The Future European Space Automation Domain

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SESP 2017
Noordwijk 28-30th March 2017

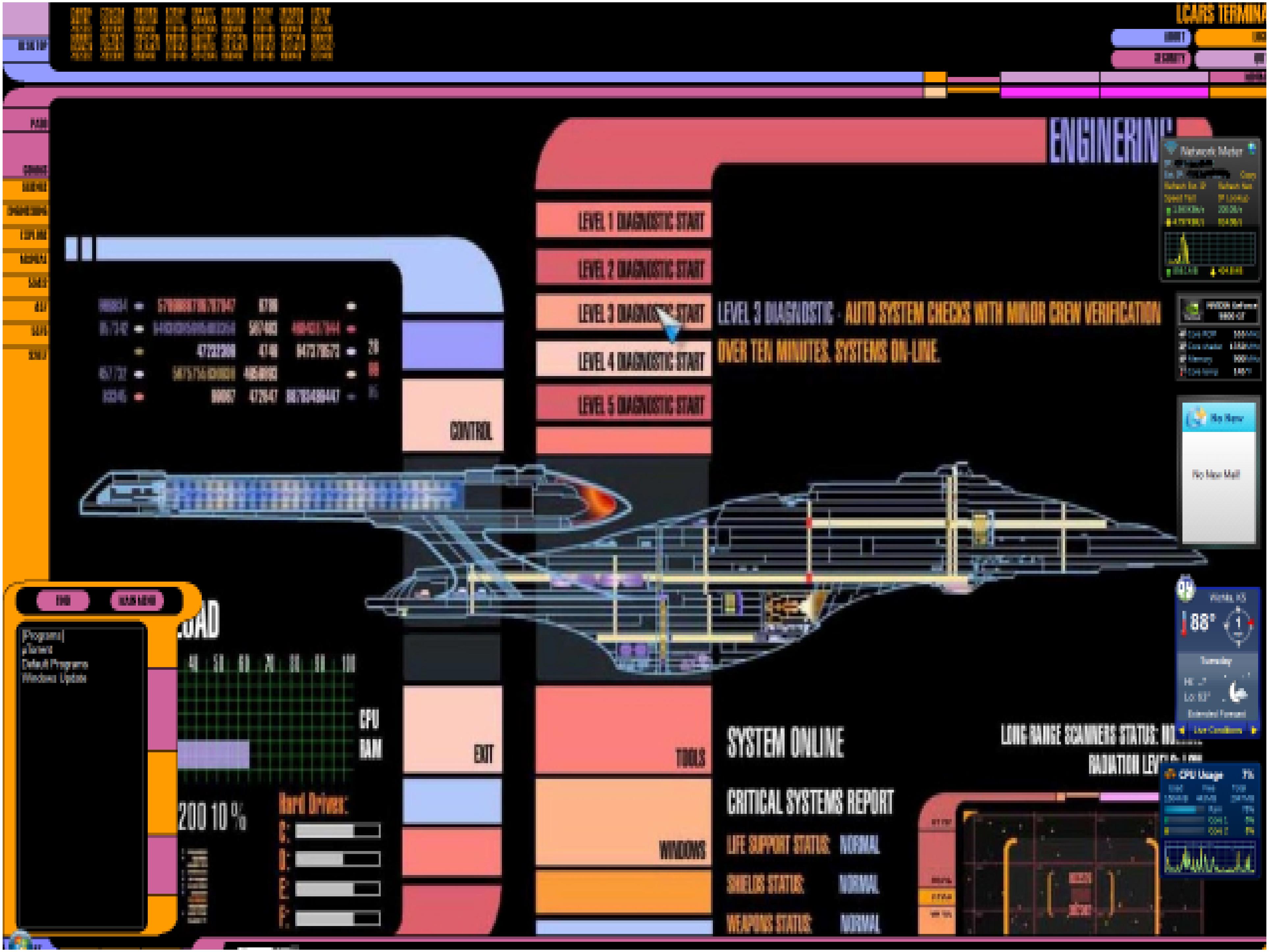
How will be the future?

Will we live on another planet?

Cars will fly?

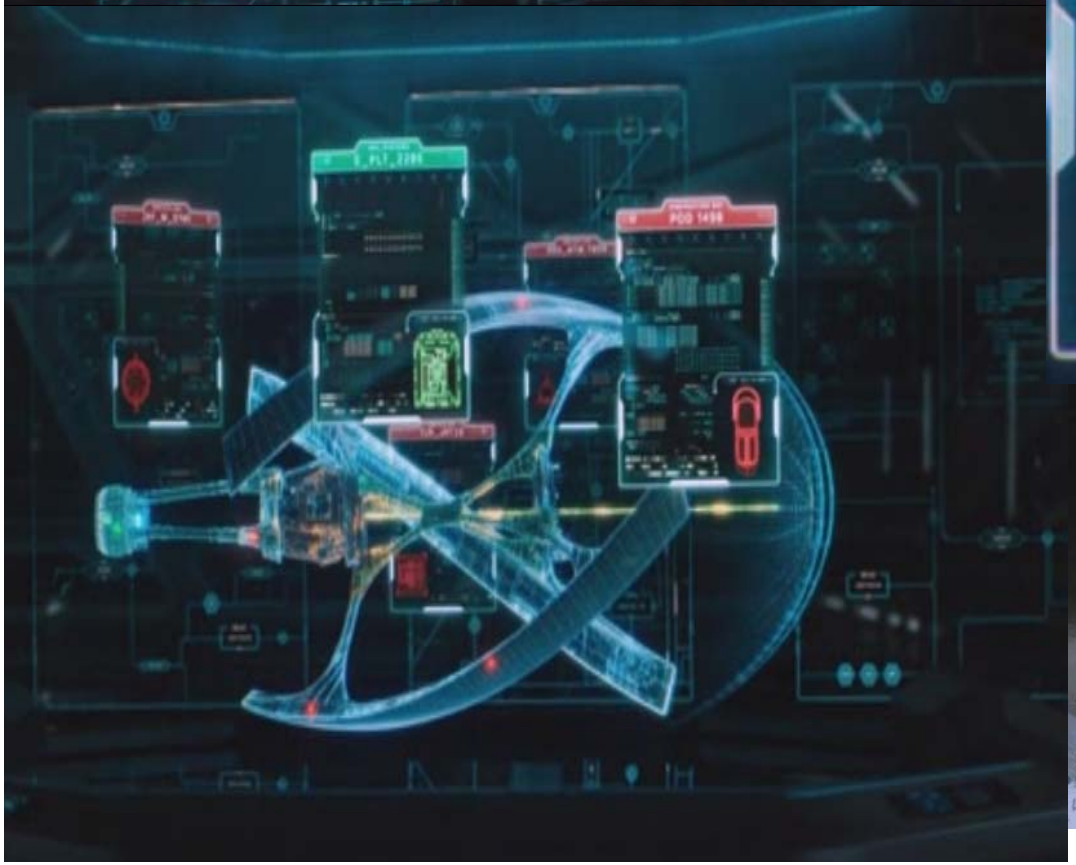
…There will be candy?

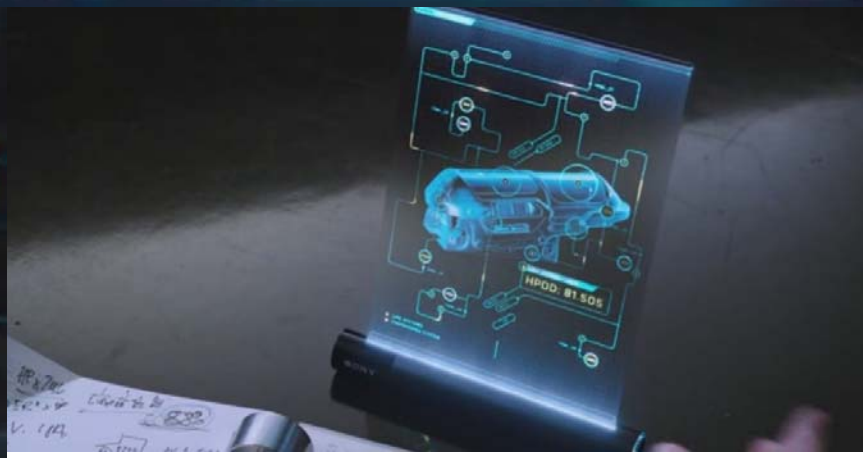

RPM
046
MPH
22
RPM
ALT
AUX
OIL PRESS
SAT COMM
OIL TEMP
ACC
EDO
RADAR
AUTO
FUEL
MP1

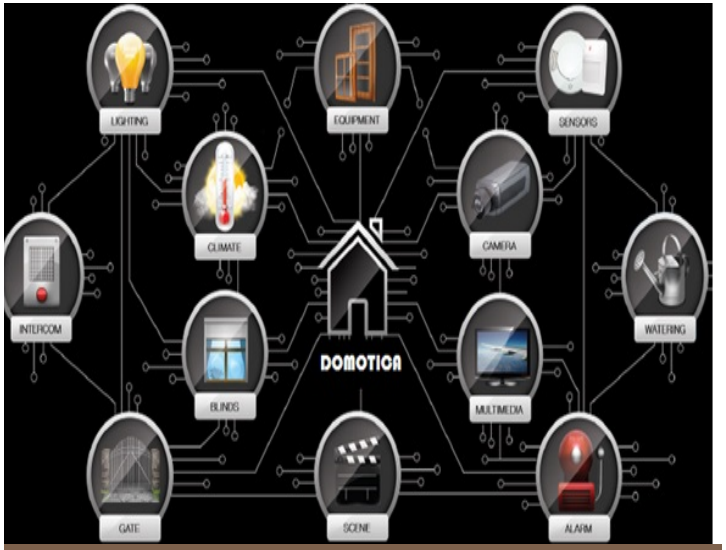

ENGINEERING
LEVEL 1 DIAGNOSTIC START
LEVEL 2 DIAGNOSTIC START
LEVEL 3 DIAGNOSTIC START
LEVEL 4 DIAGNOSTIC START
LEVEL 5 DIAGNOSTIC START
LEVEL 3 DIAGNOSTIC - AUTO SYSTEM CHECKS WITH MINOR CREW VERIFICATION
OVER TEN MINUTES. SYSTEMS ON-LINE.
CONTROL
EXIT
TOOLS
WINDOWS
CPU
RAM
Hard Drives:
C:
D:
E:
F:
[Programs]
µTorrent
Default Programs
Windows Update
No New Mail
88°
CPU Usage
SYSTEM ONLINE
CRITICAL SYSTEMS REPORT
LIFE SUPPORT STATUS: NORMAL
SHIELDS STATUS: NORMAL
WEAPONS STATUS: NORMAL

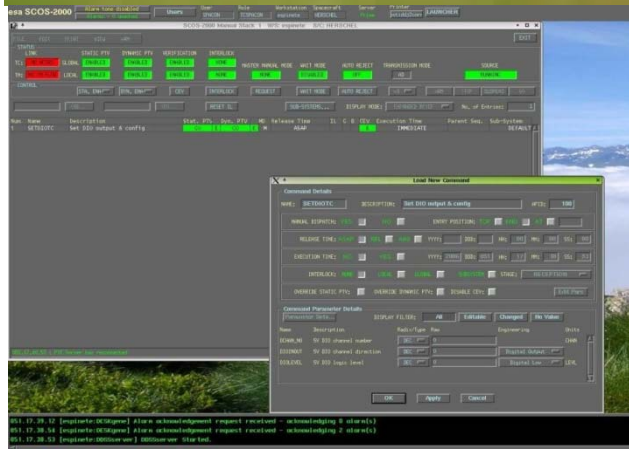

REPAIRING
REPARANDO


TRANSPORT CONTROL
FAILURE ELEVATOR_28
// CRITICAL //
ERROR




HPDD: 81.505



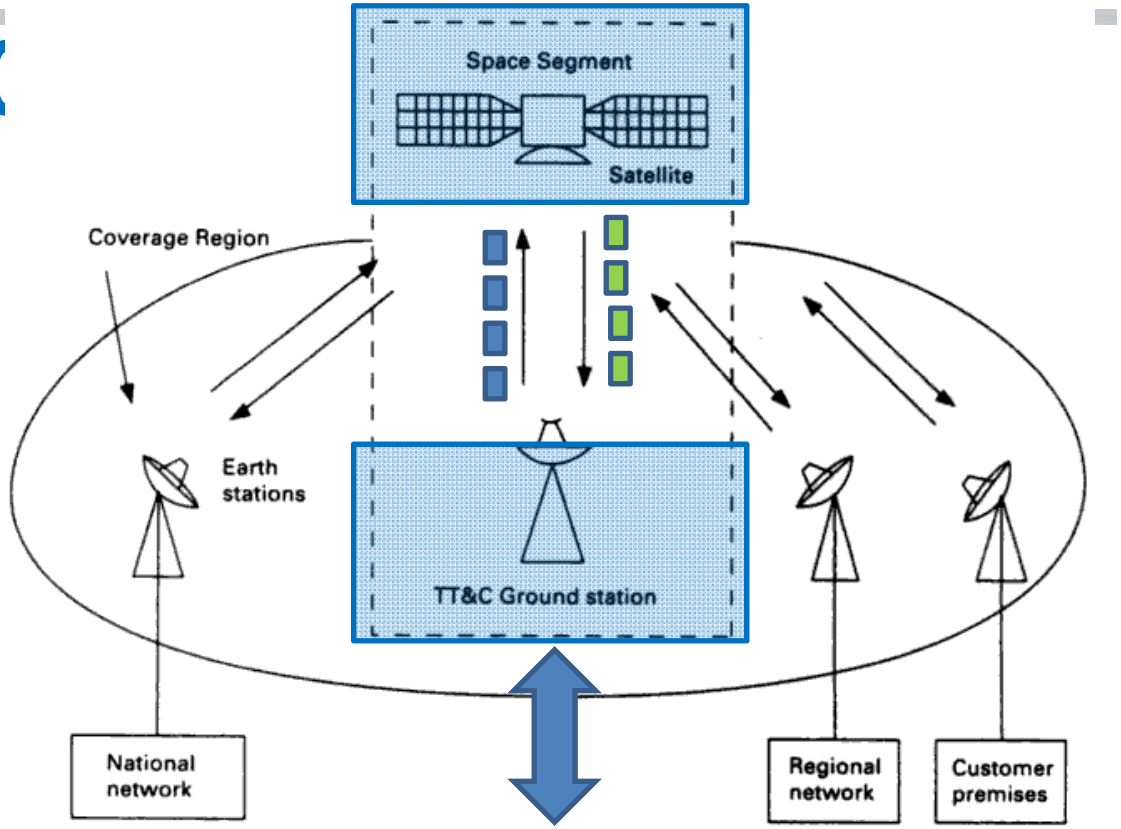


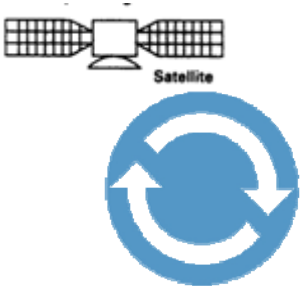
Not yet so advanced…

…but getting there.

AUTOMATION IN SPACE

1(





AUTOMATION IN SPACE – WHAT WE HAVE

What's there:

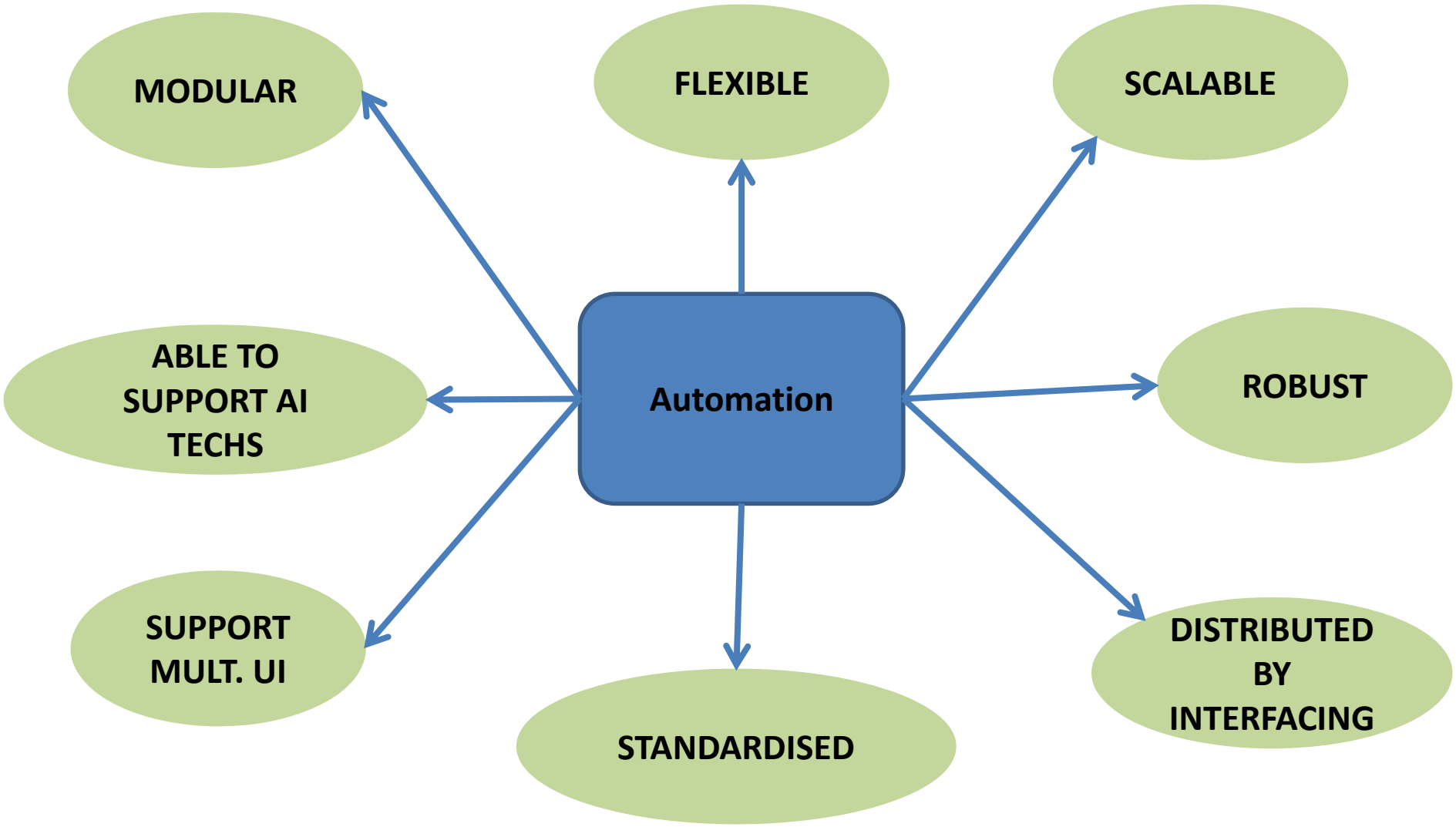
- Development of procedures and workflows → Prepared in AIT phases
- Describe contingency behaviors and alarm raising.
- Receive new instructions from ground segment
- The operator assess the problem based on notifications/events.
  - The operator defines a new procedure in specific format to solve the error
  - The automation system sends the procedure to the space segment by
    - Decomposing the operations in commands
    - Format the commands in the correct packet structure(s).
    - Send via uplink the info.
  - The space segment receives and perform the listed actions.
  - The space segments sends the confirmations via downlink,

AUTOMATION IN SPACE – WHAT WE HAVE

…a quantitative jump is needed...

…and a technological one.

PROCESS FOR IMPROVING AUTOMATION




WHAT?!

STATUS OF AUTOMATION IN SPACE

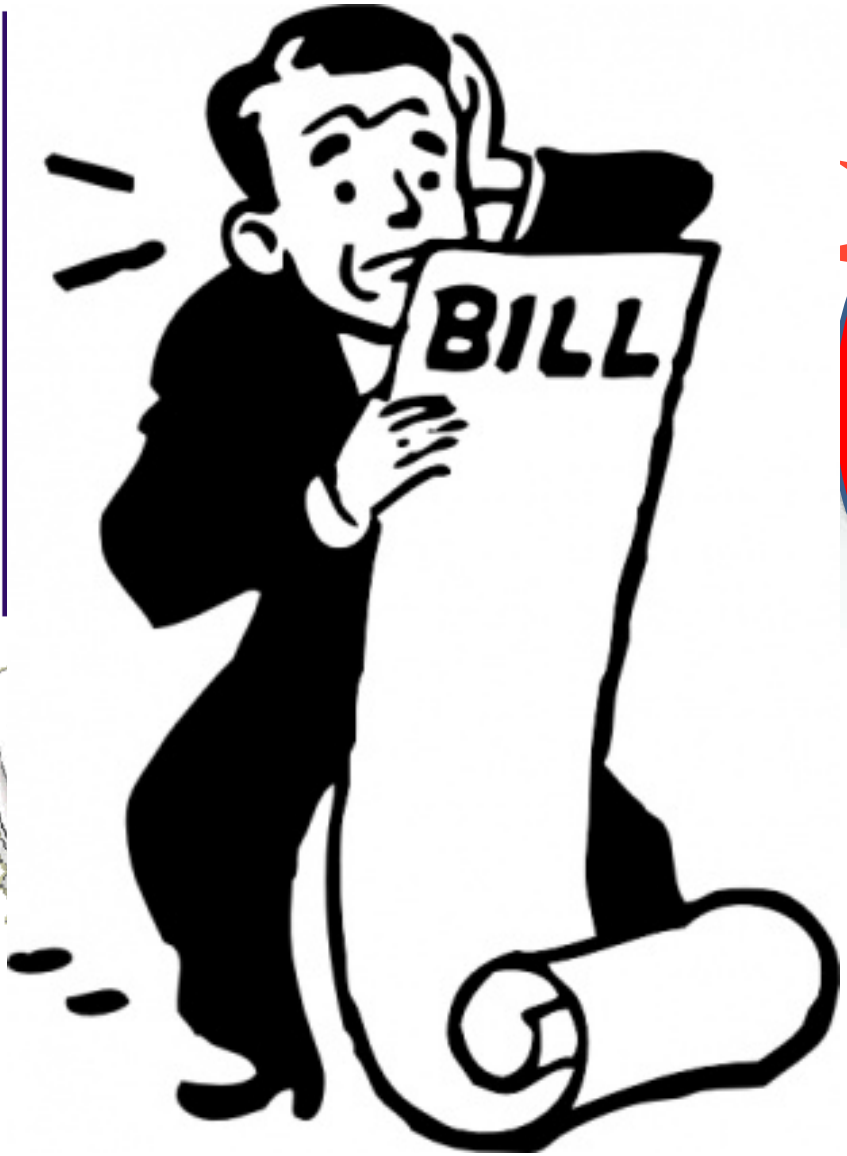
IN EUROPE

∃AUTOMATION?

YES

SO…WHAT'S THE PROBLEM

Issues in Procedure Interoperability



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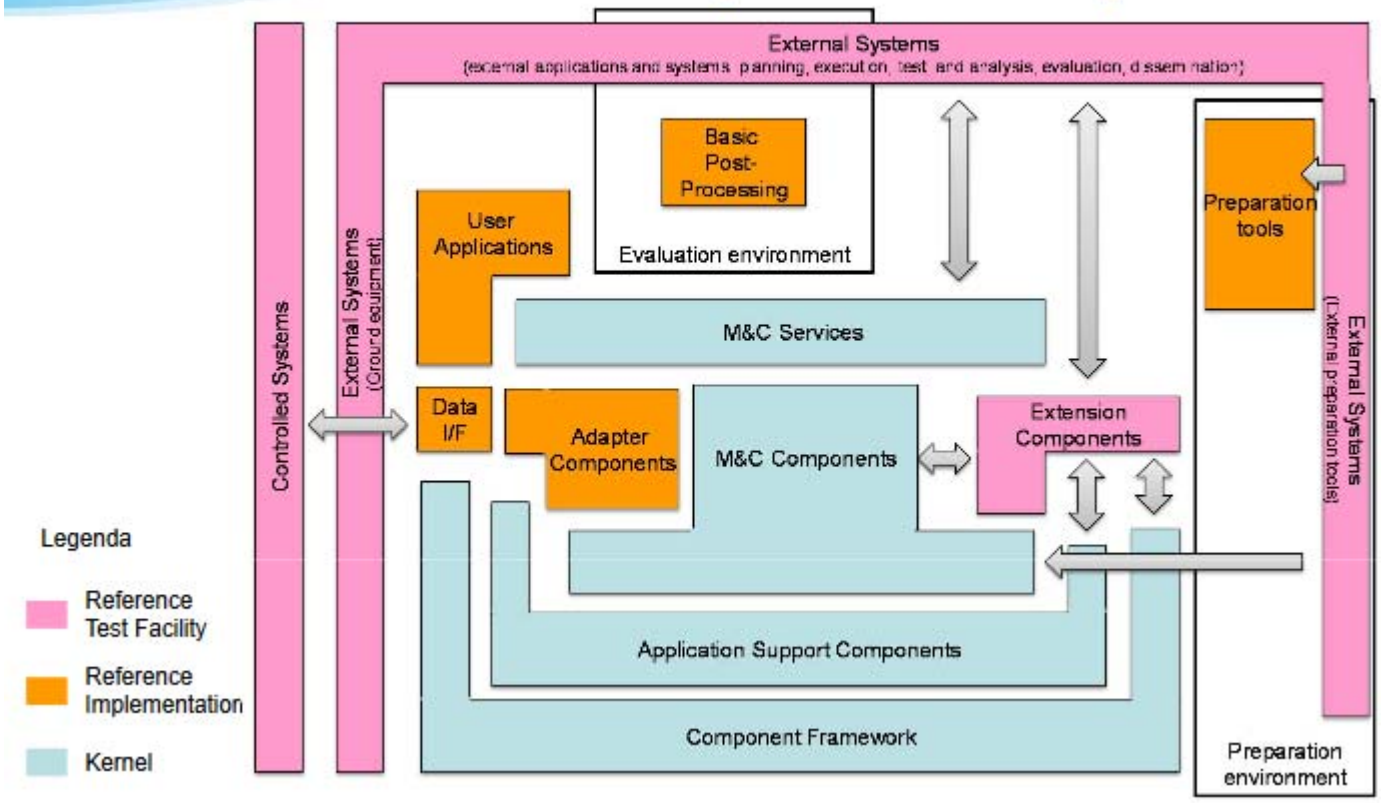
ON THE WAY TO FINDING A SOLUTION

EGS-CC EUROPEAN GROUND SYSTEMS COMMON CORE

Top Level Decomposition



ENSURING USABILITY AND FUTURE

Assessment of all user needs { **All stakeholders** / **All phases** } **+2 year requirement elicitation**

Verification against applicable requirements of existing standards

Analysis of up-to-date technologies → applying criteria { **Stability** / **Amount of Usability** / **Licensing** / **Maintenance** / **Features** }

Creation of a modular architecture based on design patterns

Definition of a language and syntax for procedures

AP DEFINITION PROCESS

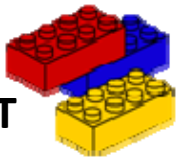
Internal meetings during Sprints

1

2

At the end of each sprint:

- Delivery to the SET



SET Leader

System Engineering Team

Cisco webex

3

At the end of each sprint:

- SET Review
- Meeting with the SET to discuss RIDs

4

Start new Sprint

Implement new features

Changes of the RIDs

Product Backlog

AP EXCHANGE FORMAT

SUPPORT LIBRARY

EGS-CC

System Engineering Team

Automation Procedure Programmer's Guide

Doc.: EGSCC-SYS-SUM-1001

Issue: 1.2

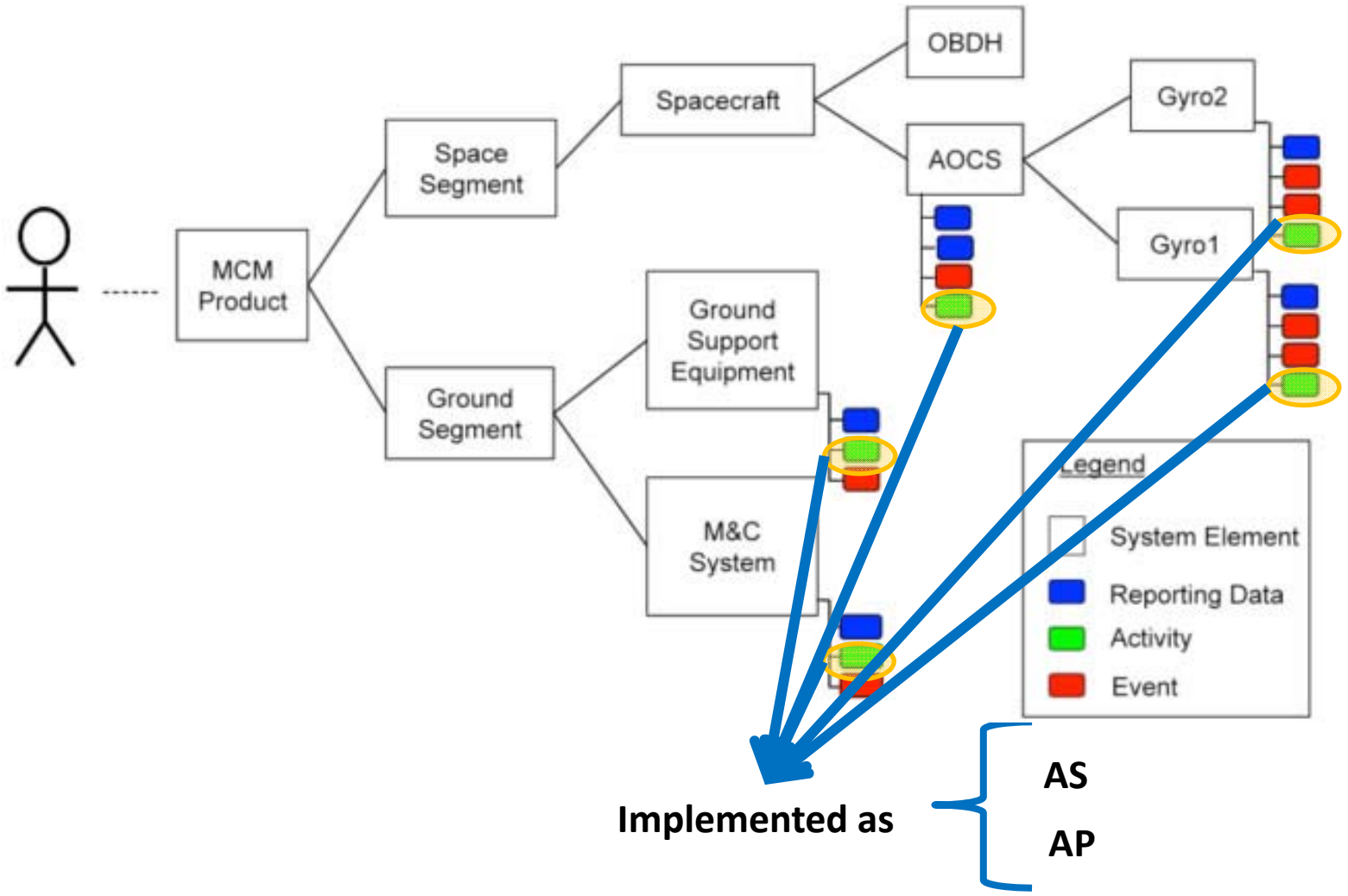
Date: 2016-12-09

- **Principles:**
  - Expose functionality of other EGS-CC components
    - Transparent to the user
    - Non-complex code
  - Access to functionality shall be static to avoid instantiation
  - To be scalable.
- **Current Functionality**
  - Packets, Monitoring Checks, Calibrations, Global Variables.
  - Log and File Support
  - Date management
  - Encoding/Decoding
  - Report Handling

AUTOMATE IN ISOLATION?

MONITORING CONTROL MODEL

Functional core of the EGS-CC kernel → abstraction layer for M&C operations



AUTOMATION IS FORCED TO BE SOCIAL PLAYER

Time Handling

Packetization

File Management

3rd Party Script Library

Logging Handling

Data Definitions

Information Monitoring

Runtime Monitoring Control

Calibrations

Parameter Injection

Event Injection

Archiving

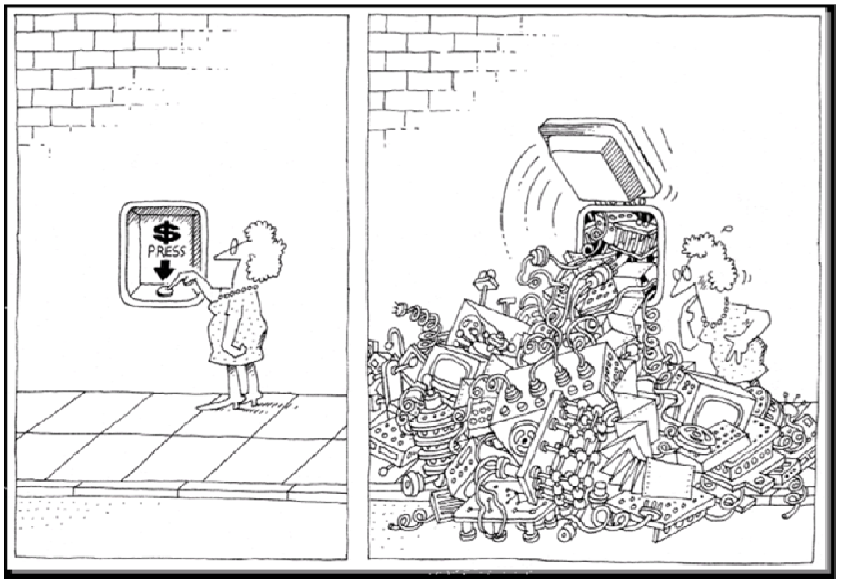
Messaging

UIs

MONITORING CONTROL MODEL – AP STYLE

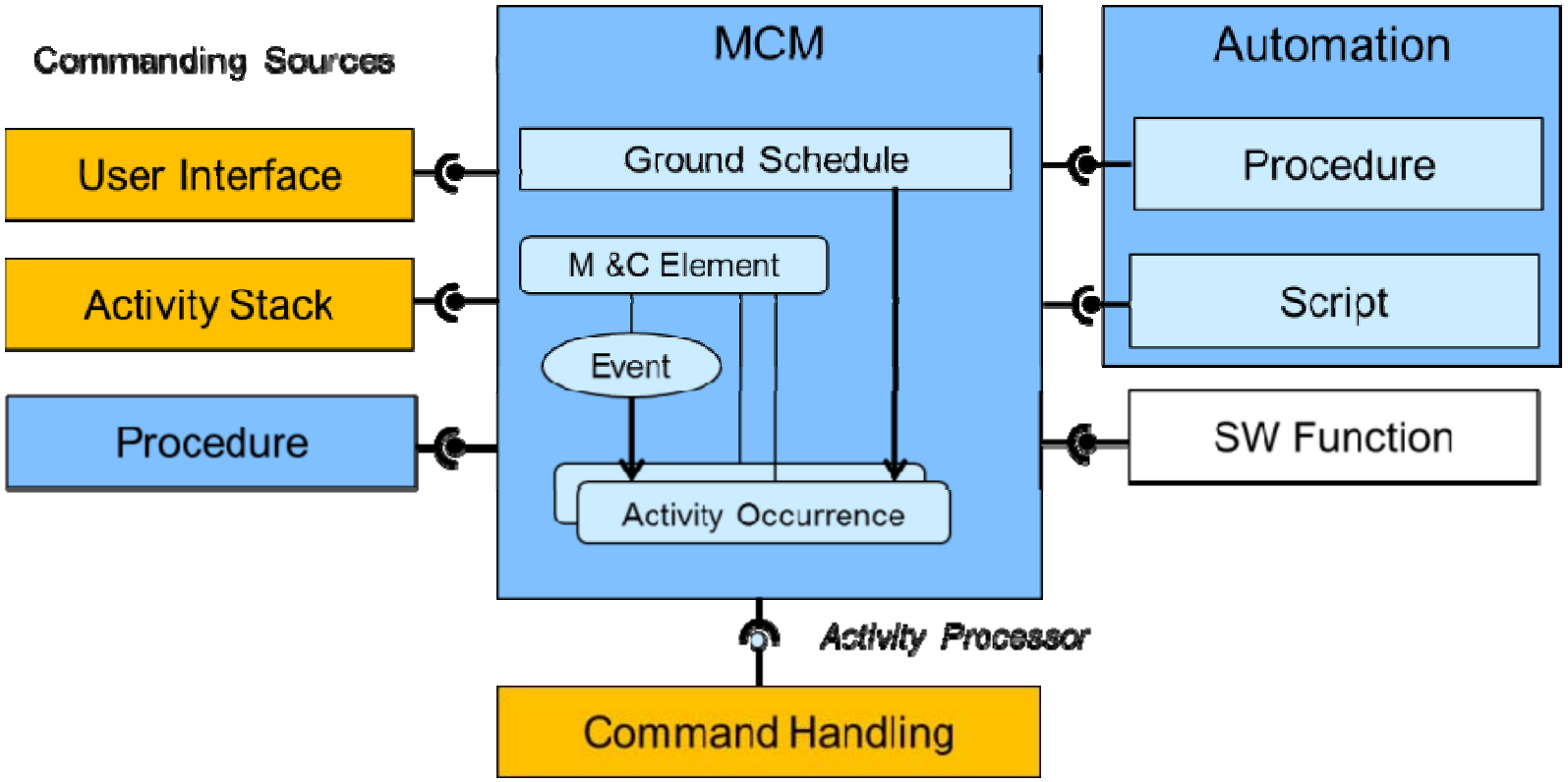
1. **Users will not navigate or use pure programming code for accessing information.**
2. **Ensure consistency of the data at compile time.**
3. **Provide most common functionalities of other components**
4. **Hide complexity to the users**

Generation of wrapping API for the MCM

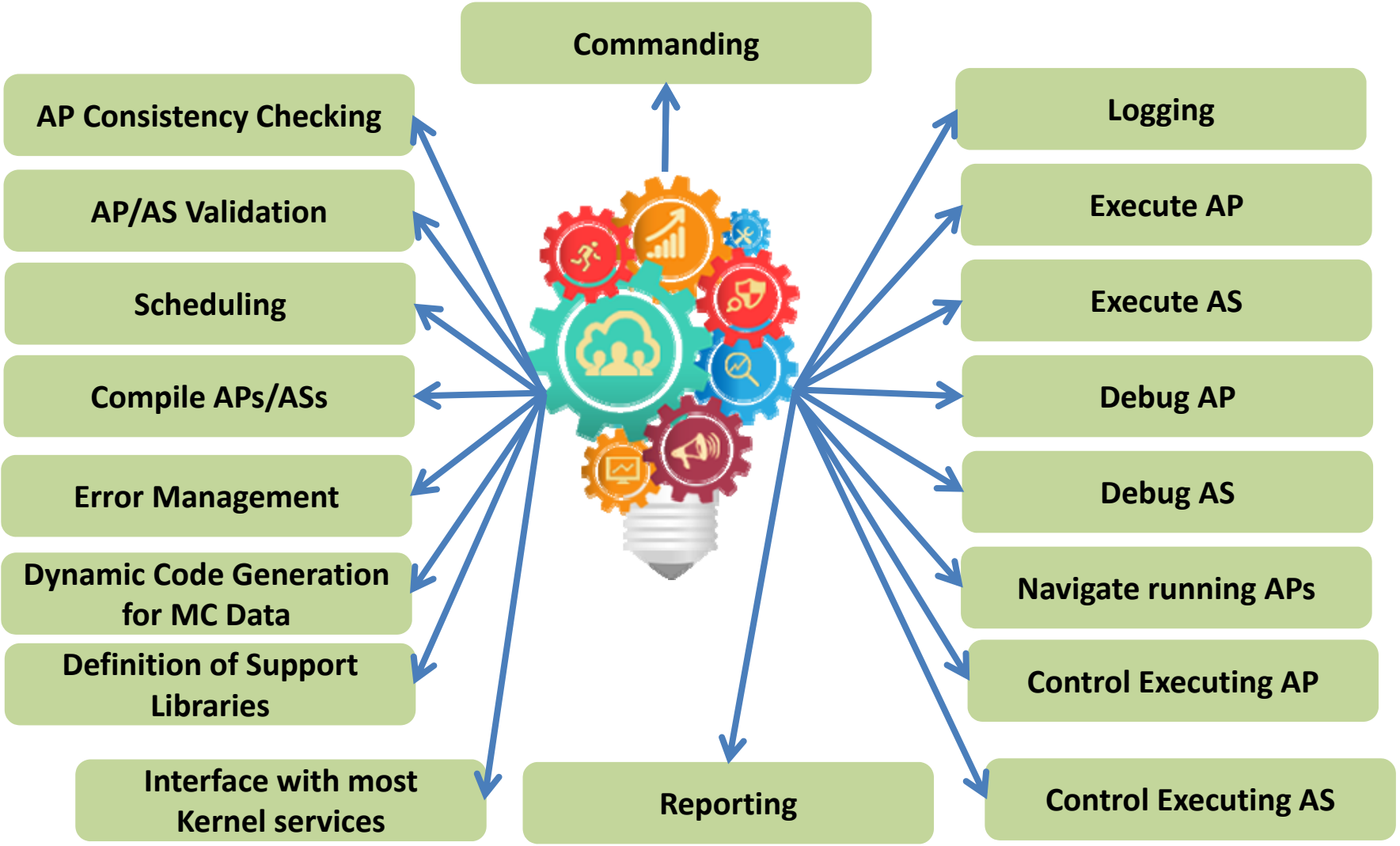


...LET'S SEE IT..

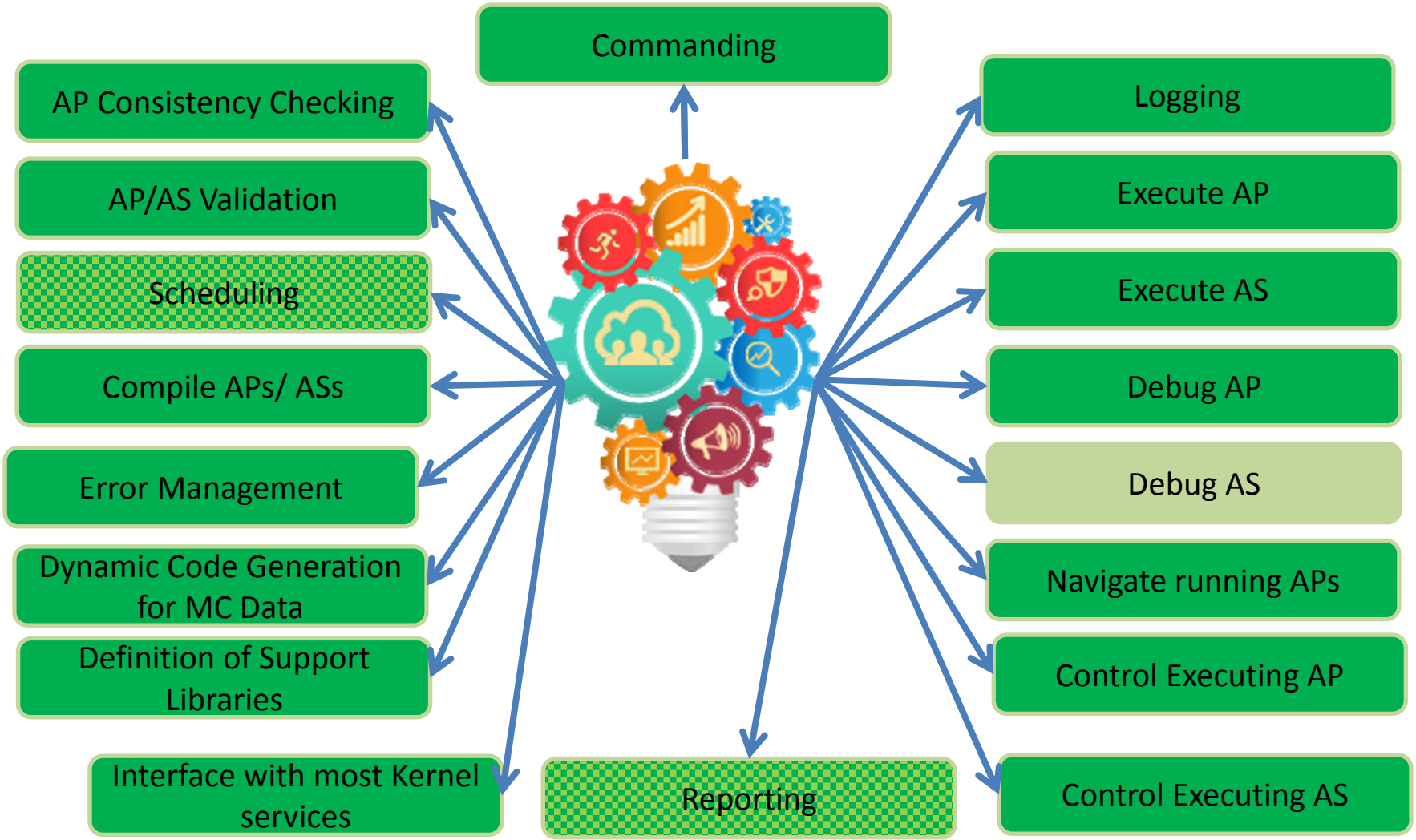
AUTOMATION PLACE IN THE SYSTEM



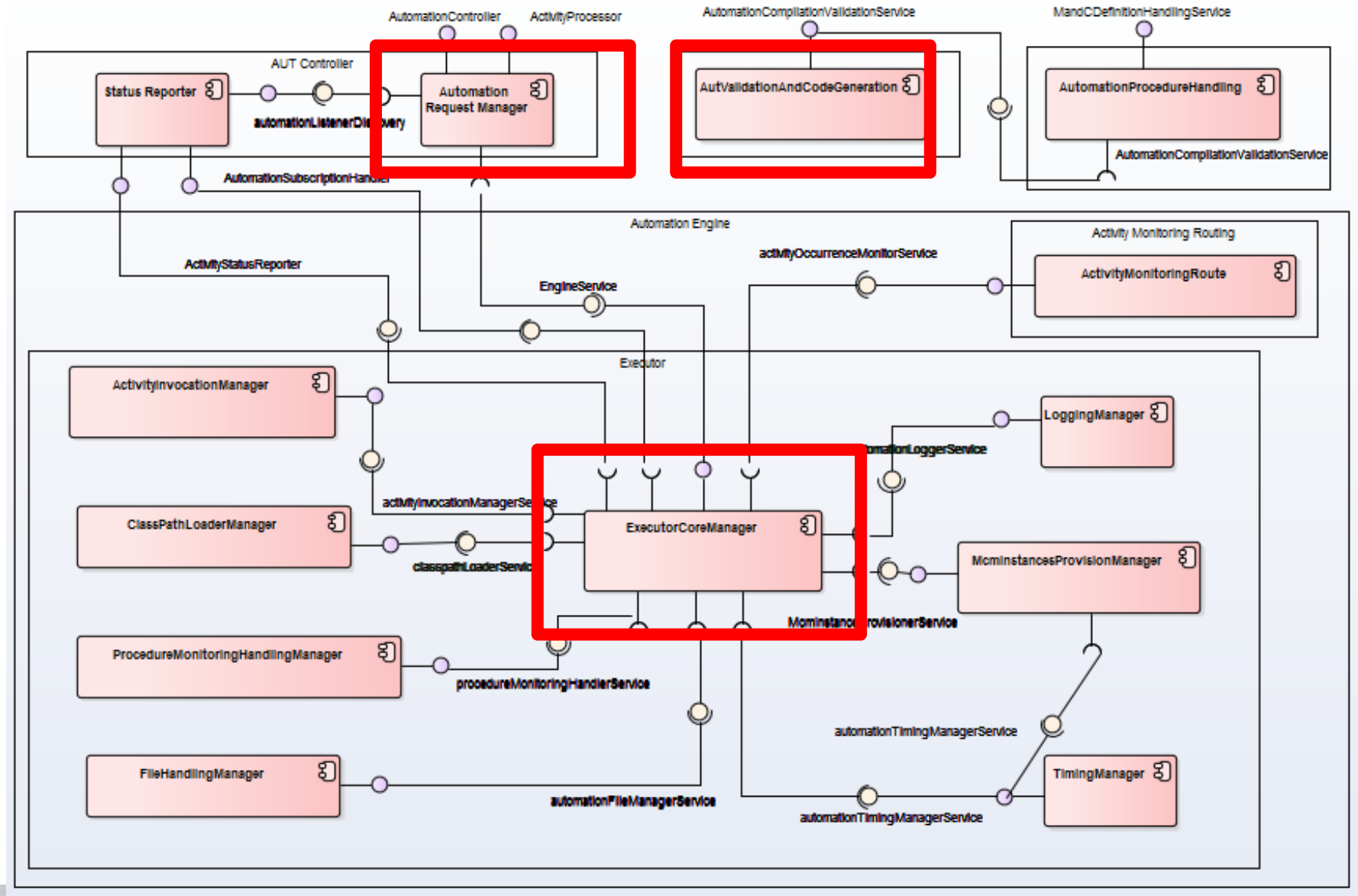
AUTOMATION FEATURES



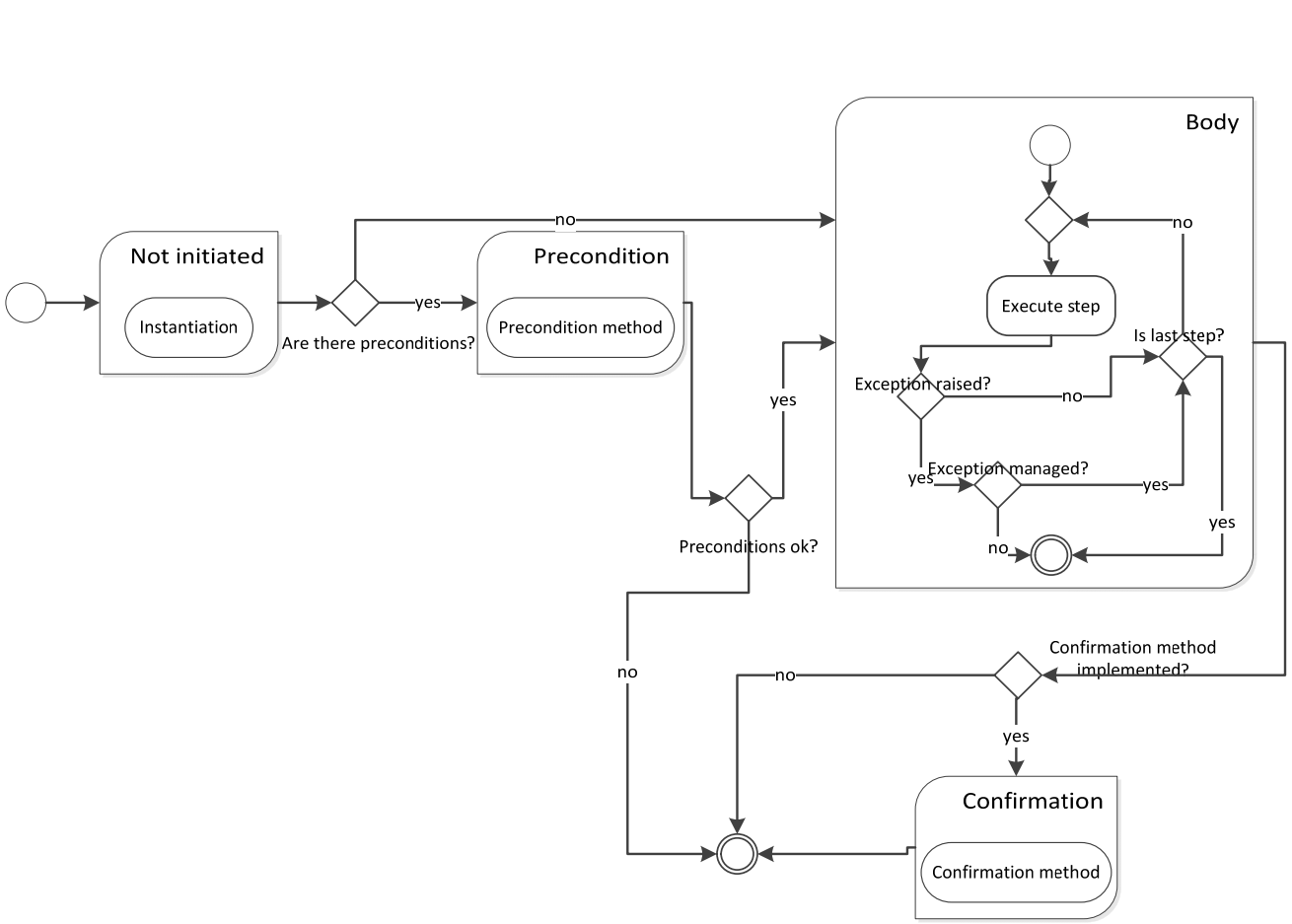
AUTOMATION FEATURES

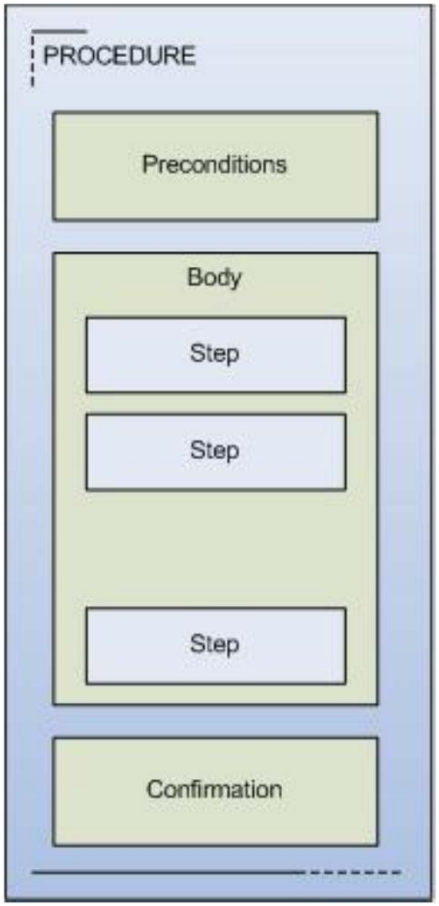


Simple Automation Architecture



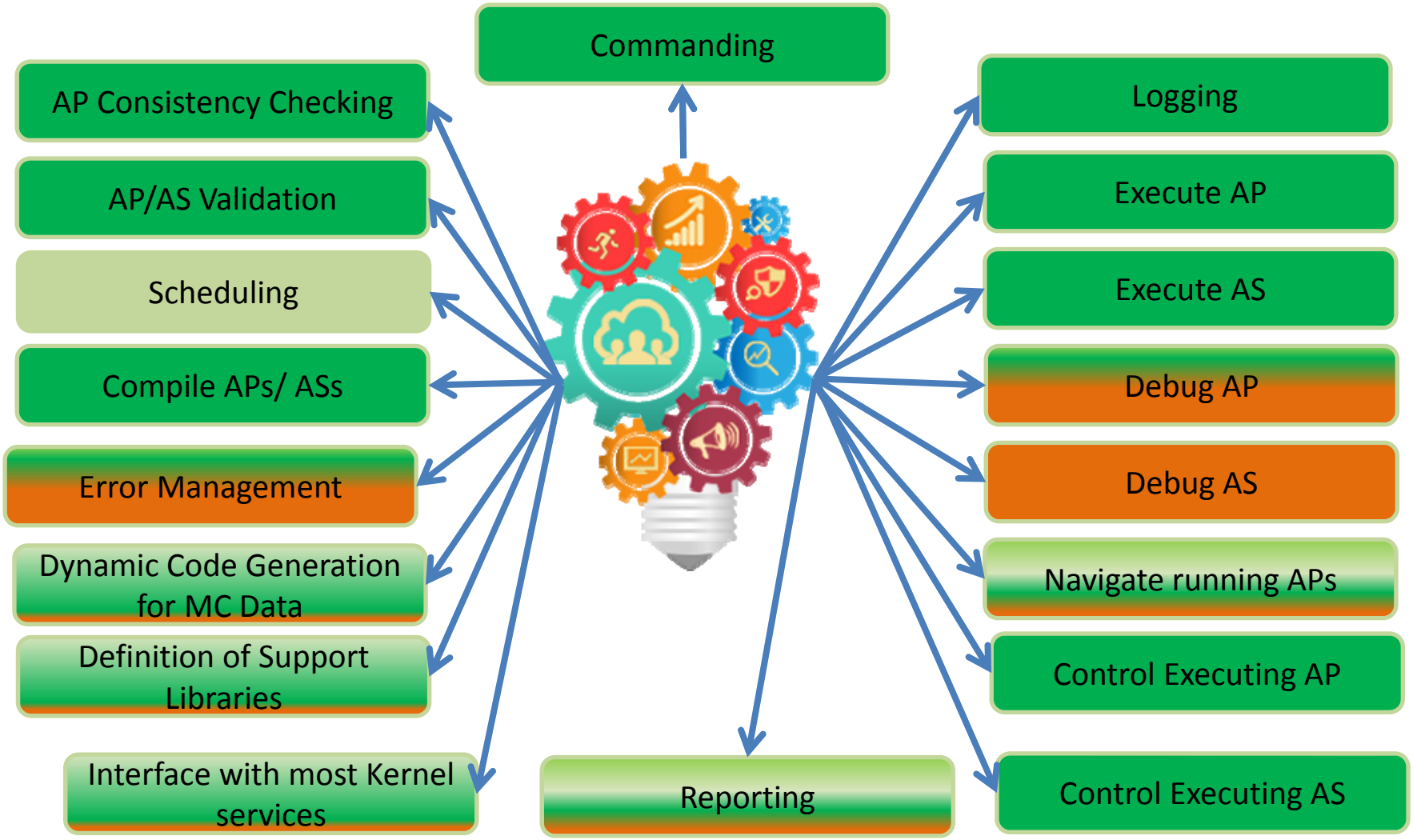
Procedure Execution Flow





IS IT WORKING ?

INTEGRATED TESTING



EXAMPLES OF PROCEDURES

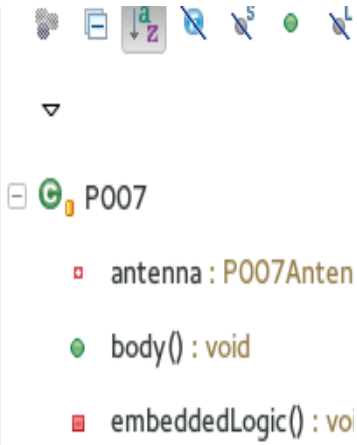
```
public void body() throws EGSCCException {
private void embeddedLogic() throws EGSCCException
{
    LogUtil.info("Started step embeddedLogic");
    LogUtil.info("Element Antenna " + this.antenna);
    ActivityInvocation act1 = this.antenna.p007_Activity()
            .directives(new Directive("The first directive", "The first directive value"),
                        new Directive("The second directive", 42),
                        new Directive("The third directive", true));

    for(Directive directive : act1.getDirectives())
    {
        LogUtil.info("The directive name : " + directive.getName() + " - the directive value : " + directi
    }
    LogUtil.info("Returned activity " + act1);
    try
    {
        if (act1 != null)
        {

            // we trigger the execution synchrounously
            ActivityOccurrence occur = act1.invokeAndConfirm();

            LogUtil.info("FINISH TO FIRST INVOCATION");
            LogUtil.info("Invoke And Confirm Confirmation Status " + occur.getConfirmationStatus().toStrir
            // this should be completed with success
            LogUtil.info("Invoke And Confirm Execution Status " + occur.getExecutionStatus().toString());

            ActivityP007_SecondActivityInvocation act2 = this.antenna.p007_SecondActivity();
        {
            LogUtil.info("\tValidity->" + state.getValidity());
            LogUtil.info("\tProcessing State->" + state.getMcmObjectProcessingState());
```



EGS-CC AUTOMATION HANDICAPS

JAVA is a programming language

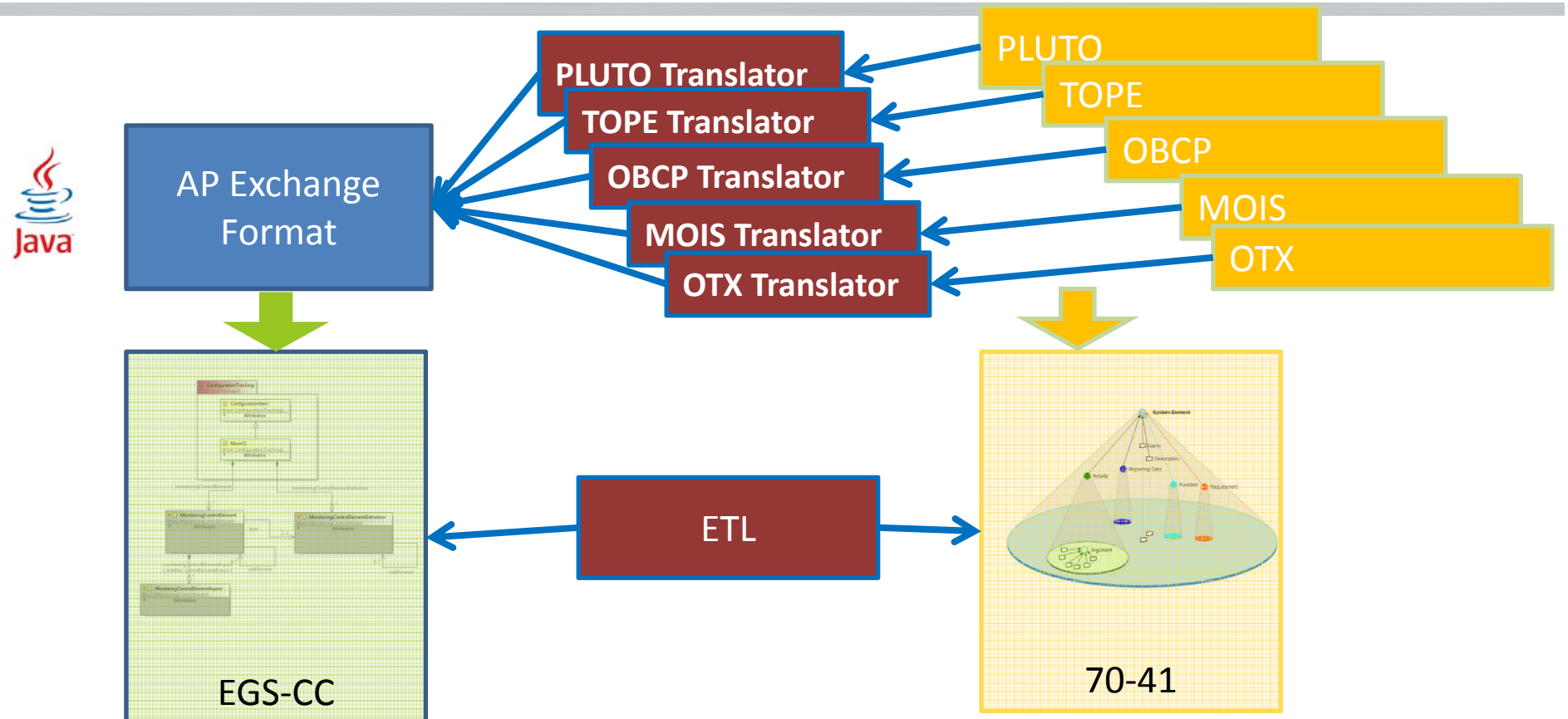
All stakeholders are NOT programmers

People want to reuse legacy procedures

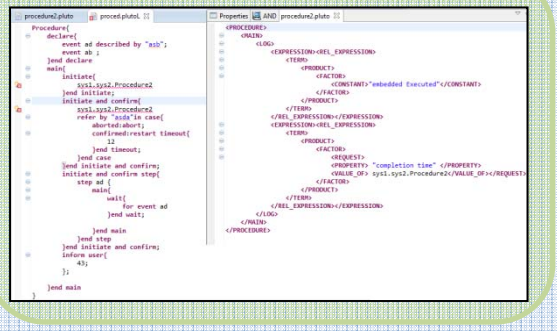
System needs to be extended

Create Scalable Modules On Top

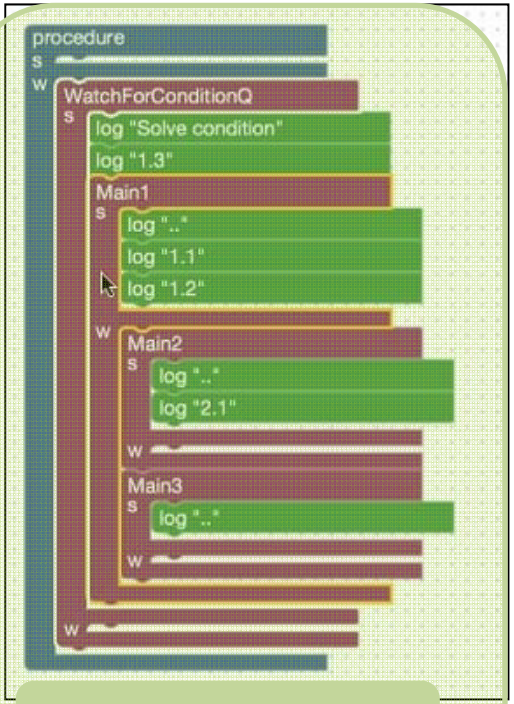
LEGACY HANDLING



AP CUSTOM DEFINITION



DSL Drivers



Graph Driver

Virtual Driver

AP Exchange Format

EGS-CC AUT COMPONENT

“We get to the peak together,

or

we don't get there at all”

EGS-CC EUROPEAN GROUND SYSTEMS COMMON CORE