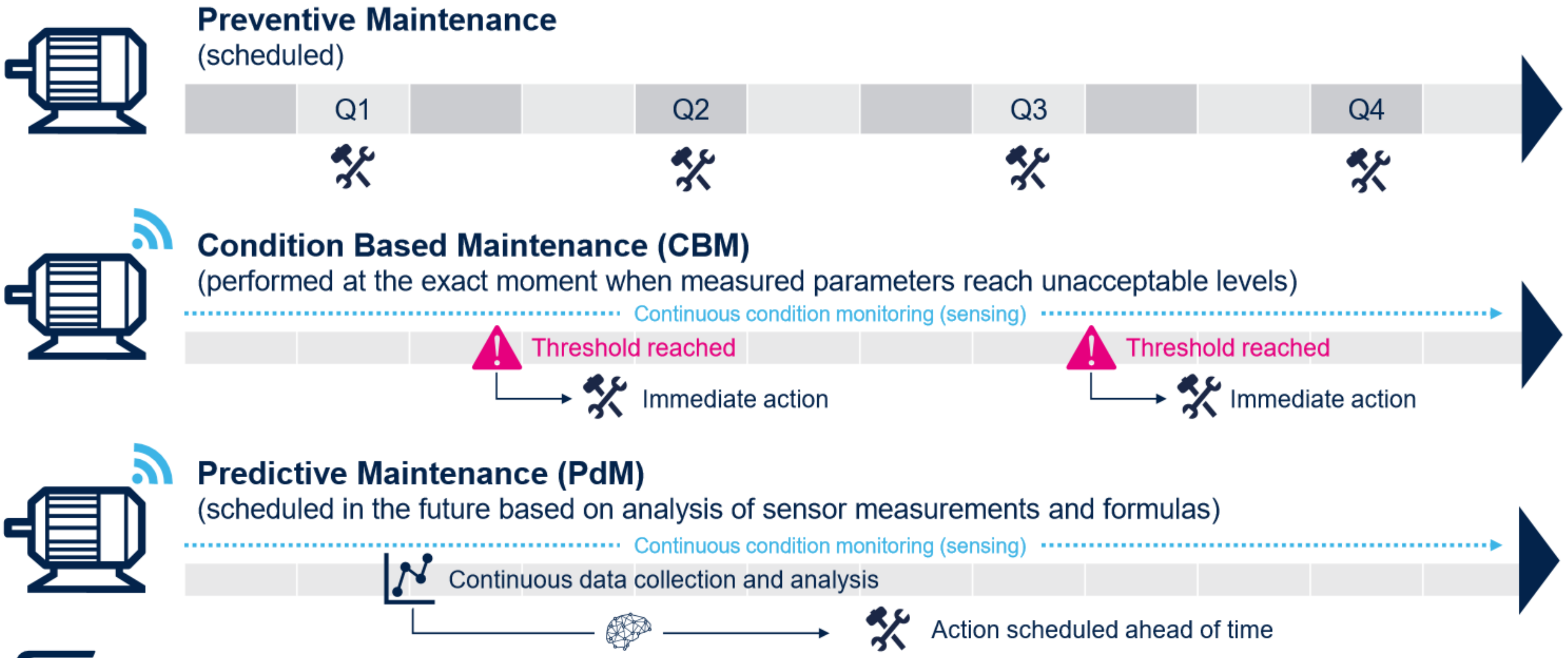
My presentation comes from what STMicroelectronics presented a few days ago at METROIND 4.0 & IoT 2020

My thanks to Eng. Nunzio Abbate for allowing me to use some of his slides

Maintenance strategy continuum
improve overall equipment effectiveness



Preventive, Condition Monitoring and Predictive what's different



Mission Reliability

The most updated Infologistic tools predict the operational availability even in a very sophisticated multi-role and multi-mission context but assuming a generic mission at a generic time.

The limitation of these tools consists in the prior definition of a set of standard missions on which the simulation is carried out

Mission Reliability

The need to evaluate Ao mission has emerged from various exchanges of opinion that took place in recent years both with Military Personnel specialized in Integrated Logistic Support Engineering and personnel from the Defense industries.

A tool able to evaluate the status of the Weapon system and that integrates the remaining useful lives of the equipment (RUL), to obtain the mission RUL. That is, the possibility that the weapon system remains efficient in the specificity of the mission at the time of its departure and for the time of the mission.

Mission Reliability

Our Armed Forces must evaluate the operational readiness of the weapon system at the mission start, taking into account to the real state of the complex system which has already faced many missions in many roles.

Once the mission to be accomplished is known, there is no longer a generic mission but a specific mission. The weapon system is in a specific state resulting from missions already accomplished.

Up to now there was no concrete possibility of measuring the state of wear for all devices, but only for those few equipped with a self wear analysis

Mission Reliability

The methodology necessary to achieve this goal has already been announced in various conferences and has also been reported in various papers.

The necessary technology could be the one indicated by STMicroelectronics

Why?

From condition based to predictive maintenance processing steps

A solid path, step by step

Evaluation of the remaining life of an equipment based on the logged data

Anomaly detection (what, how, where) and **classification**

Data logging from **one or multiple nodes**

- Sensing, sampling rate, connectivity, preprocessing
- Secure data routing
- Field robustness with changing conditions
- Anomaly and gravity ranking
- Advanced data processing

Condition Based Maintenance → Predictive Maintenance

Courtesy of https://www.ge.com/digital/blog/5-steps-reaching-smart-predictive-maintenance // revised by STMicroelectronics

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Condition Based Maintenance → Predictive Maintenance

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Courtesy of https://www.ge.com/digital/blog/5-steps-reaching-smart-predictive-maintenance // revised by STMicroelectronics

By suitably integrating the RULs of the components, the RUL (short-term) of the outgoing mission can be obtained

Our Heritage

More than 20 publications

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2) F. Leccese, M. Cagnetti, S. Giarnetti, E. Petritoli, B. Orioni, I. Luisetto, S. Tuti, M
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Study Towards a Smart Analysis," (2018) Contemporary Agriculture, Vol. 68, No
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3) F. Leccese, M. Cagnetti, S. Giarnetti, A. Pecora, L. Maiolo, E. De Francesco,
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4) Ett. De Francesco, R. De Francesco, F. Leccese: "Use of the S3000 for the Optim
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237. DOI: 10.1109/MetroAeroSpace.2019.8869586. eid=2-s2.0-85074409926.

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Rome, Italy, pp. 440-445. DOI: 10.1109/MetroAeroSpace.2018.8453631. eid=
WOS:000454855500082.

6) F. Leccese, M. Cagnetti, S. Giarnetti, E. Petritoli, I. Luisetto, S. Tuti, A. Pecora, L
Pejčev, T. Đorđević, A. Tomašević, V. Bursić, E. De Francesco, R. Quadarella, L.
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Sea, October 08-10, Bari, Italy, ISBN: 978-153867644-8. DOI: 10.1109/Met
eid=2-s2.0-85063919033.

7) F. Leccese, M. Cagnetti, S. Giarnetti, E. Petritoli, I. Luisetto, S. Tuti, M. Leccisi, A.
Đurović-Pejčev, T. Đorđević, A. Tomašević, V. Bursić, E. De Francesco, R. Qu
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84907340232.

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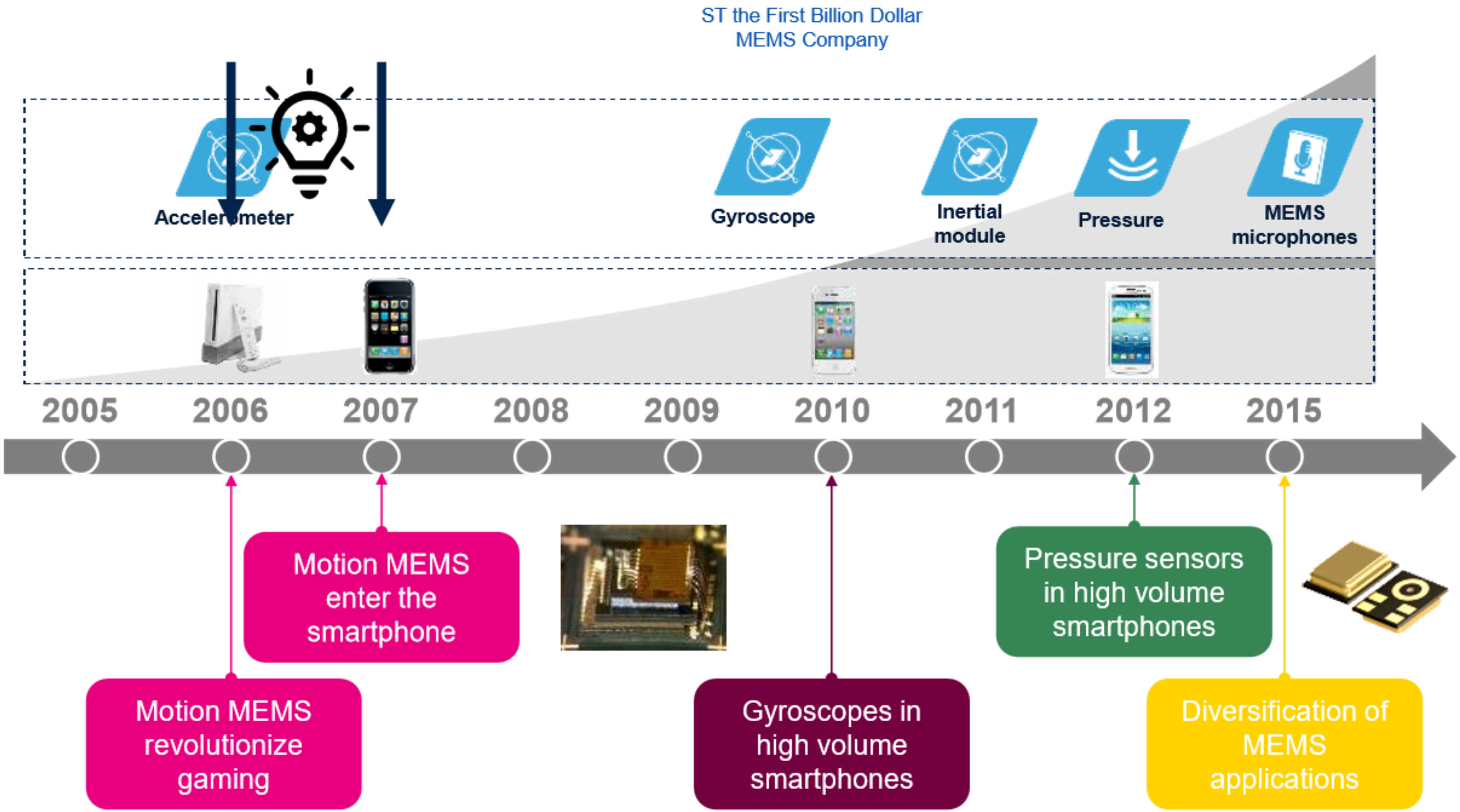
20) F. Leccese, M. Cagnetti, S. Giarnetti, E. Petritoli, S. Tuti, I. Luisetto, V. Arenella, P. Gabriele, E. De Francesco, R. Đurović-Pejčev, T. Đorđević, A. Tomašević, V. Bursić, A. Pecora, L. Maiolo: "Array di sensori di gas commerciali per l'individuazione qualitativa di pesticidi in aree agricole: primi miglioramenti" - II Forum Nazionale Delle Misure – Sezione GMEE – Padova, 17-19 Settembre 2018. ISBN: 978-88-31901-06-2.

And….


Railways
SCALO MERCI
HABSAN – RUWAIS (EAU)
AV TORINO – PADOVA
FERROVIA TIRRENICA
MERSIN -
AV GEBZE -
ALE 711-132-FM
TAF (TRENO ALTA FREQ.)
VOSSLOH G2000
METRO ATLANTA
METRO MANCHESTER
METRO COPENHAGEN
METRO ANKARA
METRO MADRID
METRO LEGGERA AARHUS
METRO ROMA C
DRIVERLESS
METRO MILANO 5
DRIVERLESS
METRO BRESCIA
DRIVERLESS
METRO STOCCOLMA
METRO ROMA B1
METRO GENOVA
TRAM SIRIO
5 CITTA'
TAIPEI CIRCULAR LINE
RETE FERR NORVEGESE
BANE NOR
METRO LOS ANGELES
E464 FS
Radars
Panama
EMPAR, FADR, PAAMS, VTS, KRONOS, SINDRE, RAN 40-L, PANAMA HOMELAND SECURITY, ATCR33S, PAR, GRIFO, SIR-M, RAT-31 S, MRCS-403, NA25X; RAN 20S; ARGOS 73, ES B
Space
ASTROLINK
ARTEMIS
COSMO SKYMED
IRIDIUM
INMARSAT
EUMETSAT
OPTSAT 3000
S.MARCO
SICRAL-SICRAL 1B
ENVISAT
VEGA
C. GEOD. SPAZ. (MT)
ESRIN
More than 120 complex systems in 47 years
Air Force
JSF
TORNAD
MIRAGE
G222
C27J
NH-90
A-149
A-129
ATC TRAPANI BIRGI SATCAS-80-2-G
ATC DECIMOMANNU SATCAS-80-2-G
ATC SIGONELLA
Civil Aviation
ATC KUWAIT AIRPORT
CRAV ROME CIAMPINO
B.AIRES EZEIZA
MOSKOW SHEREMETYEVO
BEIJING INTERNATIONAL
ANKARA ESEMBOGA
ATR 42
AEROPORTO DI LOCARNO
Navy
CAVOUR
ORIZZONTE
FREMM
BDSL ALGERIA
MAESTRALE
COMANDANTI (NUMC)
BAYNUNAH
LERICI
LAT-YA
GAETA
U212A
MS ROTTERDAM
SPARVIERO
EL KASSEH ALGERIA
NITEROI
LUPO
VITTORIO VENETO
MEDINA SAWARI
Missiles &
Artillery
SPADA
SPADA 2000 PLUS
SAMP/T
MEADS
MK2 TESEO
MILAS TORPEDO
PLANCTON
40/70
Integrated Logistic Support Engineering
SeTeL
GROUP

Some technical notes about MEMS

The First “MEMS” Decade @ ST



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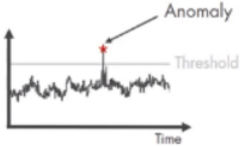
Machine learning strategies partitioning Edge vs. Cloud

Edge - Factory Level (processed sensors data)	Company Level (ERP, etc.)

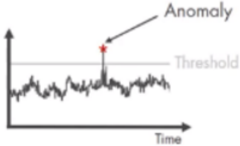
Learning on Fly
Data is acquired and processed at once

Machine Learning **Supervised**

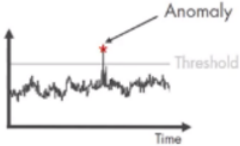


Learning Offline
Data is acquired and later processed

Machine Learning **Unsupervised**



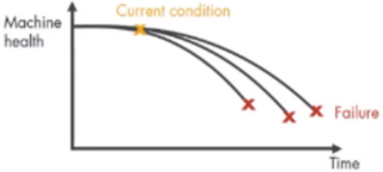
Machine Learning **Supervised**



Identify the type of fault

Oil leakage
Mechanical problem

Estimate remaining life



The engine will fail after 10 ± 2 flights

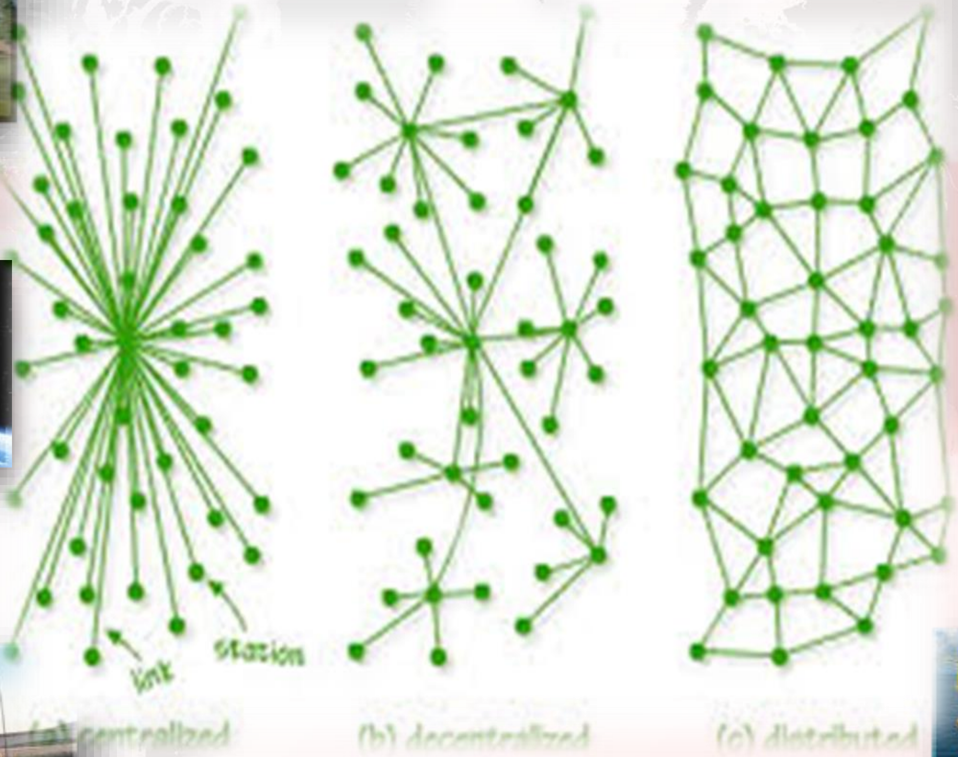
Mission Reliability

The technology indicated by ST microelectronics is a KET (Key Enabling Technology) which can make use of concepts already gained from a methodological point of view.

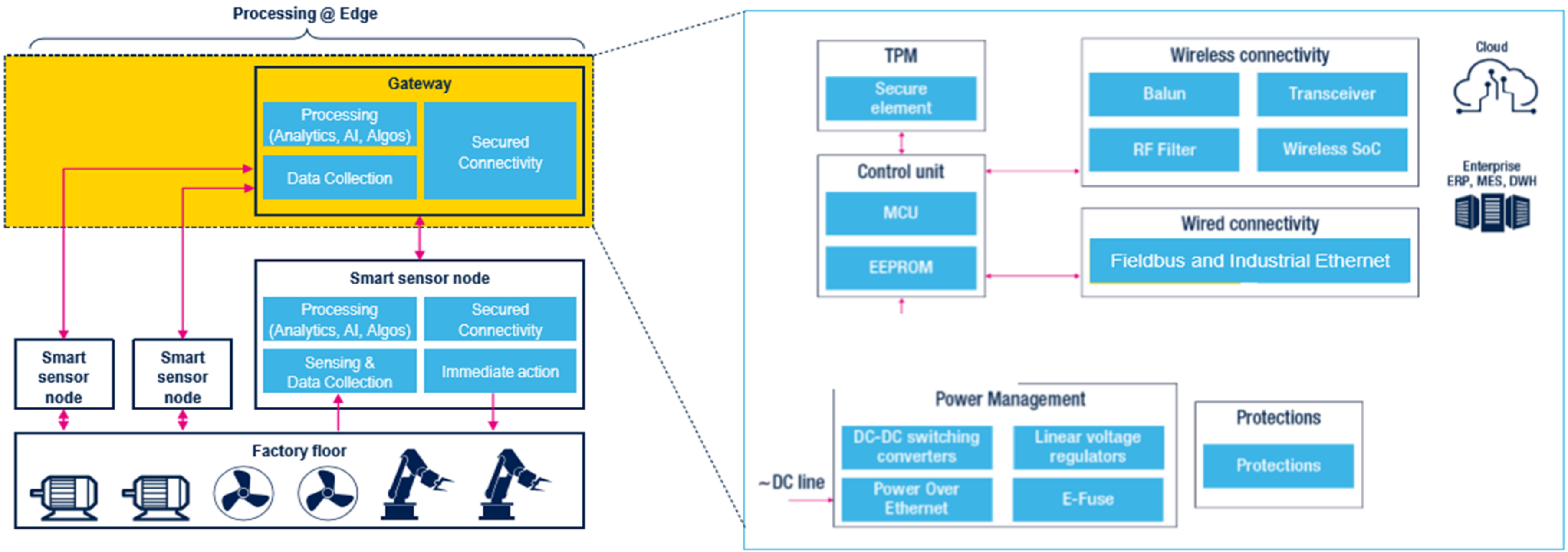
The integration between the two concepts does not require a redesign of the existing weapon systems but instead can be added to carry out a revamping of equipment that can still guarantee military performance but no longer considered de facto reliable.

The measurement network for calculating the remaining useful life can be placed side by side with the already existing components without hindering the operation.

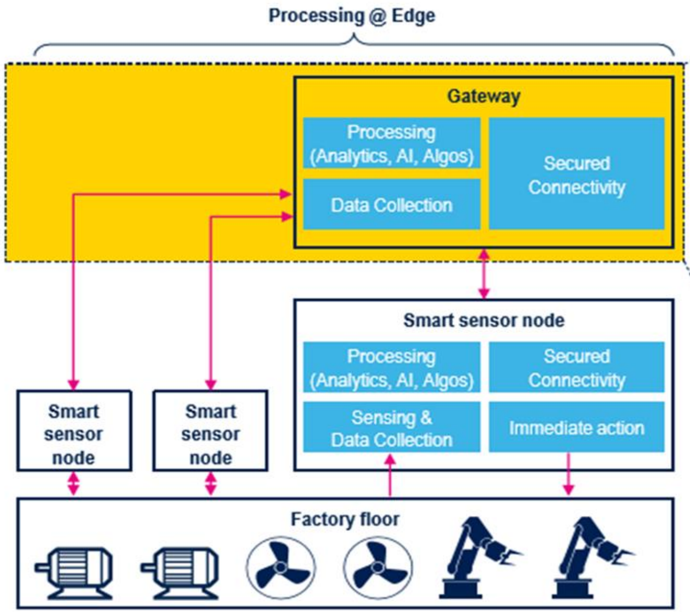
Diagnostic system architectures

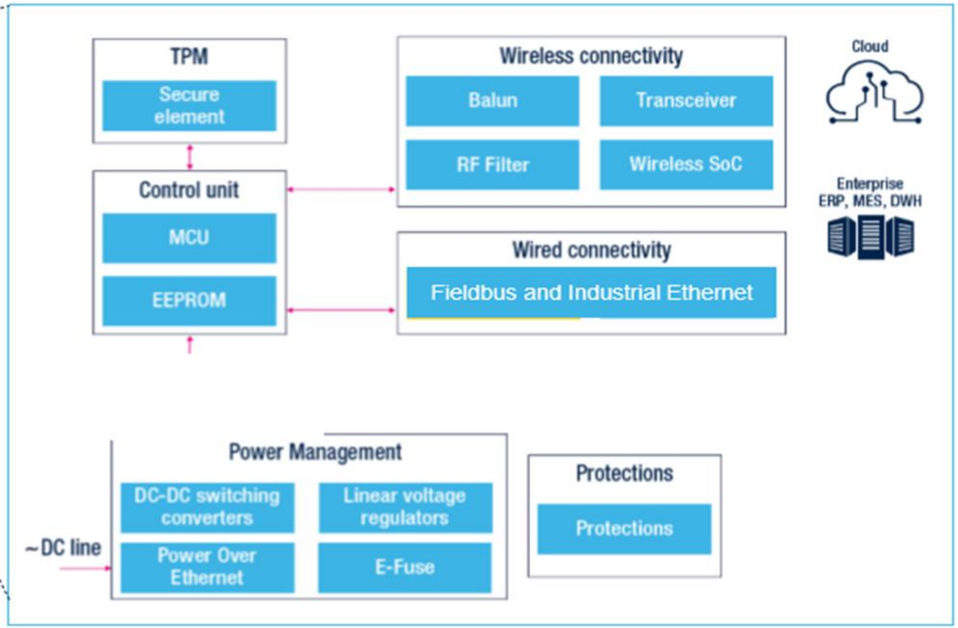


Gateway block diagram



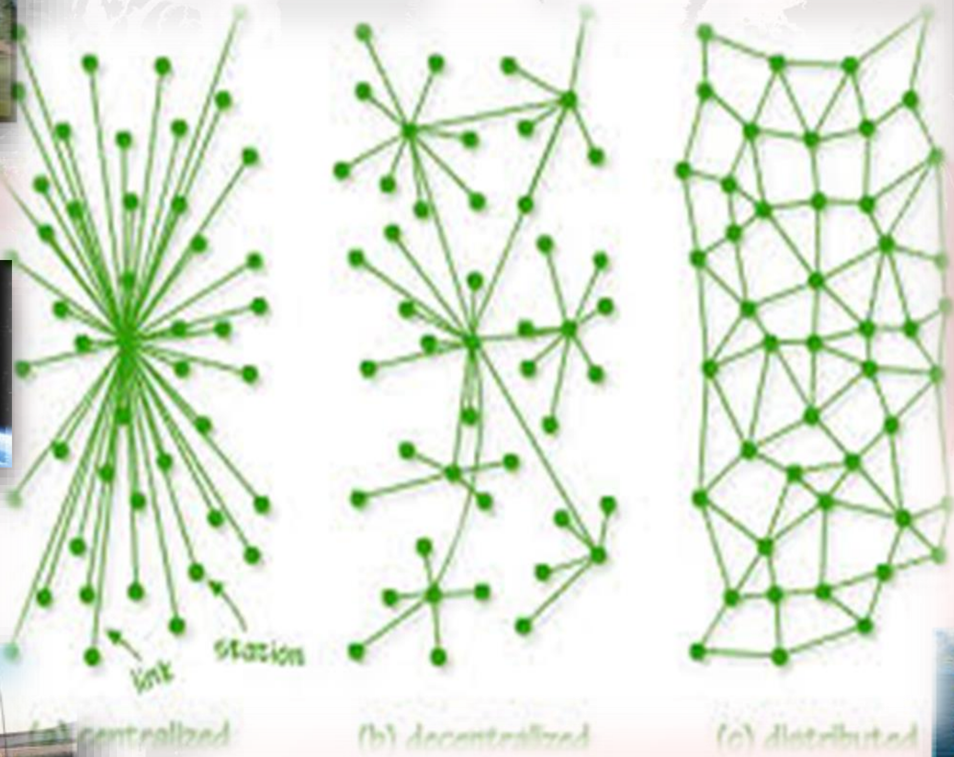
Gateway block diagram





Independent Sensors Network

Diagnostic system architectures



Proposal

From reliability to mission reliability -
the role of edge processsing

An experiment on a minor weapon system to verify the effectiveness of this technology

It should be emphasized that the project would be totally Italian both at the component level and as a system methodology

There are no ITAR limitations and both the technological and metological components are of top of class.

Thanks

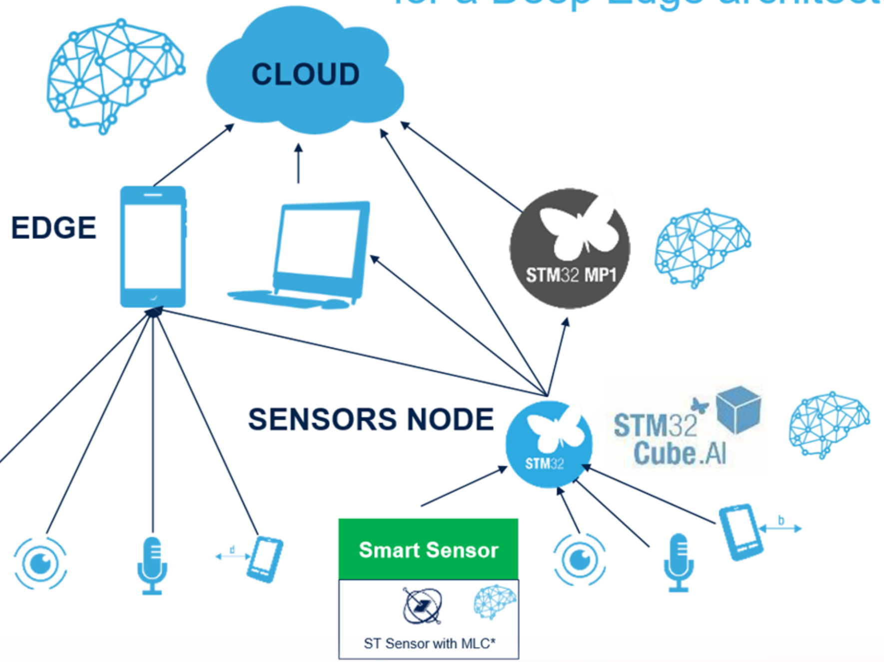
Independent Sensors Network

.....

ST MEMS Sensors for Artificial Intelligence (AI)

for a Deep Edge architecture

- Responsiveness
- Bandwidth
- Privacy
- Security
- Energy Saving



*MLC (Machine Learning Core)