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PANEL ICAS/CONNET

Autonomy and Autonomic Computing Synergy: Behavioral Challenges

Today's Panelists

- **Moderator:**
  Petre Dini, Concordia University, Canada || China Space Agency Center, China
- **Panelists:**
  Markus Bader, Vienna University of Technology, Austria
  Acceptances, safety and security issues of autonomous systems in industry and home/building automation
- **Dan Necsulescu, University of Ottawa, Canada**
  Integration of sensing in control for autonomous mobile systems
- **Petre Dini, Concordia University, Canada || China Space Agency Center, China**
  adaptability, autonomy, autonomous, feedback….

Adaptability, Autonomic, Autonomous, ..

- **Adaptability**

- **Autonomic**
- **Autonomous**
- **Feedback / sensing**
- **Control-loop (monitoring, analysis, planning, execution)**
- **Smart real-time mechanisms**
- **Exception handling**

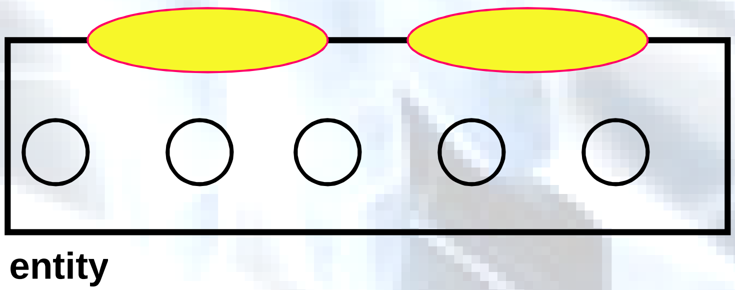
➔ **Humans**

Autonomic (computing, behavior)

Autonomy = Adaptation + special mechanisms

Self-adaptive
Self-reconfiguration
…. Self-x

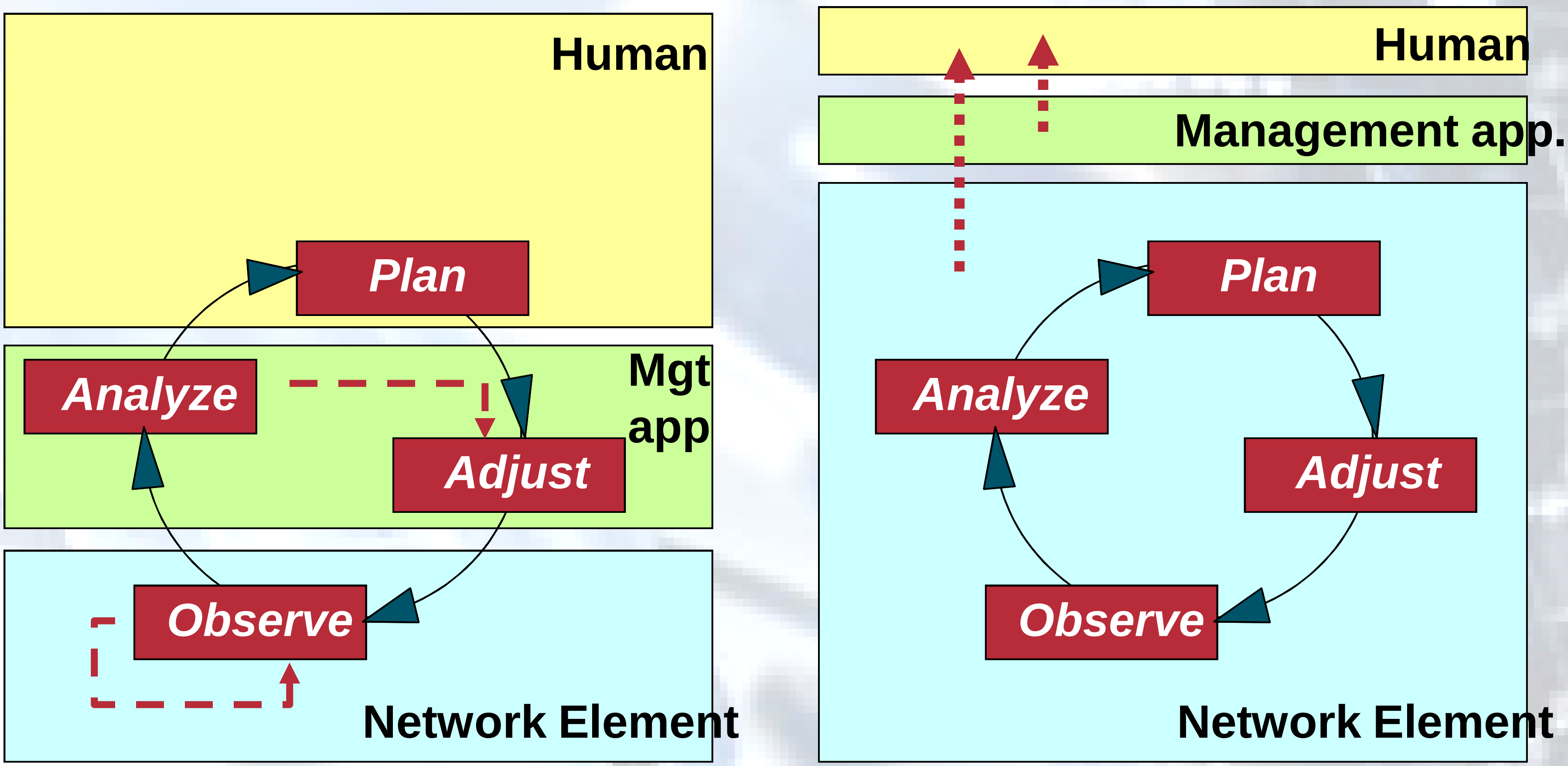
Autonomous: mainly related to the movement/mobility
Autonomous = Autonomic + (environmental sensing
+ (controllable means to move)



Operational interface

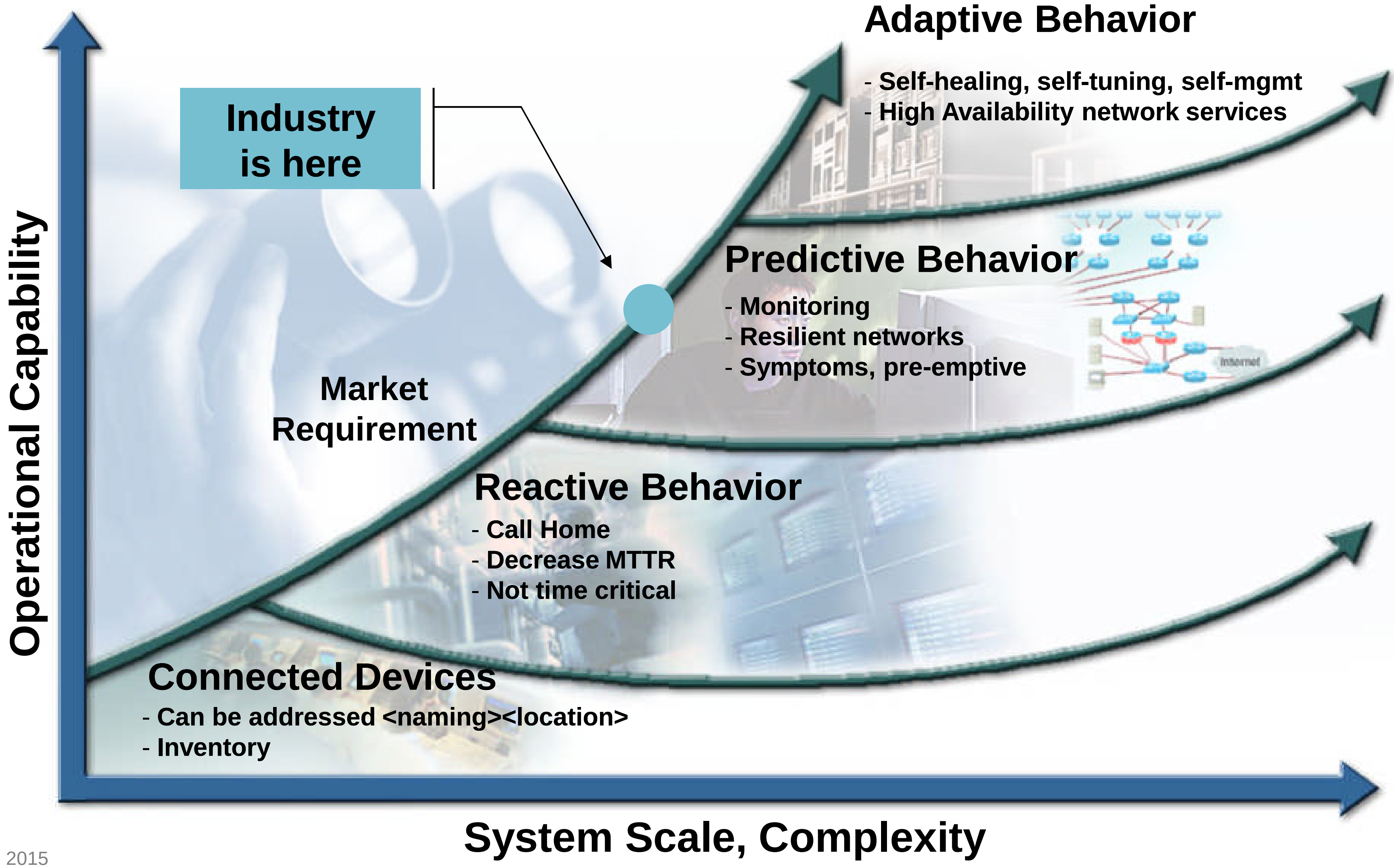
Autonomic interface

Becoming Autonomic



(a) Typical management control loop **(b) Closed management control loop in autonomous network**

System Smartness



Thanks!

Qs & As

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Panel on:
Autonomy and Autonomic Computing Synergy: Behavioral Challenges

Markus Bader

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Market

- Separated Workspace
  (Warehouses, …)
- Joined Workspace with no interaction
  (Assembly lines, hospitals, ...)
- One Workspace with interaction
  (Service robotics, ...)

Kiva Systems
[source: http://www.kivasystems.com]

LKH Klagenfurt
[source: http://www.youtube.com]

Transitbuddy - FFG: 835735


LKH Klagenfurt
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Markus Bader <markus.bader@tuwien.ac.at>

Integration of sensing in control for autonomous mobile systems

Prof. Dr. Dan Necsulescu
University of Ottawa

Sensor inputs have normally an extremely large dimension and have to undergo truncation during sensor fusion and result in very low dimension commands to the mobile platforms.

An important issue is the coordination of the sensor fusion bandwidth with the required bandwidth for control, taking into account the subjectivity of experts involved in sensor fusion setup.

Multi-Sensor Monitoring
for autonomous mobile systems

1) **Mono-physics Sensing-**. Ex. kinematic: position, velocity Acceleration

Sensor Fusion = model based :

- -Kalman Filter
- -Inverse Problem Solving:
    - a)Matrix Inversion, SVD
    - b)Adjunct problem solution

Issues: Limited frequency domain for estimators due to:

- a)truncation of matrix
- b)finite number of iterations

<u>Multi-Sensor Monitoring</u>
for autonomous mobile systems
(continuation)

2) **<u>Multi-Physics Sensing</u>**: kinematic variables, light, temperature, pressure etc

<u>Sensor Fusion –not model based</u>:

- Voting Logic
- Dempster-Shafer approach
- Type-1 and Tyope-2 Fuzzy Logic etc.

<u>Issues</u>: expert chosen parameters = subjectivity, variability
lack of expertise in new facilities

<u>Integration of sensing in control</u>
for autonomous mobile systems

- Limited Frequency Domain of estimations from sensing due to:
  - -truncation in matrix inversion
  - -finite number of iterations
  - -limitations of expert knowledge in non-model based cases

-Control commands- coordination of <u>Time Varying Desired Inputs</u> with <u>Limited Frequency Domain of estimations</u> from sensing