COMBEST

Modeling and Analysis of Avionic Systems

Challenges around the corner

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Rome, Nov. 2008

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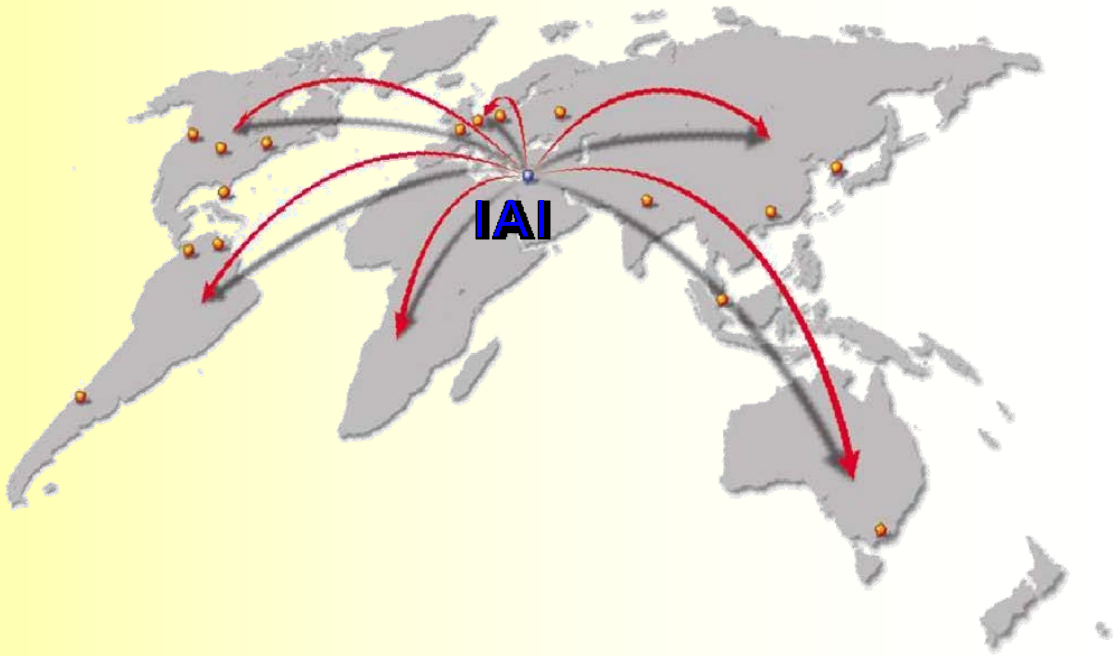
SEVENTH FRAMEWORK PROGRAMME

Topics

- IAI – short intro
- Model Based engineering in “Avionics” - state of the practice
- Present challenges and interesting examples from novel systems
- Novel solutions we are already addressing in applied research (SPEEDS, COMBEST,etc)
- Challenges that we see around the corner
- What next?

IAI at a glance

- Active on land, at sea, in the air and in space
- Current work force - 16,000
- 6 Groups & 15 plants in Israel
- Subsidiaries and offices around the world



IAI Groups

Military A/C Group	Commercial A/C Group	Bedek Aviation Group	Elta Systems Group Ltd.	Systems Missiles & Space Group	Engineering Group

IAI is in a period of accelerated growth

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Unmanned aerial vehicle systems

MPR
Maritime
Patrol Radar

Mini POP

POP

UAV-borne
GMTI radar

UAV payloads

MOSP

I-View Mk 250

Unmanned Aerial Vehicles (UAVs)

- Urban warfare
- Tactical echelons
- Strategic missions

Multi-payload Heron

Mosquito
micro-UAV

I-View Mk 50

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C4ISR, EW and situation awareness

RICENT
Realtime Image intelligence Center

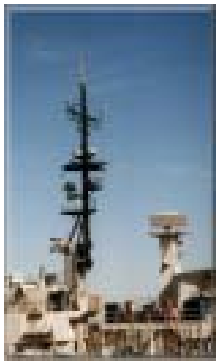
Twister
Multi-mission joint operations control center

Command and control systems and situation awareness centers

Electronic warfare systems

Self-defense EW

Integrated intelligence systems



COMINT/ DF system

TECSAR

OFEQ

LOROS

Ground-based ELINT

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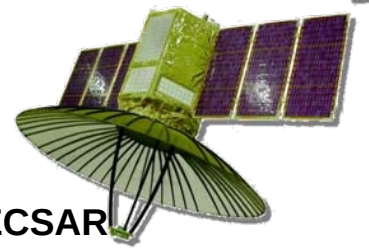
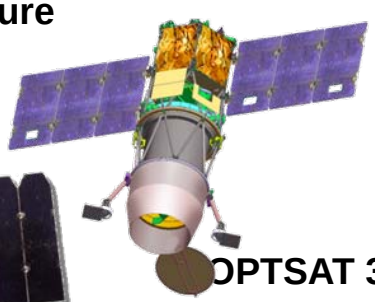
Space systems

Venus

Observation satellites



TECSAR
Synthetic Aperture
Radar



EROS C

OPTSAT 3000

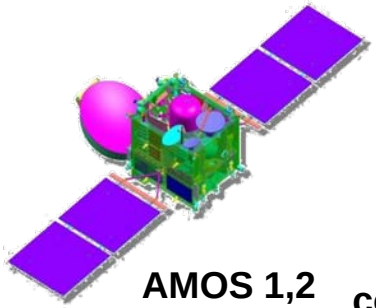
OFEQ

Shavit launch vehicles

Ground control stations

Communication satellites

AMOS 3
advanced
communication satellite



AMOS 1,2

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SEVENTH FRAMEWORK PROGRAMME

Advanced air-defense and early warning

V-SHORAD

Air & missile defense

Air-defense systems

- Arrow - TBM defense
- NG – ship-defense
- Long-range air and missile defense
- V-SHORAD - air-defense

MMR

Ground radars

Arrow Green Pine radar

Airborne Early Warning (AEW) systems

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Land systems

Ground-based radars

Northern Star

POP

Intelligence

Navigation

AMAPS

TRF90a / FOG

Ground ELINT

A/D radar

Tactical A/D radar

Observation balloon

Heavy engineering and protection suites

Heavy engineering equipment

Robotic defense / security vehicles

Robotic tank

Guardium
Autonomous vehicle

Robot D9

REEM

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SEVENTH FRAMEWORK PROGRAMME

Commercial aircraft

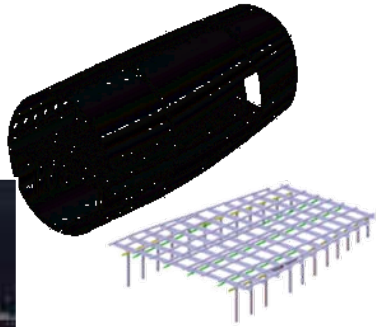
Aircraft design, testing and certification handled by IAI's Engineering Group

Business jet production

- G-150
- G-200
- Special mission

Advanced composite aerostructures

- Parts manufacturing for the Boeing 787
- Air inlets



State of the practice, the IAI example

- Avionics is pervasive: in space, on air, on ground, at sea
- La vie en rose, or is it? 3rd generation MDD at IAI (Go to separate presentation ☺), return
- Present needs, and then……some solutions and then…..more needs

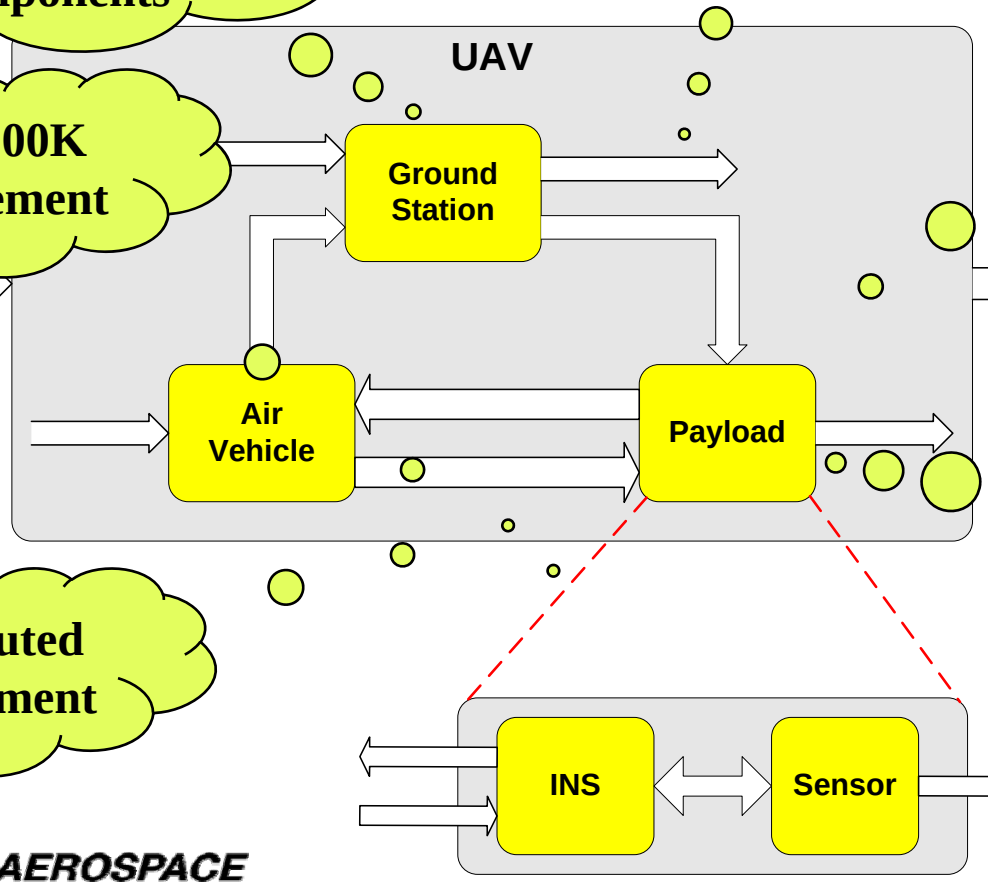
Challenges

Building systems from library of components

Clear splitting of responsibilities

Various viewpoints:
Functionality
Real time
Safety,…

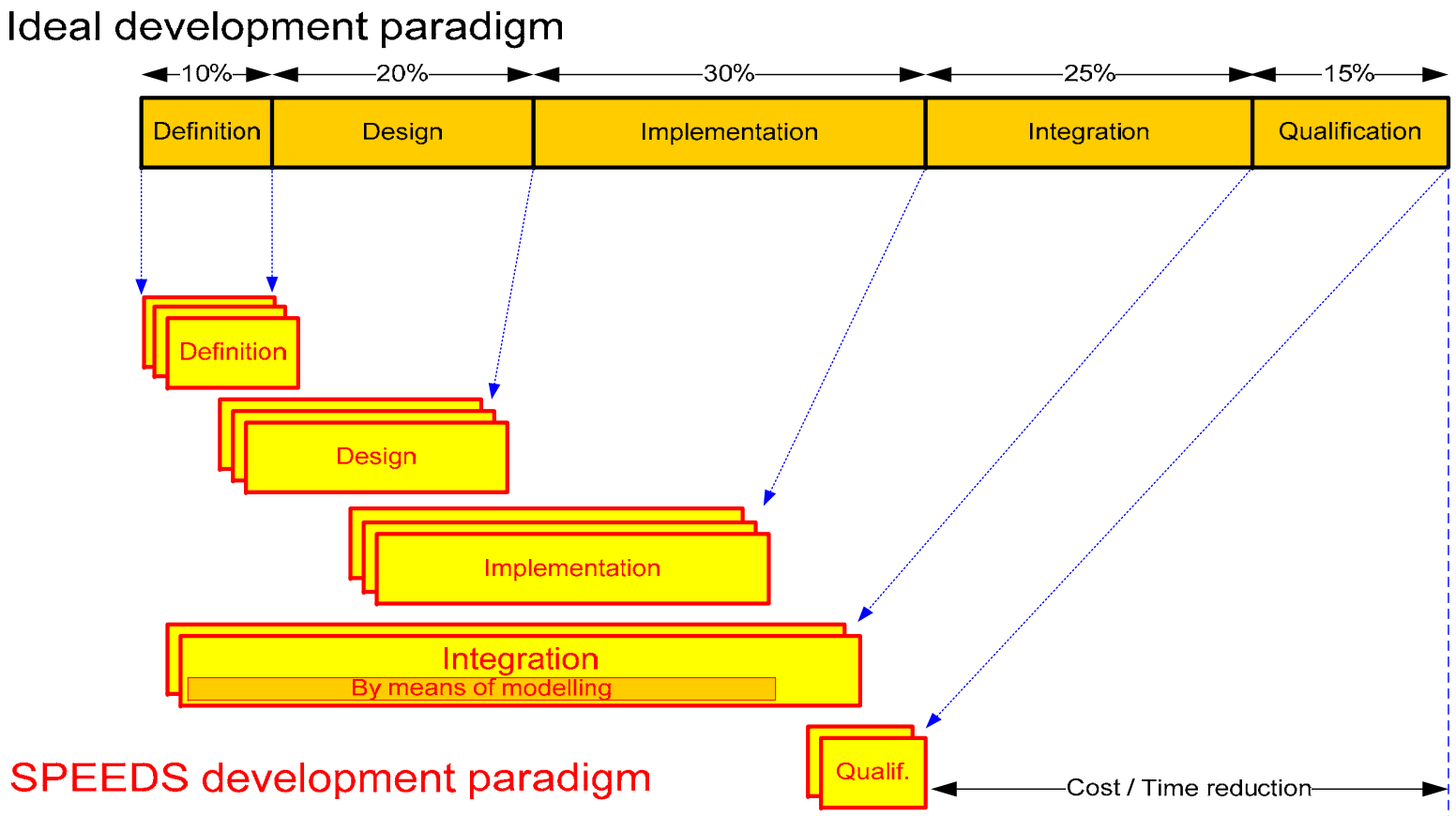
10K-100K requirements



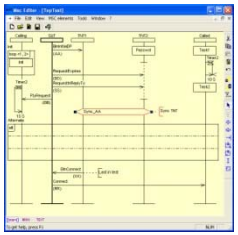
Heterogeneous behavior:
Discrete & Continuous

Distributed development

SPEEDS Development Paradigm



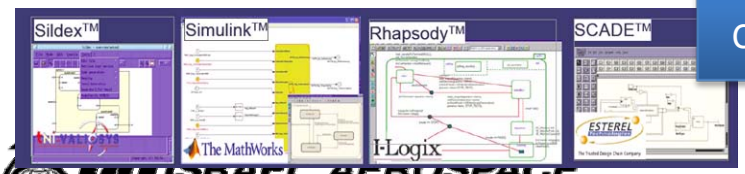
Classical Design Cycle ...



System requirements capture (excel)

System partitioning

Sub-System specification



COTS modeling

Code generation

Sub-System implementation

Sub-System deployment

Integration

problem decomposition

integration

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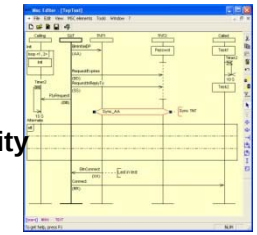
... viewed by Speeds



compatibility

System requirements capture with ***contracts***

problem decomposition

integration

System partitioning

Integration

dominance

Sub-System deployment

Sub-System ***contract*** specification

COTS modeling

compatibility

satisfaction

Sub-System implementation

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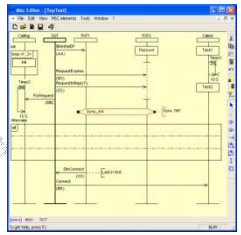
... viewed by Speeds



System requirements capture with ***contracts***

recursive

System partitioning

Sub-System ***contract*** specification

compatibility

integration

integration

Sub-System deployment

Network components

COTS modeling

compatibility

satisfaction

SubSystem implementation

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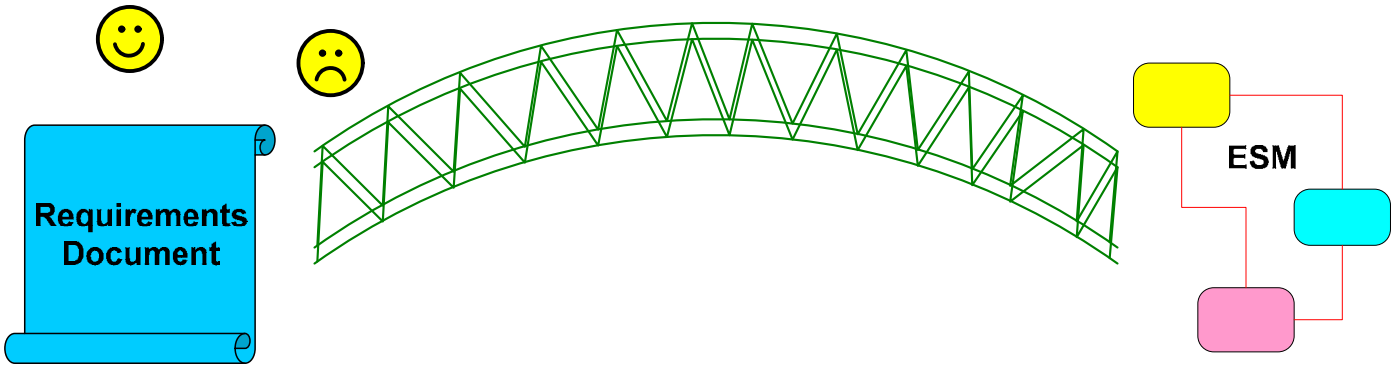
CSL-Contracts Specification Language

- In order to enable usage of SPEEDS technology, contracts (Assumptions/Promises) need to be presented in an Extended State Machines (ESM) formalism
- Direct specification by ESM is beyond the capabilities of average system/software engineer.
- The Contract Specification Language CSL is intended to cover the gap by providing a user friendly interface to formal contract specification.



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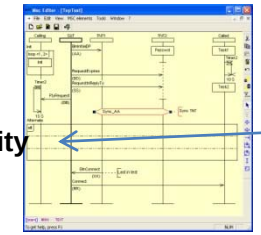

compatibility

System requirements capture with ***contracts***

System partitioning

dominance

Sub-System ***contract*** specification

compatibility

problem decomposition

Contract compatibility verification

Contract dominance verification

Contract satisfaction verification

ADT analysis

COTS modeling

satisfaction

Sub-System implementation

Virtual Engineering

integration

Integration

Sub-System deployment

Network components

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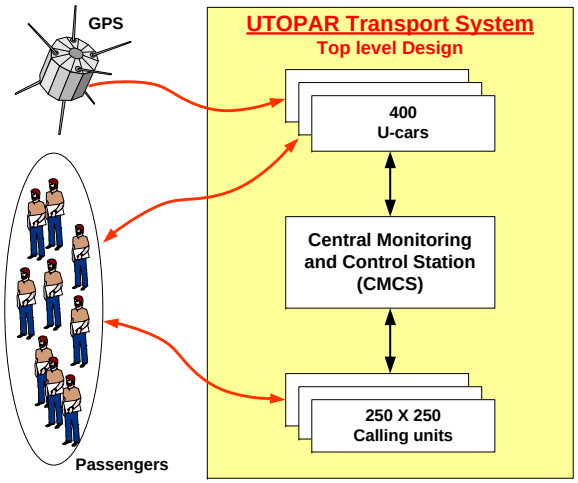
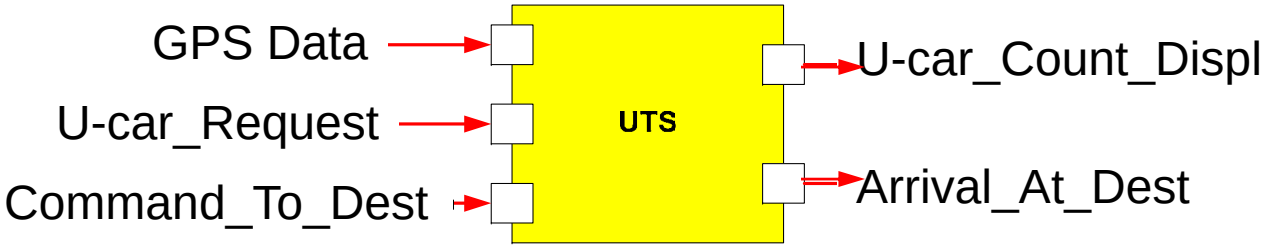
SEVENTH FRAMEWORK PROGRAMME

Example UTOPAR

- In UTOPAR, capital city of Utopialand, all transportation is public; carried out by autonomously driven electric cars (U-car). The city is built as a grid of square blocks with U-car stations located at each corner.
- U-cars are used in a manner similar to manned taxis. A group of passengers at a station may call a U-car (unless an empty U-car is already present), board the U-car and designate a destination. A designated U-car move to its destination and after arriving it waits there until further service is required.

Example UTOPAR, Contd.





Requirement: If the request-button at an arbitrary calling-station is pressed, an empty u-car shall arrive at this station with TBD minutes.

CSL-Contracts Specification Language

<u>CSL by Patterns</u> – Textual language, easy to use supporting supports only a pre-defined set of kinds of properties. (It is already being applied to pilot projects)

<u>Example:</u>

Property to be specified:

Whenever the request button is pressed a car should arrives at the station within 10 minutes

Instantiated in CSL:

Whenever **[request-button-press]** ***occurs***
[car-arrives-at-station] ***holds within*** **[10 min]**

•

COMBEST

Example real life: TALOS Program

***T*ransportable *A*utonomous patrol for *L*and b*O*rder *S*urveillance system**

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SEVENTH FRAMEWORK PROGRAMME

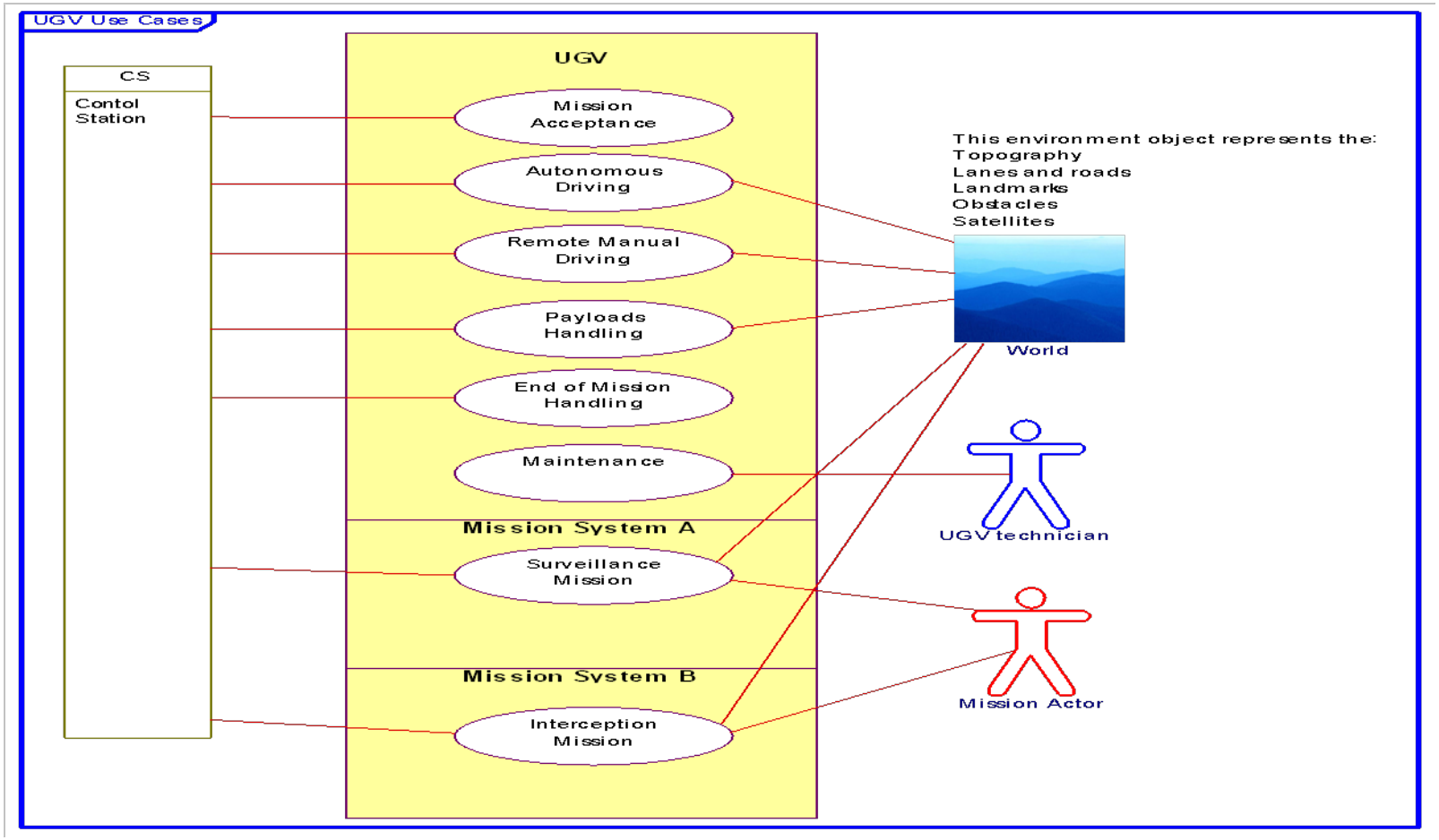
General

- TALOS – ***T***ransportable ***A***utonomous patrol for ***L***and b***O***rder ***S***urveillance system
- For European Border security missions
- Within FP7 EU programs
- Defined as Demonstration Project (DP) and spread over 4 years
- Consortium composed of 14 companies
- Managed and coordinated by Przemyslowy Instytut Automatyki i Pomiarów (PIAP)

TALOS Concept Advantages

- **Transportability of all system components**
- **Fast deploy capability**
- **Detect and locate intruders**
- **Multi sensors data fusion capability**
- **Scalability in terms of area, tasks and level of danger**
- **Learning capability of the system**
- **Modular Architecture for phase 2 (UAVs)**

Use Case Analysis



Challenges around the corner

- Market forces in Systems Development:
  - Many “semi autonomous intelligent systems” collaborating
  - Miniaturization, miniaturization
  - Complex business chain
- Technology challenges
  - Standards, really???
  - Semantics unifying covering more heterogeneous multiple views
  - Diverse vendors pushing multi-tool integration environments: Jazz, Modelbus, ToolNet, Eclipse
  - Scalability
  - Public challenge?
  - Car industry needs –legacy with added complex functionality (mainly at the low level), evolvability
  - Integration to CAD_CAM (Mechanical, Electronics)
- Our challenge: international collaboration, finding the means and the ways to increase and grow