Towards resilience against highly dynamic challenges for Wireless Sensor Networks

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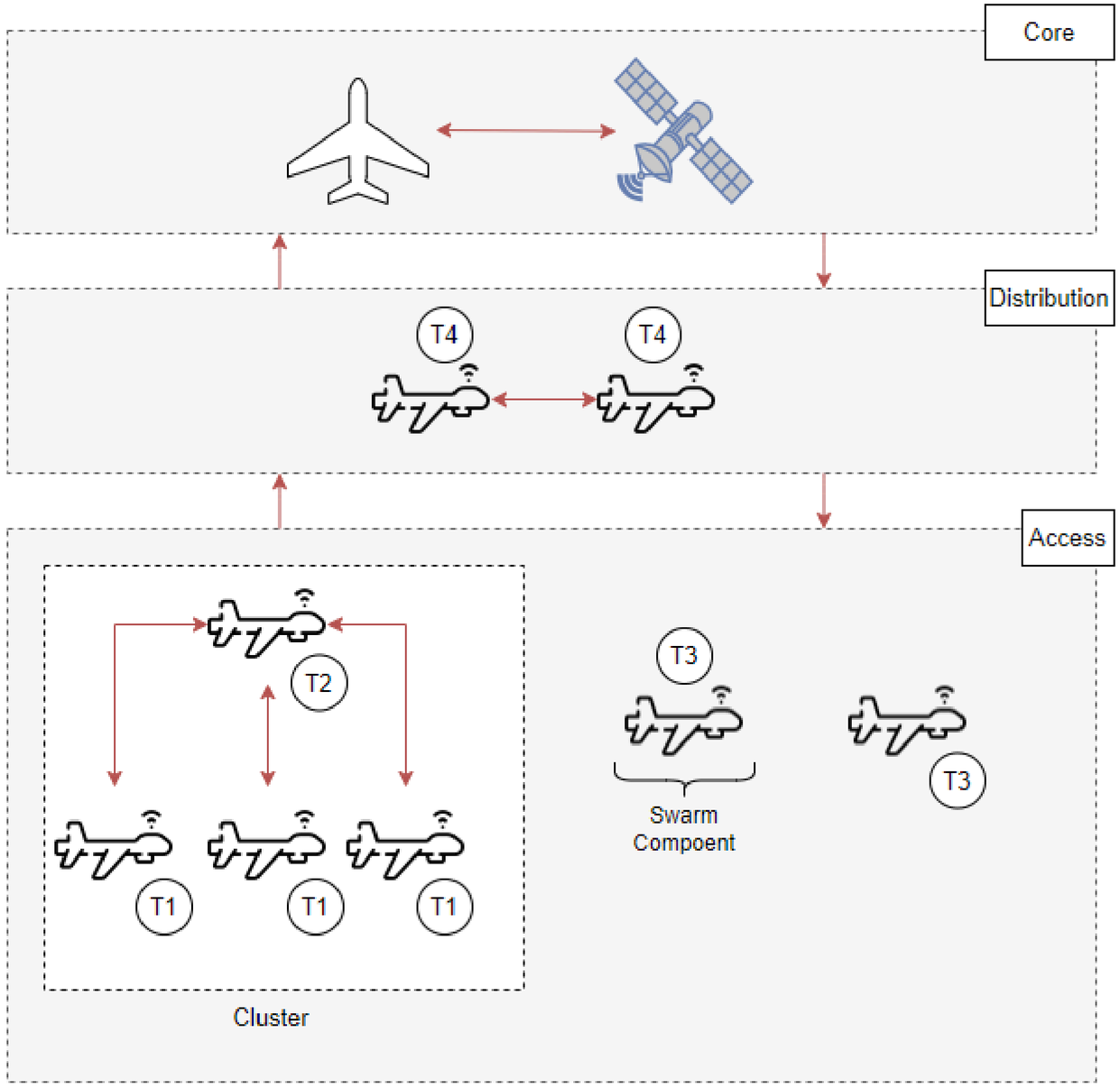
System of Systems Architecture (SoS)

System of Systems:
finite number of constituent systems which are independent and operable, and which are networked together for a period of time to achieve a certain higher goal.

Maier (1998) [1]

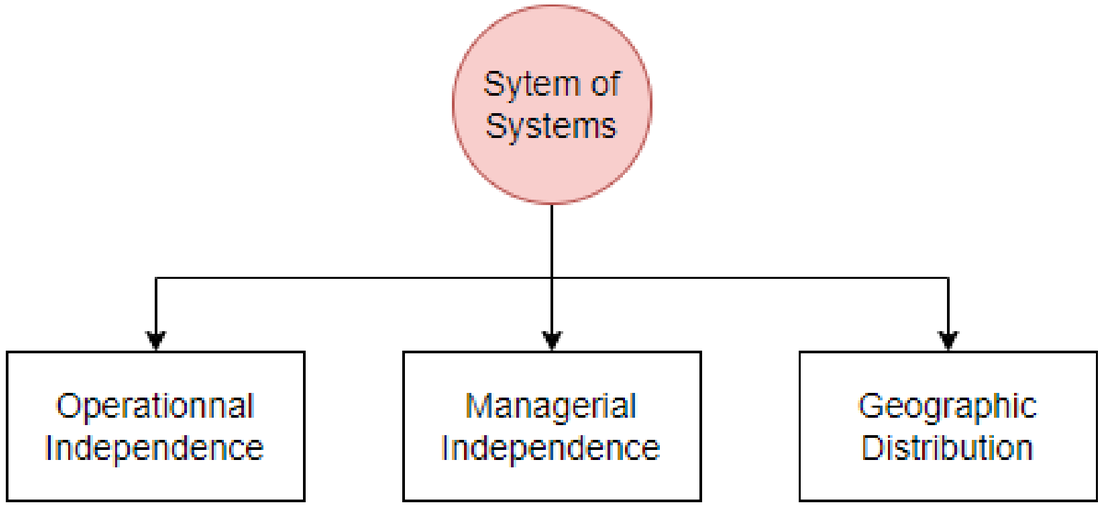
Tasks - Missions:

$$\text{let } T = \{T_1, T_2, \ldots, T_n\} \quad \text{and} \quad M = \{M_1, M_2, \ldots, M_m\}$$
$$\forall M_i \in M, \quad M_i \subseteq T$$



System of Systems example : Unmanned Vehicules (UVs)

System of Systems Specificities



System of Systems properties

Maier (1998) [1]

- Scalability
- Flexibility and Adaptability
  - Modular Approach
- Robustess and Reliability
  - Fault Tolerance
  - Redundancy
- Enhanced Performance
  - Load Distribution
  - Specialized System

Wireless Sensor Networks ?

Data and functional Heterogeneity

Current research questions

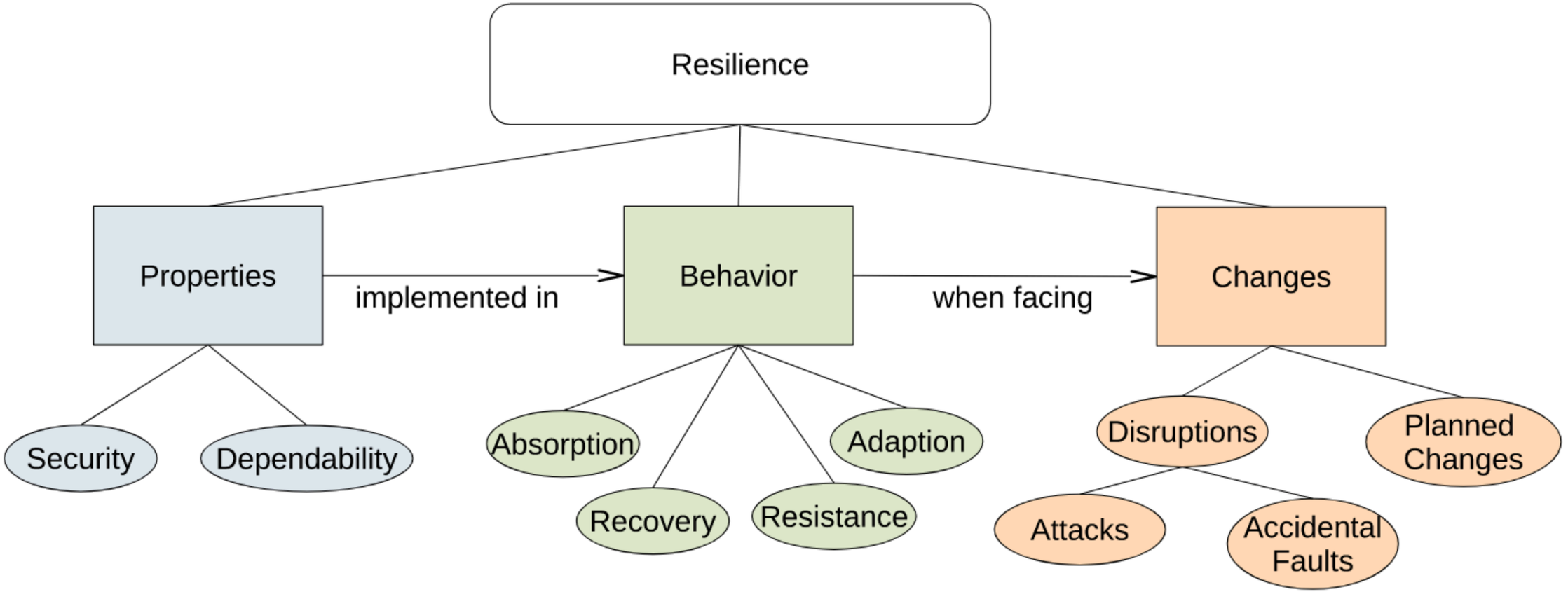
Q1 : How to ensure the adaptability of the IoT infrastructure to guarantee reliable functionality and interactions ?

-> `orchestration`

Q2 : How to design task allocation policies within the IoT infrastructure in an uncertain and evolving environment ?

-> `ad-hoc composition`

Resilience concept



Resilience is the property of preserving the dependability and security of a system when the system encounters changes, thus withstanding or recovering from impairments. *Resilience mechanisms* are all means that work toward achieving this property.

Resilience concept

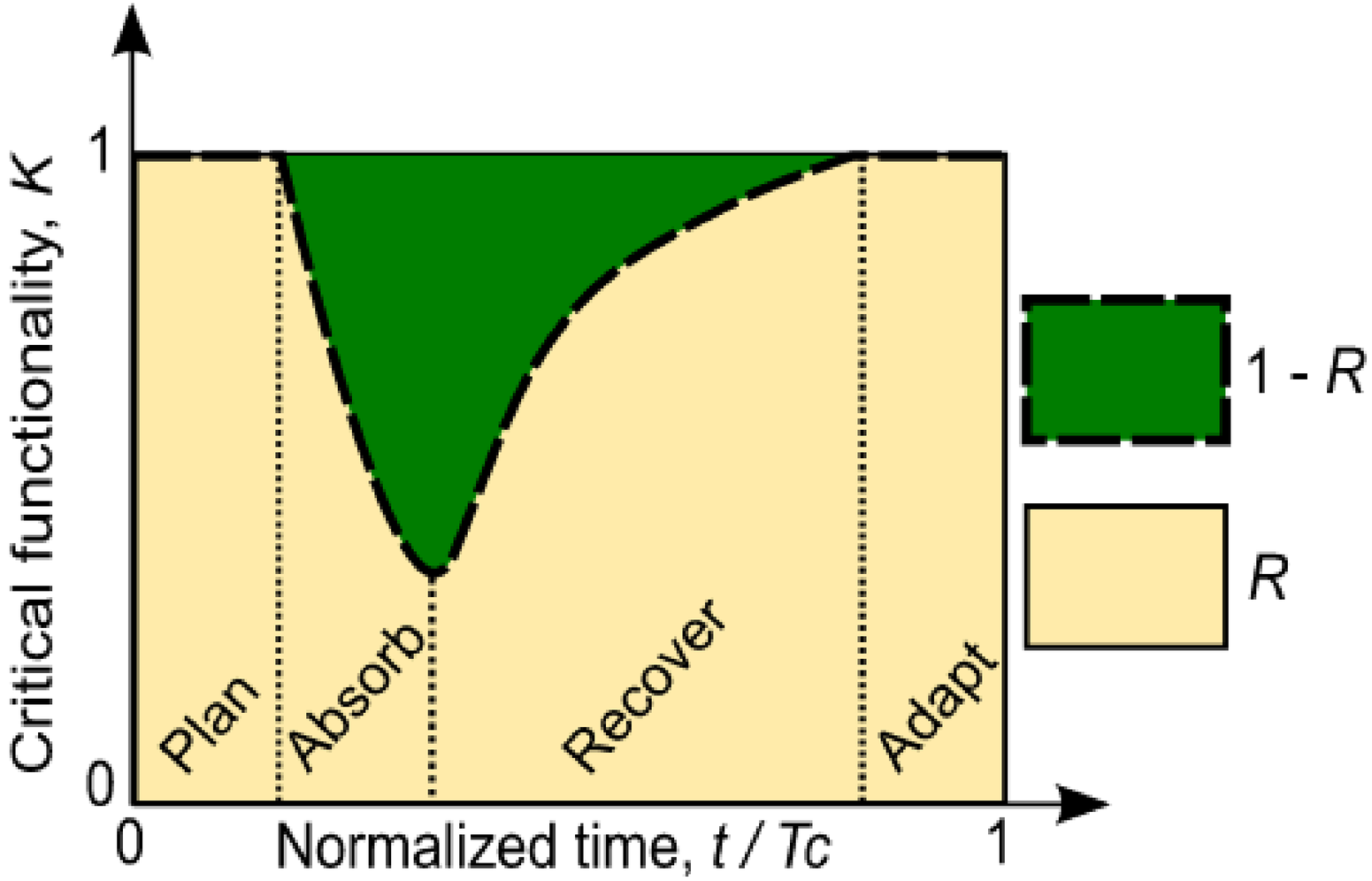
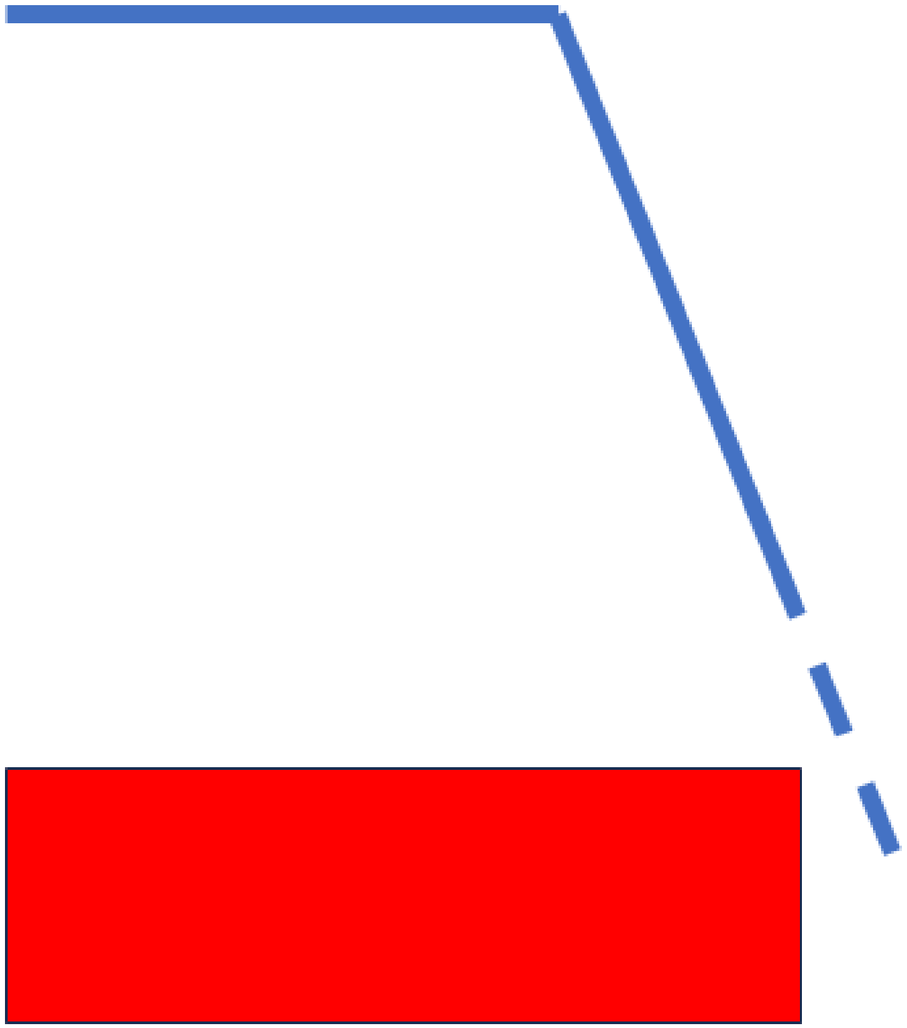


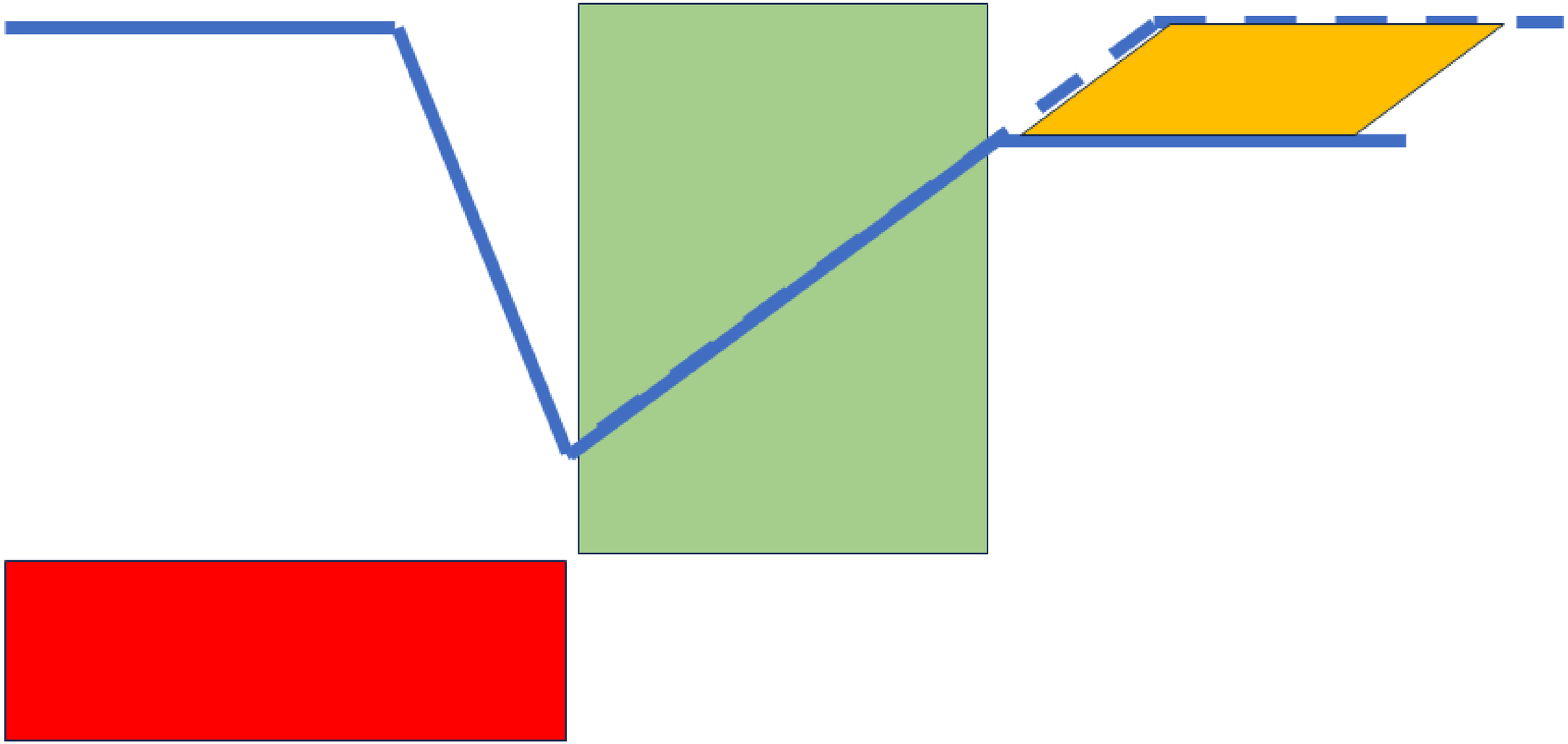
Figure 1. Resilience and critical functionality concepts as advanced by the NAS. The system's resilience is evaluated as the integral of the critical functionality's (K) dependency on time.

Resilience concept



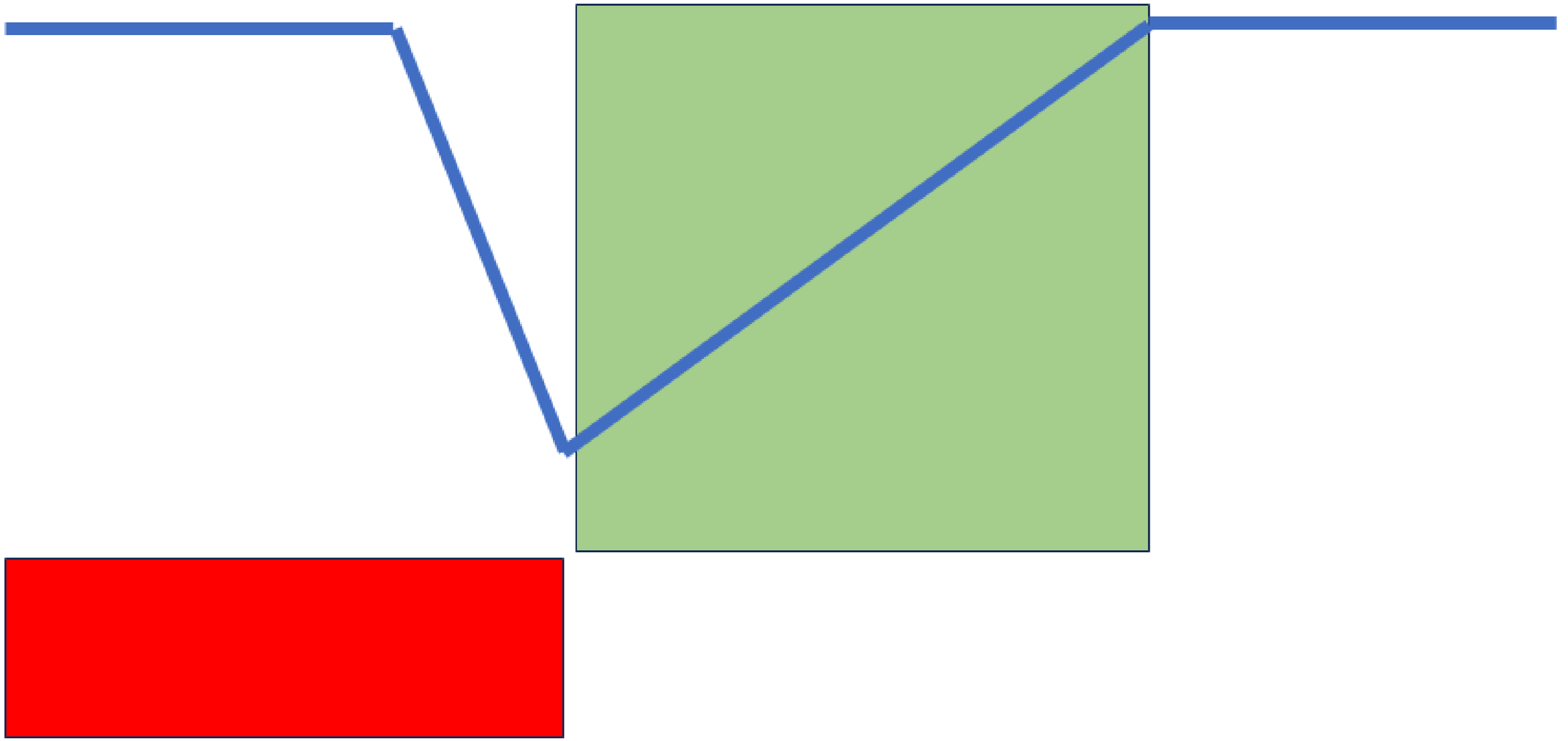
Robustness tanking phase then **collapse** phase

Resilience concept



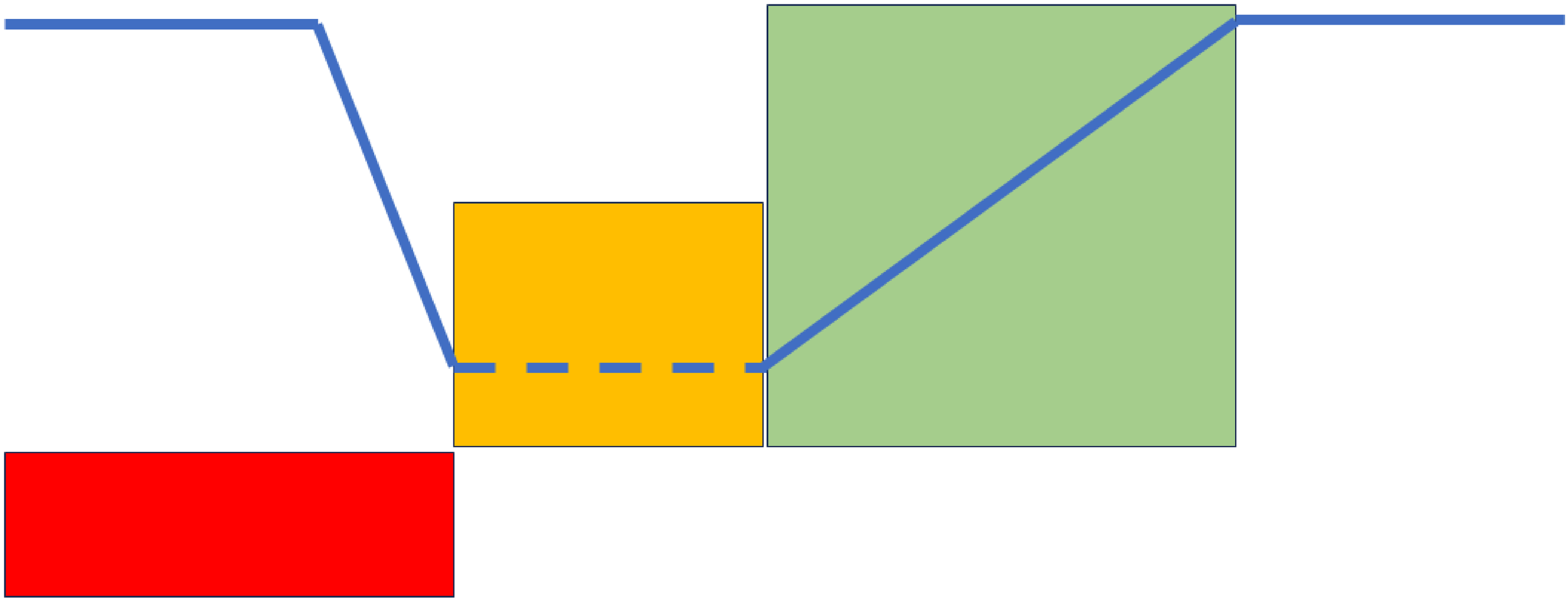
Robustness tanking phase then **partial recover** phase

Resilience concept



Robustness tanking phase then **total recover** phase

Resilience concept



Robustness tanking phase then **graceful degradation** phase then **total recover** phase

On going work

Package

Master image

Monitoring plan

Digital twins

Decision :
Monitor and plan to master image
or
Package to deployed image

Package Suppletive code or data

Deployed images

Monitoring Plan

Hazard

Connect multiple entities : **MQTT Pharo**

Task scheduling : **TaskIt**