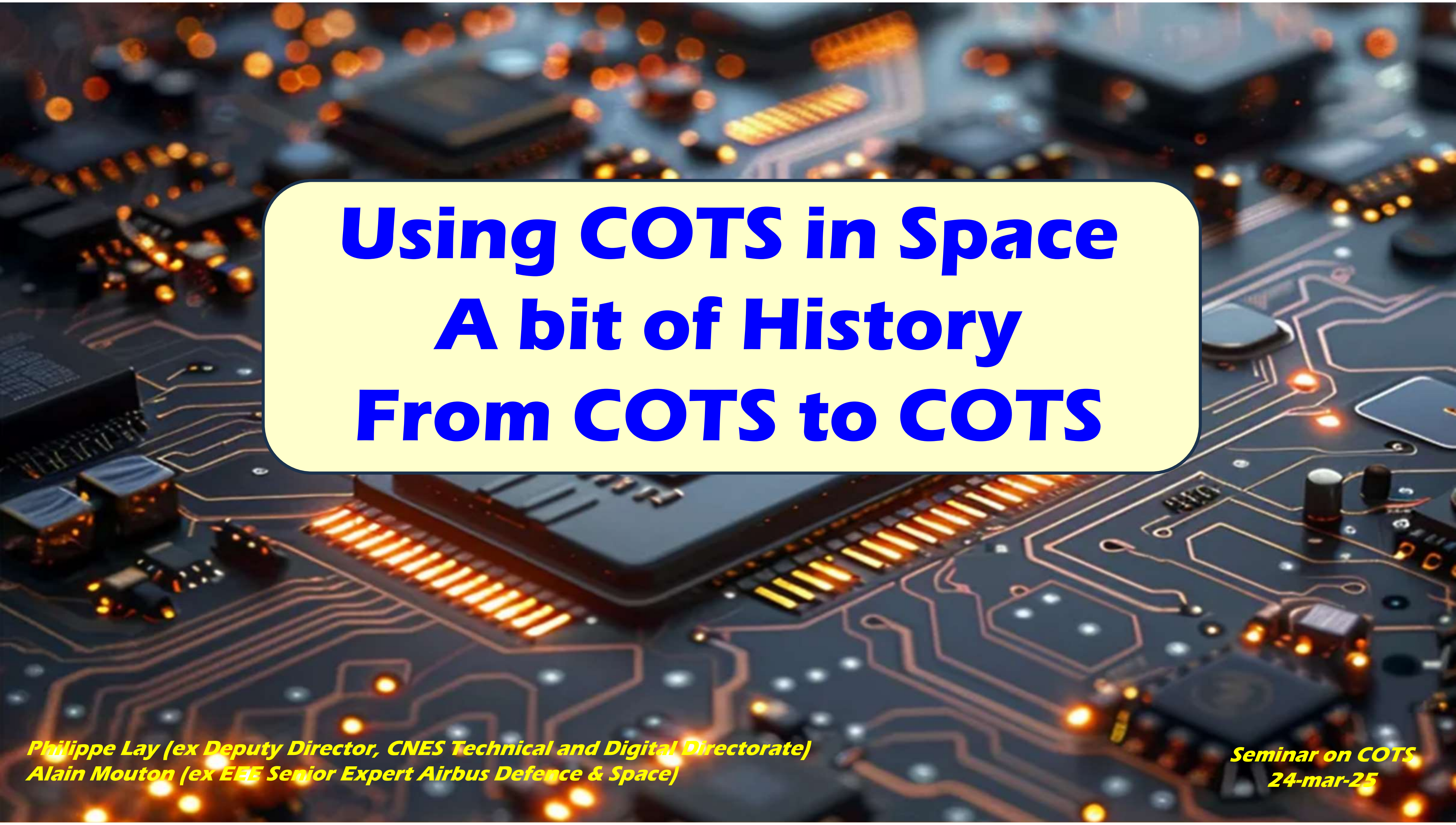

Using COTS in Space
A bit of History
From COTS to COTS

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Seminar on COTS
24-mar-25

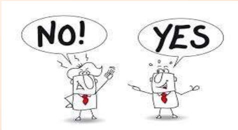
COTS – A bit of History
Agenda

1. Landscape
2. Strategy
3. Timeline
4. Working method
5. Issues to be managed
6. Possible axis of progress
7. The final messages

COTS – A bit of History
1. Landscape

COTS – A bit of History
2. Strategy

- Need to start with **convinced people**



- **Need leaders** to drive the works

- **Partnership/Coworking** between Agency and Industry

- **Global system** approach (not only focus on quality level)
- **« Onion peel »** approach (gradual assembly of players)

- **Progressive approach**

- Use of **benchmark and field return**

COTS – A bit of History
3. Timeline (1/3) – a real marathon

ALCATEL — cnes — MATRA MARCONI SPACE — SPWG APRIL 27-28, 1999

Space Parts Working Group
April 27-28, 1999

French initiative on commercial 3E parts policy for space applications
follow up of 98's presentation

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- **1998-1999 (starter) : First common works between CNES, MMS *(now Airbus)* and Alcatel *(now TAS)* for using COTS in space and presentation of works in USA (SPWG).**

- **1999-2001 : Creation of BCC (Bank of Commercial Components) funded by CNES and managed by Astrium *(now Airbus)* (to gain experience how to specify, procure and store commercial components).**
  Astrium as procurement agent for CNES Microsat product line (Myriades)

- **2000-2004 (French initiative) : Definition of a referential for commercial parts in space by CNES, Astrium, Alcatel, Thales and Dassault**
  => 14 CNES guidelines RNC-Q-60-5xx covering mission profile, selection, risk analysis, state of the art, procurement, systematic tests, incoming, handbook, …

COTS – A bit of History
3. Timeline (2/3) – a real marathon

- **2004 : Sharing of CNES standards with DLR (1st stage of onion peel 😊).**
- **2007 : Publication of ECSS-Q-ST-60B pretailored in three classes.**
- **2008-2010 (French initiative) : French works (CNES, Astrium, Thales) to update the 2004 requirements for using COTS in space based on :**
  - Field return of usage of COTS (e.g. Gaïa, Microsat, Pleïades, Ariane 5)
  - Definition of 3 classes of requirements for COTS i.a.w. ECSS-Q-ST-60B
  => one standard RNC-CNES-Q-ST-60-100 iss.4 (22-Dec-10) split in 3 classes

COTS – A bit of History
3. Timeline (3/3) – a real marathon

- **2010-2011 (dissemination) : Presentations of the French standard to ESA, DLR (supported by Tesat), JAXA, Telecom customers (e.g. Eutelsat) and**
  Benchmark with agencies and industries (including US via G12), EEE hirel & commercial manufacturers (2nd stage of onion peel 😊).

- **Dec-10 to Oct-13 (standardisation) : Elaboration of an European standard for commercial EEE parts in space by ESA, CNES, DLR, Astrium, Tesat, TAS, Alter, Atmel, ST**
  => ECSS-Q-ST-60-13C (21-oct-13), split in 3 classes.

- **2014-2021 (promotion) : Promotion and use of ECSS-Q-ST-60-13 in institutional and commercial programs when agreed by customers.**

COTS – A bit of History
4. Working method (1/2)

- **The EEE standards unrivalled signature**
  Pretailoring in 3 classes
  Class 1 for traditional approach and more freedom for classes 2 & 3

- **Multi-parametric approach**
  Design, cost, technology, geopolitics, communication

- **Global view**
  From EEE part to system

- **Skills upgrading**
  To handle specificities of commercial EEE parts

- **Progressivity**
  Start with active components (microcircuits & discrete)

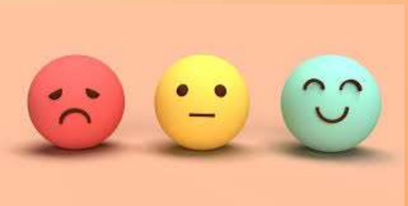
COTS – A bit of History
4. Working method (2/2)

- **Meetings with EEE manufacturers**
  Hirel (Atmel and ST) and commercial (including automotive)

- **Benchmark with agencies and industries**
  (non space : aircrafts, defence, automotive, medical, energy, transport, distributors, …)

- **Risk analysis**

- **Permanent and progressive lessons learned**



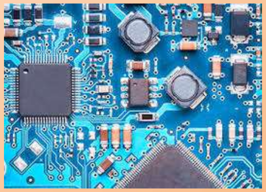
COTS – A bit of History
5. Issues to be managed (1/2)

- **Cost of ownership (COTS not for COST !)**
  (be careful with non recurring cost)

- **Knowledge of commercial market**
  (best-in-class manufacturers)
- **Radiation *(including system level)* and Traceability**
- **Reliability prediction (e.g. use of FIDES)**
- **Obsolescence**
  ***(higher turnover of COTS)* => strategic stock**
- **Prevent counterfeiting *(higher risk with COTS)***

COTS – A bit of History
5. Issues to be managed (2/2)

- Storage of COTS (mainly non-hermetic package)
- Testability of COTS
- Follow-up of errata sheets
- Pure tin finish of commercial components



- Compatibility of hirel mounting process vs COTS
- Replace EEE screening by screening at board/equipment level

COTS – A bit of History
6. Possible axis of progress

- **Reduce bureaucracy**
  - Simplify and merge requirements
  - Use compliance matrix (lighter)
  - No JD (Justification Document) for AEC-Q parts
  - Simplify JD content
  - Use datasheet instead of specific procurement specification
- **European database for COTS** (shared between agencies and industries)
- Pursue **benchmark** (e.g. new space players)
- Continue **lessons learned**

COTS – A bit of History
7. The final messages

- **A long way requiring perseverance through adversity !**

- **Results are there !**
  - Standards for "COTS in space" are available
  - COTS implemented an in orbit (> 1000 types)
  - No known in-orbit failure

- **Agency/Industry partnership is win-win !**
  - Fruitful and complementary cooperation
  - Different angles of view

- **Compensate lighter process by expertise and competence**

- **More delegation for trusted suppliers**

- **Hirel and COTS : an enlarged tool box !**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ANNEXES

SWOT for COTS

STRENGTHS

- Access to performing components (state-of the-art).
- Access to more integrated functions and components.
- Limited procurement cost (in case of high volume).
- Short procurement lead-times.
- High procurement volume => quality based on SPC.
- Existing qualification systems (automotive AEC-Q).
- Similar reliability/quality results at equipment level *(based on AGS feedback – ESCCON 2016)*

WEAKNESSES

- Limited access to EEE manufacturers and limited lever.
- Traceability management (mainly vs radiation requirements).
- Important minimum buy.
- Automotive qualification (AEC-Q) based on self-certif.
- Some EEE manufacturers not experienced in space.
- No systematic screening at component level.
- Pure tin is manageable but some customers to be convinced.

OPPORTUNITIES

- Access to very innovative technologies (e.g. GaN).
- Anticipation of lead-free transition for space.
- Links created with new EEE manufacturers.
- New qualification methods.
- Development of innovative stock strategies.

THREATS

- High cost of ownership if too heavy requirements.
- Long procurement lead-times (allocation risk).
- Higher turnover for microcircuits => obsolescence risk.
- Management of PCNs (tool is needed and requires effort).
- Maverick lot.
- Development of products driven by non-space market.

ECSS-Q-ST-60-13C ***(21-oct13)***
from class 1 to class 3

Class 1 : Fly Commercial screened and lot tested as Hirel-Space

↓

Class 3 : Fly Commercial as is with a strict selection process

ECSS-Q-ST-60-13C *(21-oct13)*
from class 1 to class 3

	CLASS 1	CLASS 2	CLASS 3
EVALUATION	COMPLETE (by the user)	COMPLETE (by the user)	LIMITED - Construction analysis - Radiation evaluation (TID, SEE)
JD (Justification Doc)	DATA COLLECTION	DATA COLLECTION used for screening reduction	DATA COLLECTION used for lot test reduction
SCREENING	COMPLETE (eq to space, by the user)	LIMITED (based on JD data) - PIND test (if applicable) - Hermeticity (if applicable)	LIMITED - PIND test (if applicable) - Hermeticity (if applicable)
LOT TEST (on screened parts) (when applicable)	COMPLETE (eq to space, by the user)	COMPLETE (eq to space, by the user)	LIMITED (based on JD data) - Construction analysis - RVT (Radiation Verification test)