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Ambient SoC Enabling Future (CPSS Cyber-Physical “Social” Systems)

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Ambient SoC Enabling Future CPSS (Cyber-Physical "Social" Systems)

November 25, 2011

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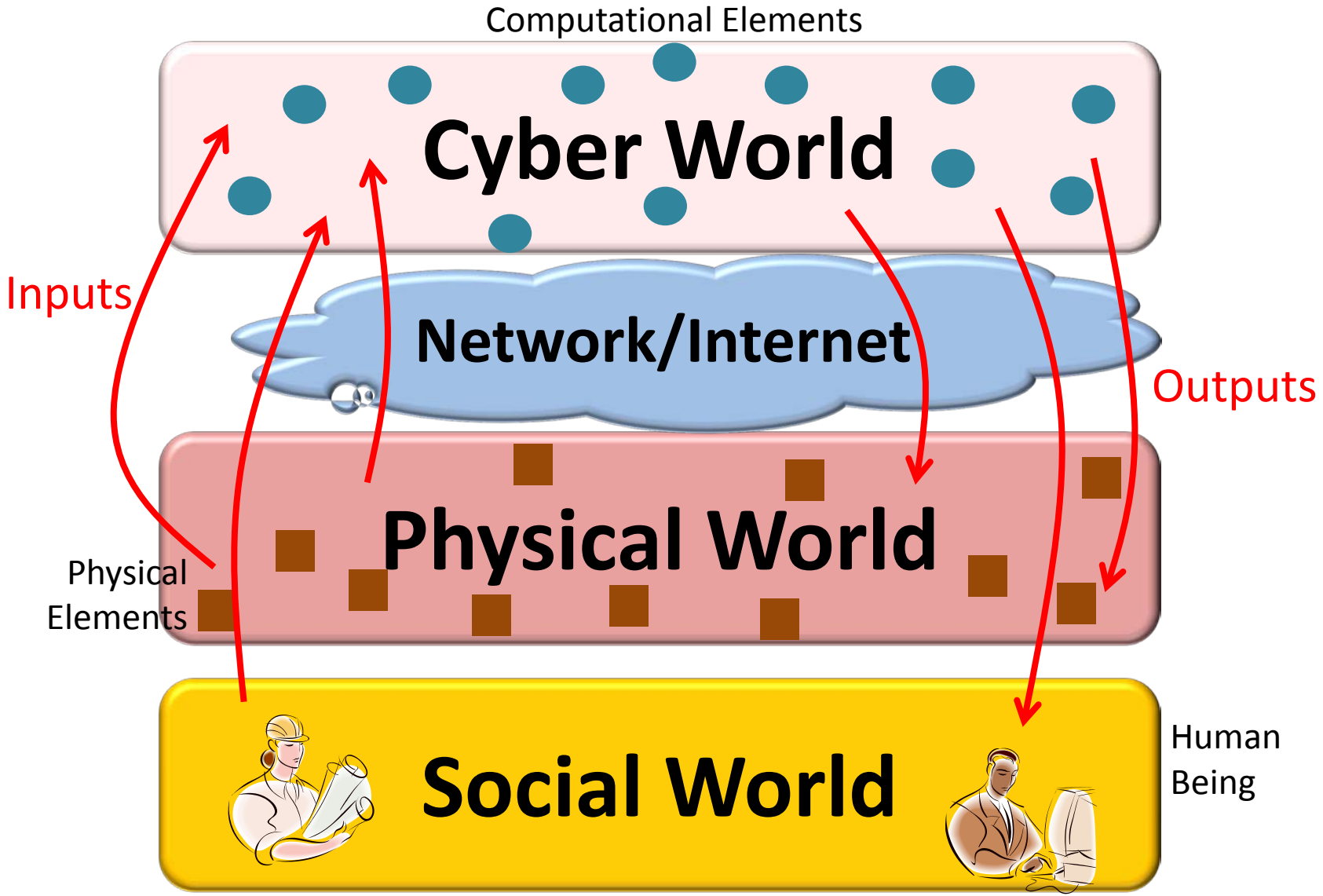
#2: ISIT/Kyushu, Japan

Our Vision

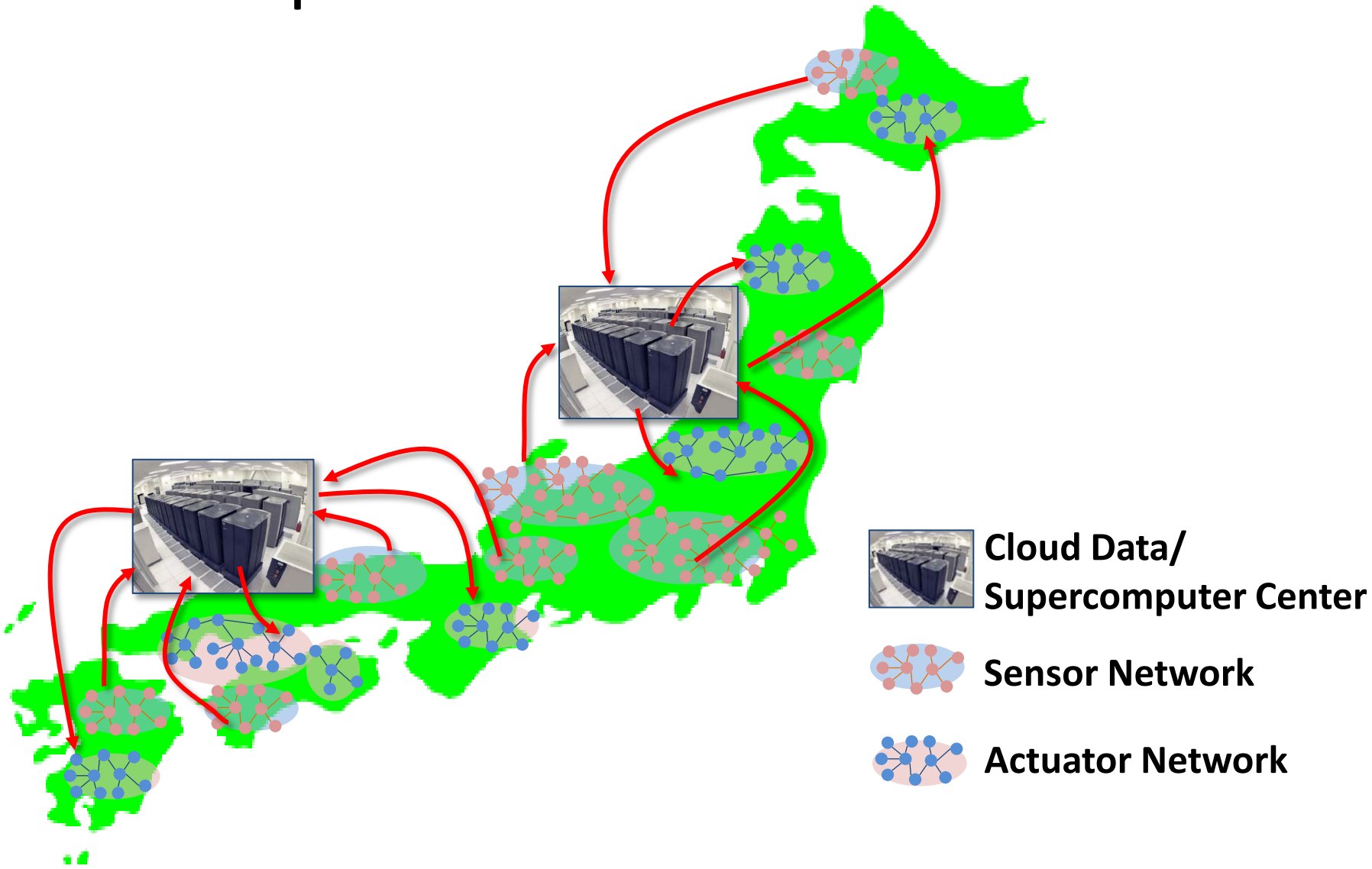
Vision: Optimize the whole earth by means of “CPSS” systematically!

Optimize the Whole Japan so as to Protect Tsunami Disasters!

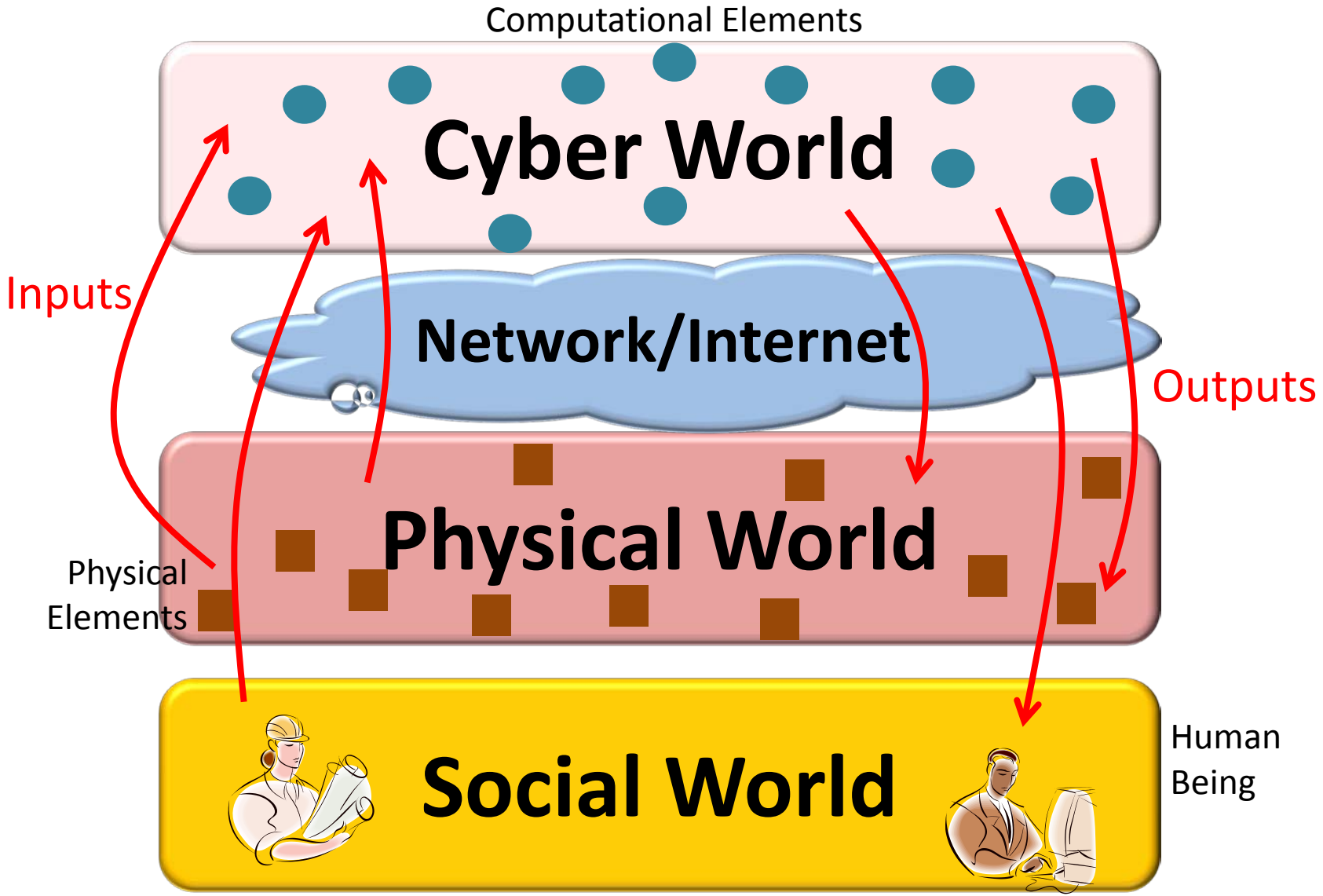
How Do We Optimize the Whole Earth?
- CPSS (Cyber-Physical-Social System) -



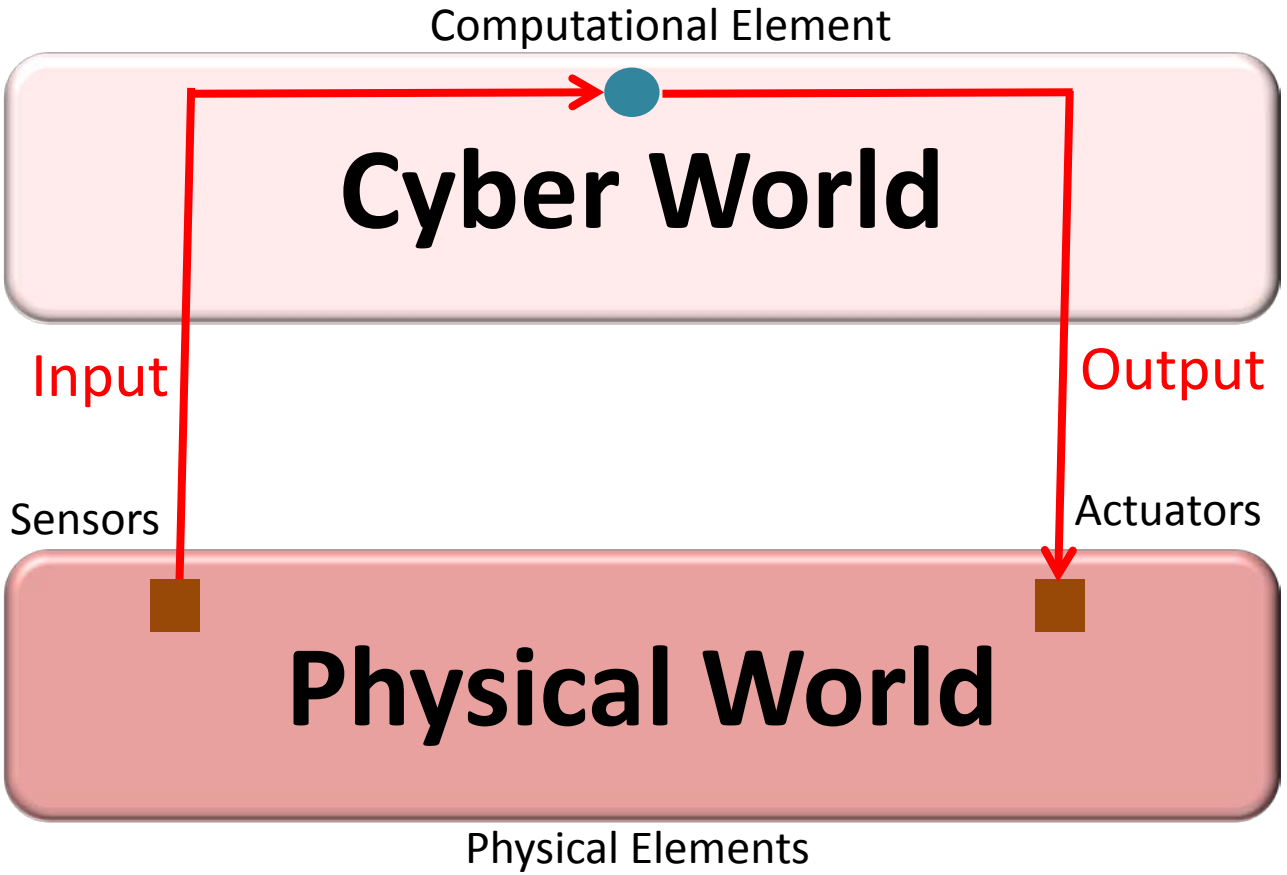
How Do We Optimize the Whole Japan?
- Japan National-wide CPSS-



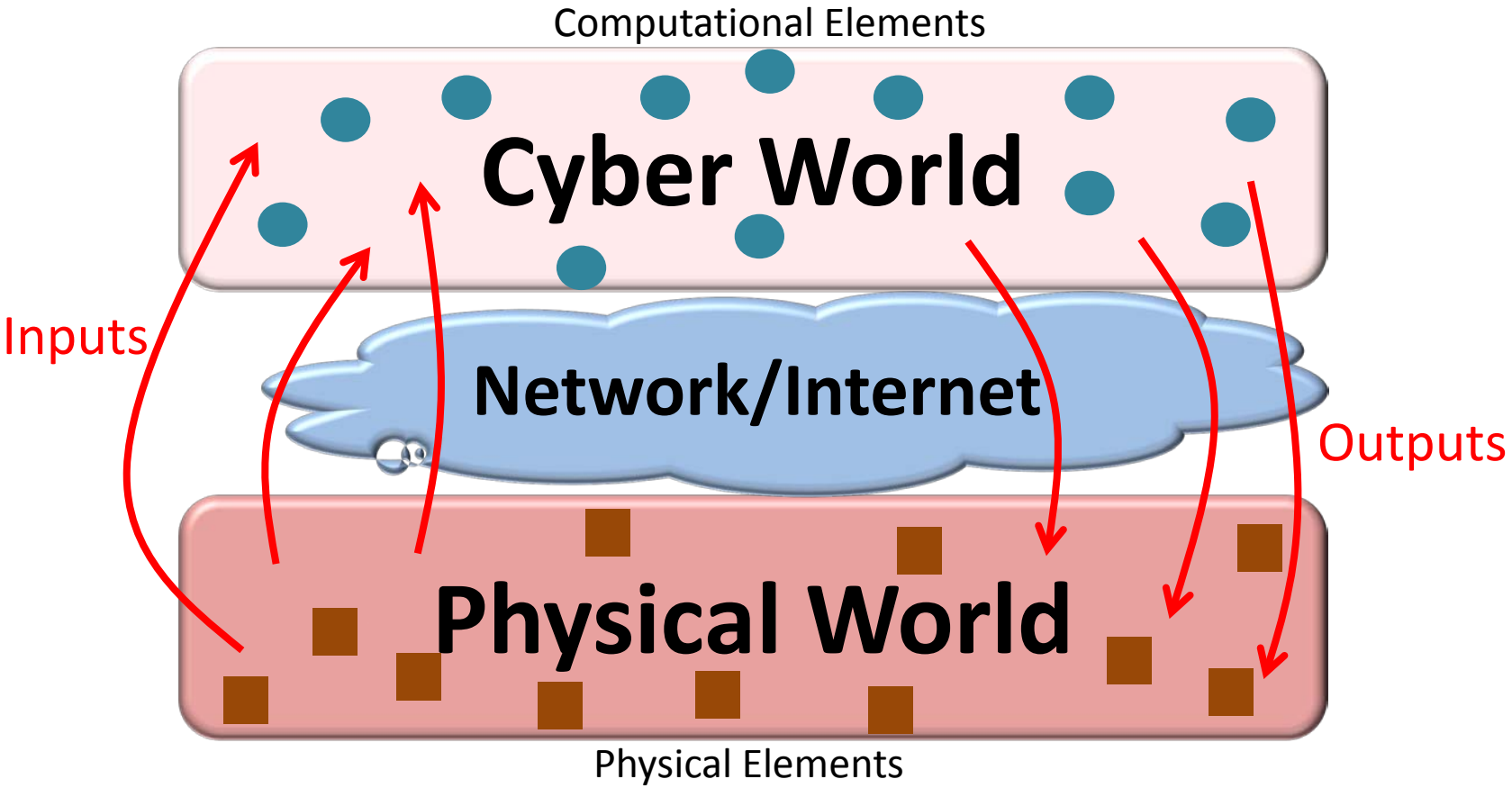
CPSS (Cyber-Physical-Social System)
- A Big Picture -



An Origin of CPSS
- ES (Embedded System) -



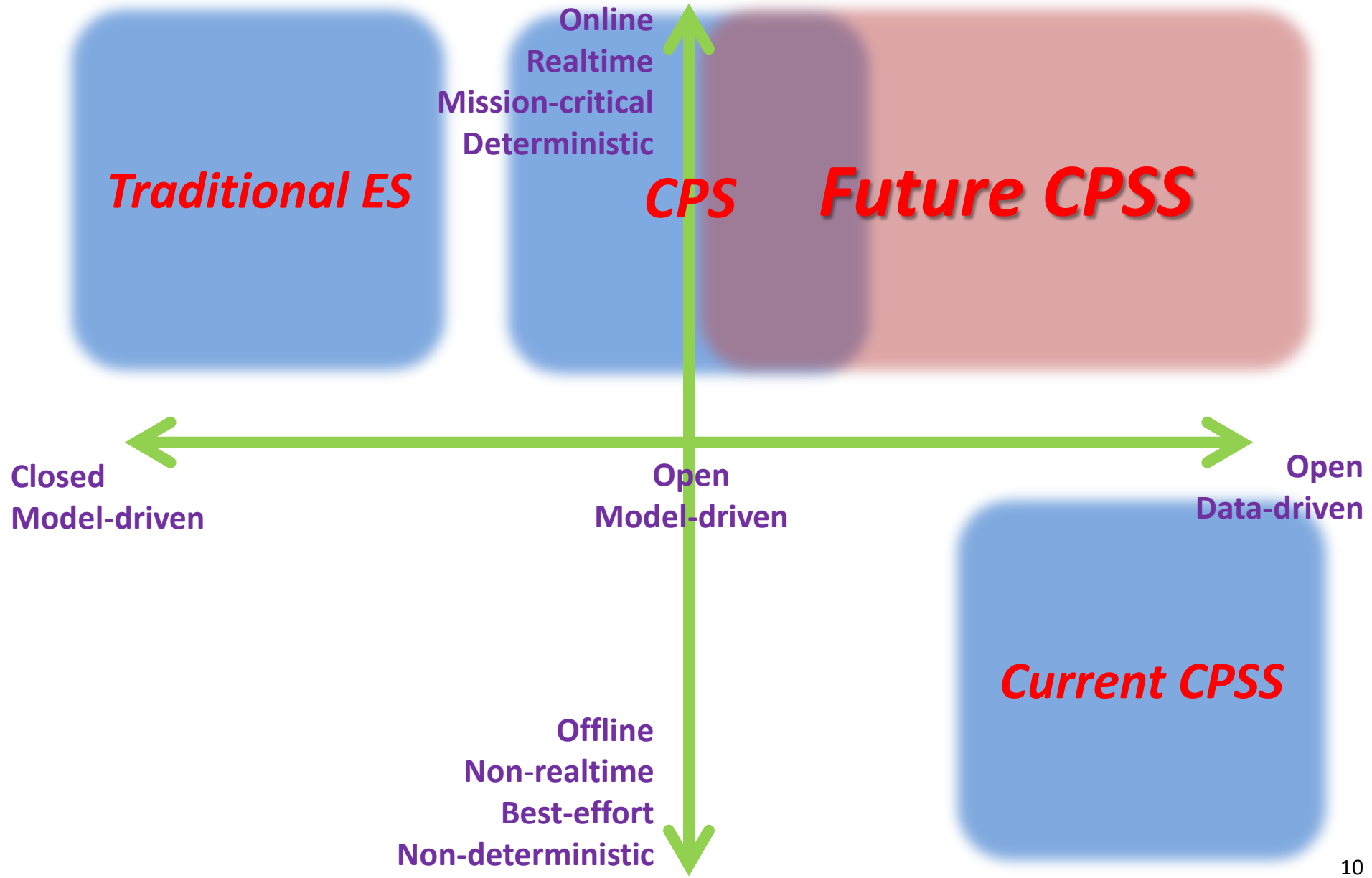
Another Origin of CPSS
- CPS (Cyber-Physical System) -



Classifying ES, CPS, and CPSS

Taxonomy		ES	CPS	Current CPSS	Future CPSS
Feedback	Offline			✔	
	Online	✔	✔		✔
Raeltimeness	Non-realtime			✔	
	Realtime	✔	✔		✔
System	Closed	✔			
	Open		✔	✔	✔
Criticality	Best-effort			✔	
	Mission-critical	✔	✔		✔
Control	Model-driven	✔	✔		✔
	Data-driven			✔	✔
Effects of feedback	Nondeterministic			✔	
	Deterministic	✔	✔		✔

Classifying ES, CPS, and CPSS



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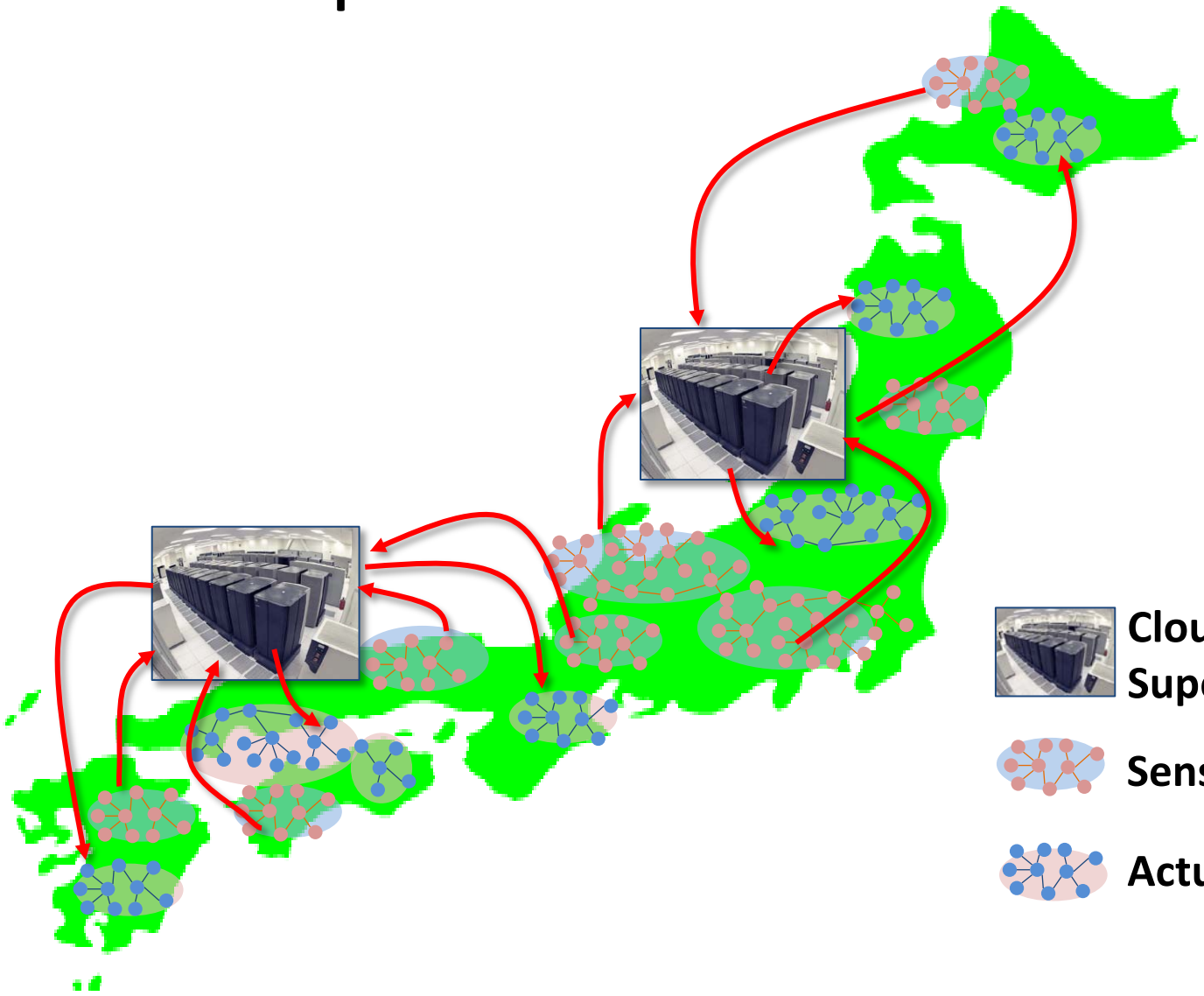
- Japan National-wide CPSS-



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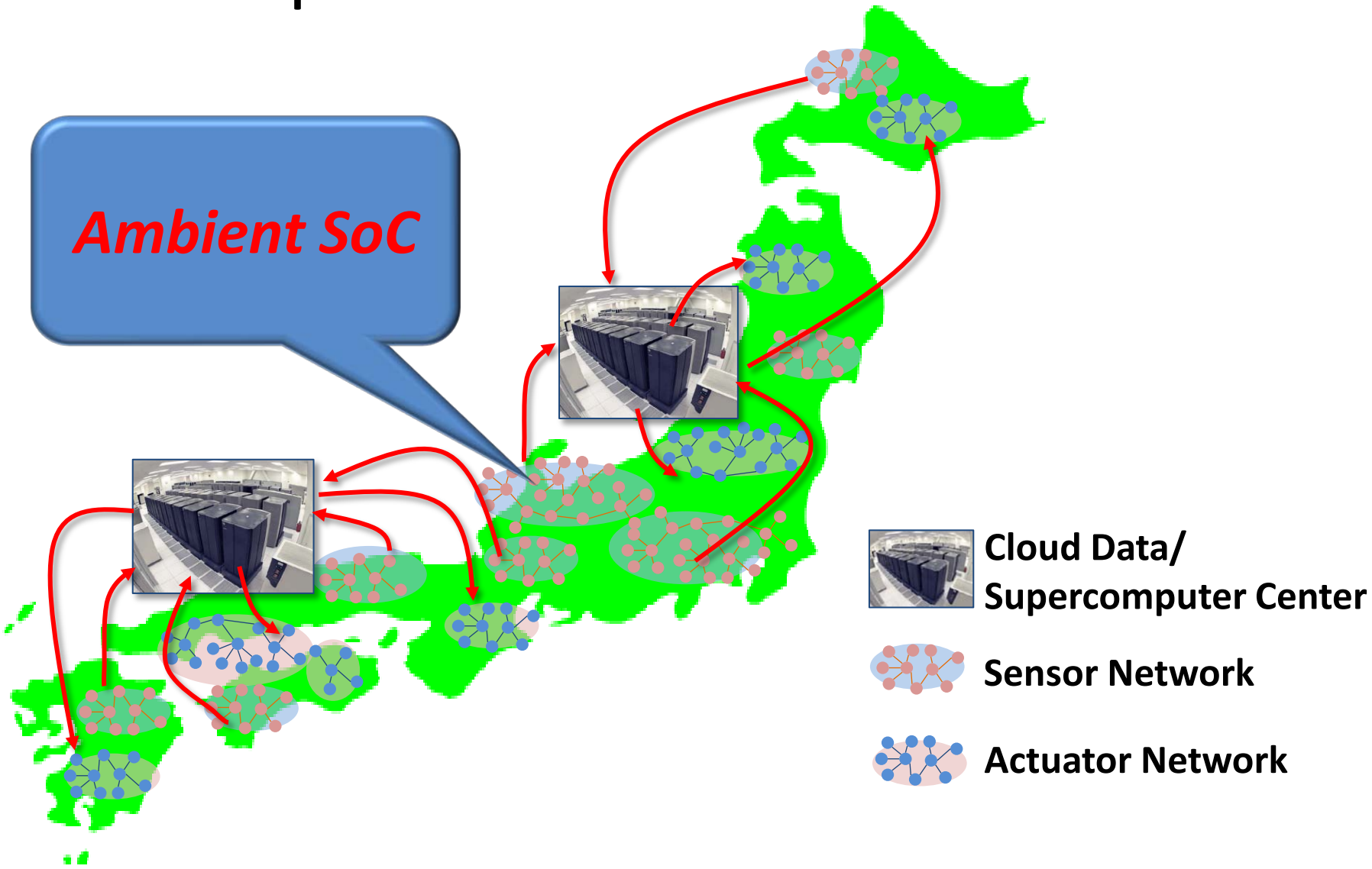
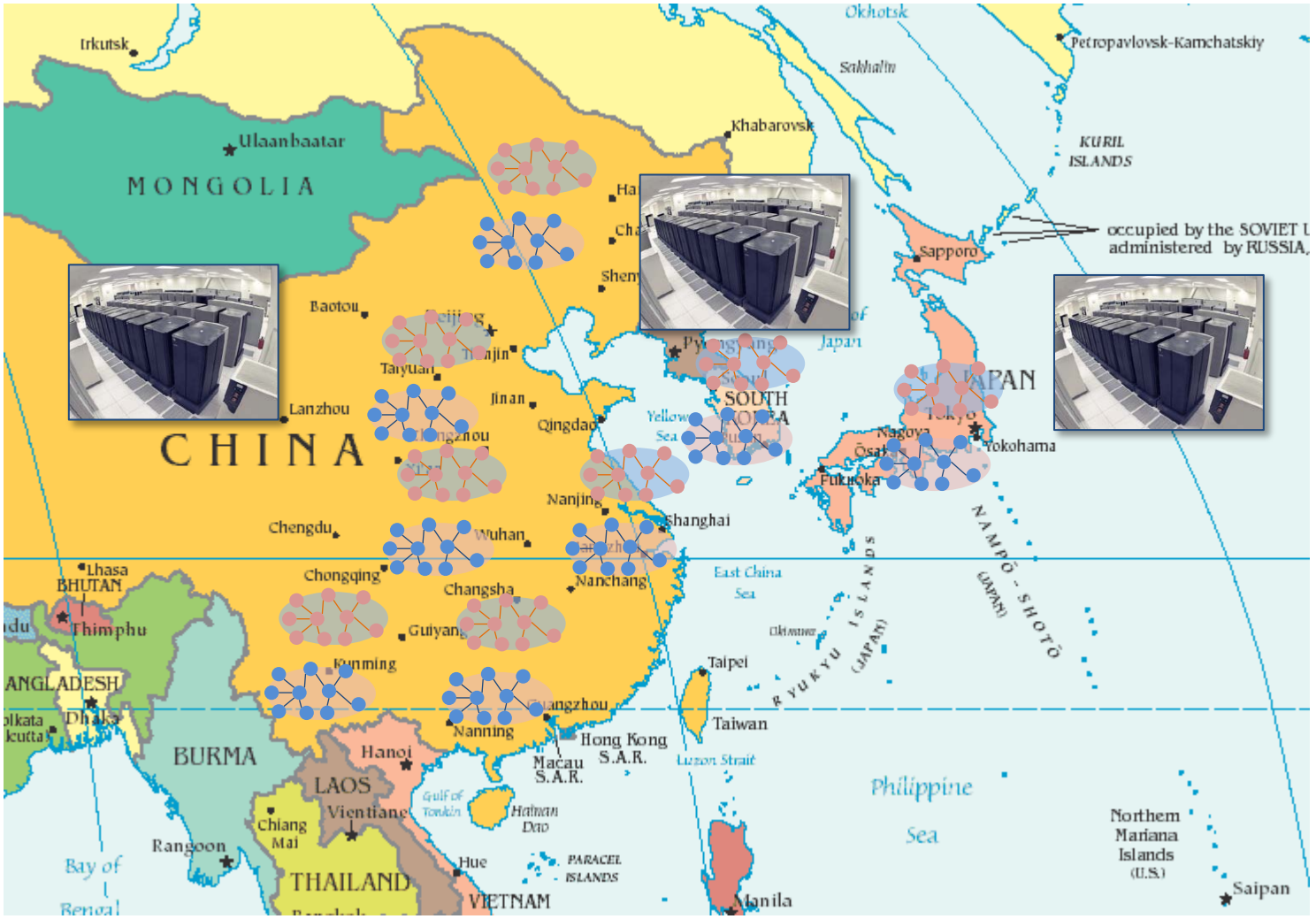


How Do We Optimize the Whole East-Asia?
- East-Asia Regional-Wide CPSS -



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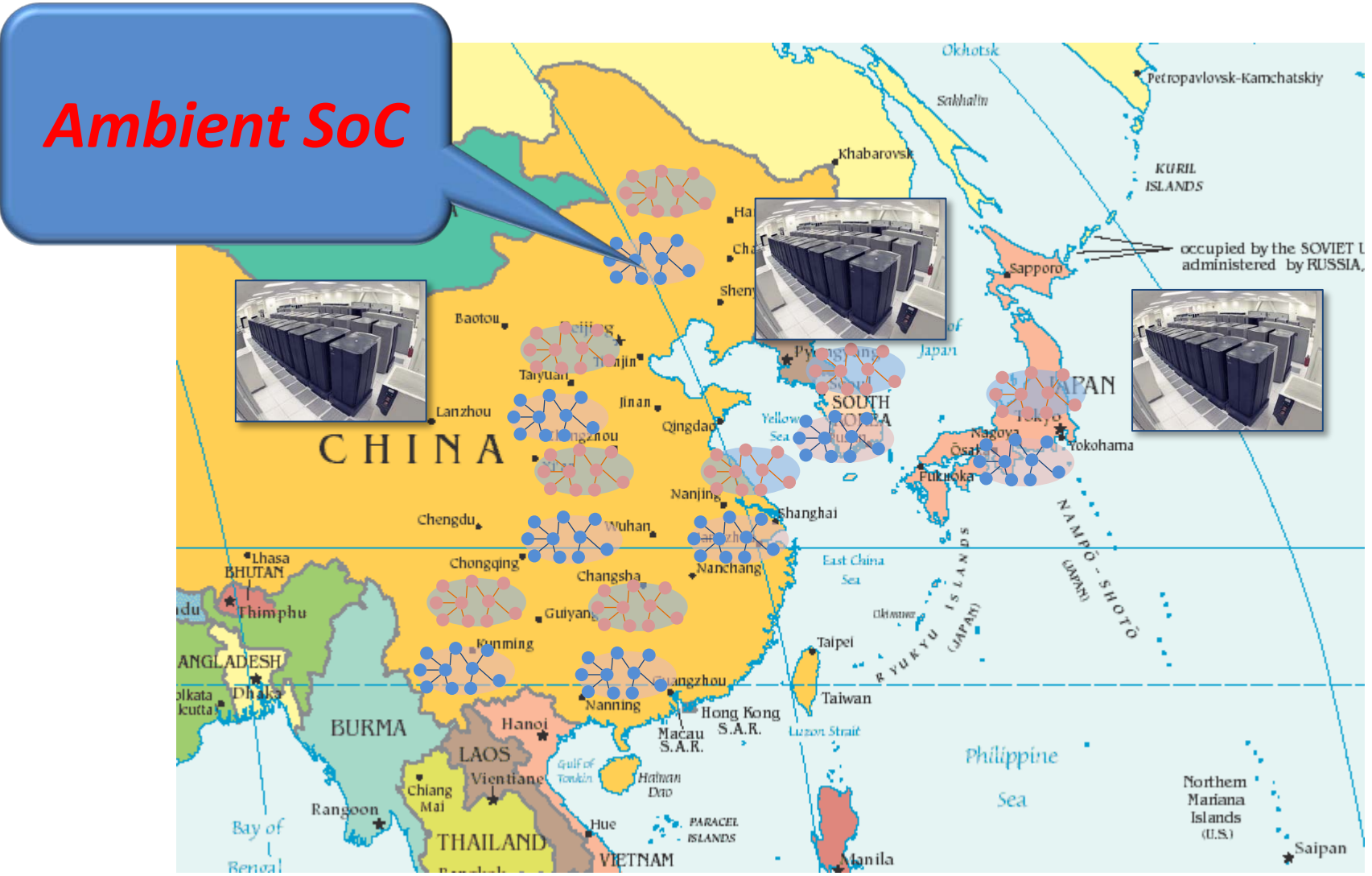


Optimize the Whole Earth by means of CPSS Systematically

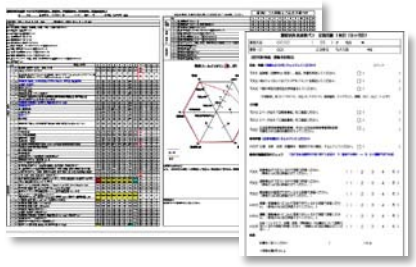
Smart ITS

Preventive Medical Service System

Smart Grid

Smart Cities

Preventive Medical Service System



- Electric medical record
- Electric critical path information

Precise disease risk control

Blood Oxygenation level
•Breathing rate
•Sleep state
•Temperature
•Humidity
• Intensity of illumination
•Noise

Blood Pressure
Weight
Blood-sugar
Behavior discrimination
Electro-cardiogram

Traditional medical treatment

Realtime information medicine(*)

Physical& Social Space

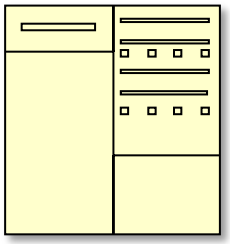
Cyber Space

Prediction of individual fluctuation

Growth type feed-back

Medical information network

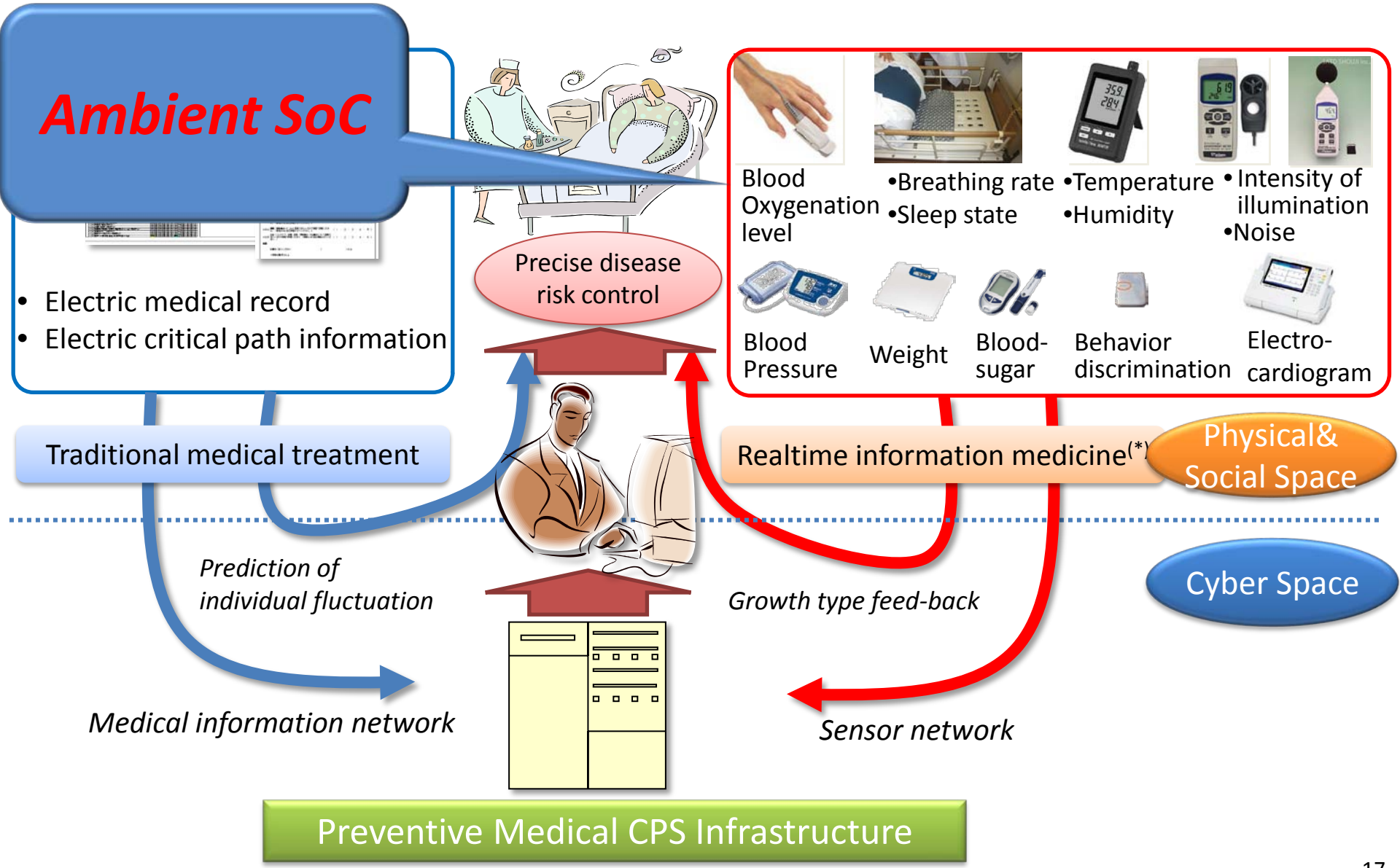
Sensor network



Preventive Medical CPS Infrastructure

(*): Information Medicine : A concept provide right information at right timing to improve health

Preventive Medical Service System



(*): Information Medicine : A concept provide right information at right timing to improve health

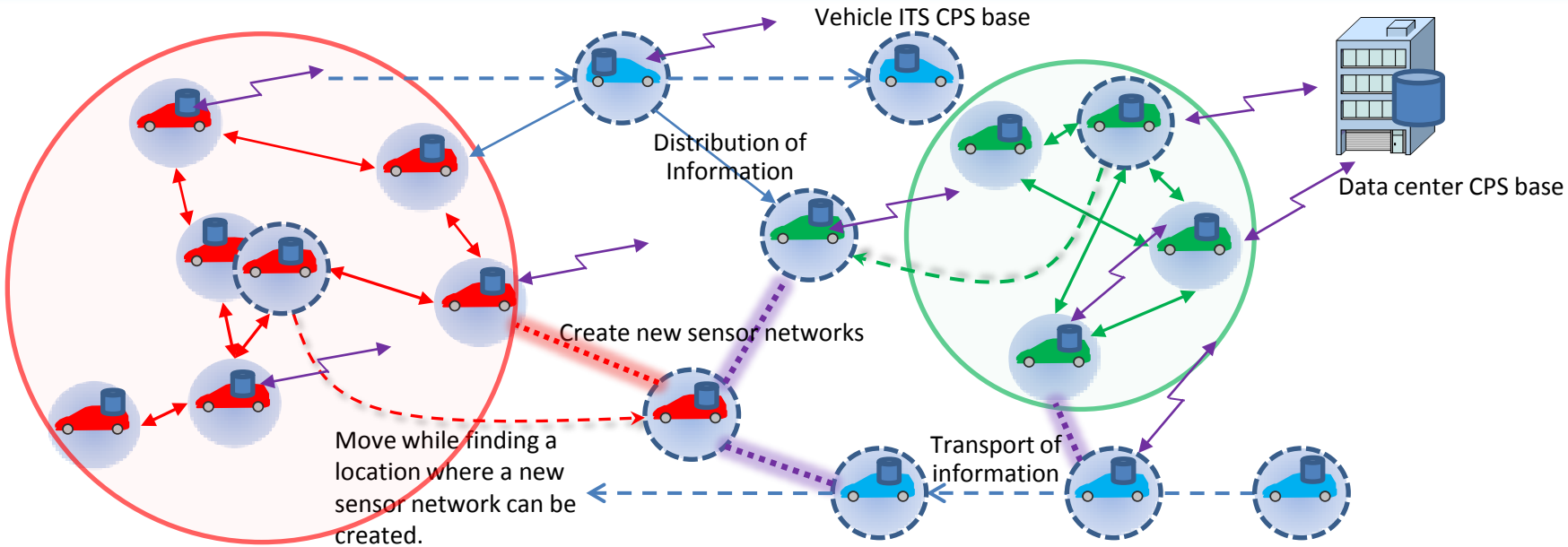
Smart ITS: Sensor-Networked ITS

Concept:

① Collect data using various sensors on vehicles, and send them via WAN to data centers. The data is analyzed for traffic conditions or other status. Then the analyzed data is used to guide vehicles for efficiency and safety.

② At the same time, the analyzed data in the data center is shared using vehicle to vehicle communication. It is used to improve own traffic information, and it also improves traffic efficiency and safety.

③ The vehicle-to-vehicle communication can be used to create sensor network which provide minimum communication capability in an emergency condition.



Vehicle sensing data: location, velocity, acceleration, load condition, temperature, rainfall, visual image, battery/fuel condition

Smart ITS: Sensor-Networked ITS

Ambient SoC

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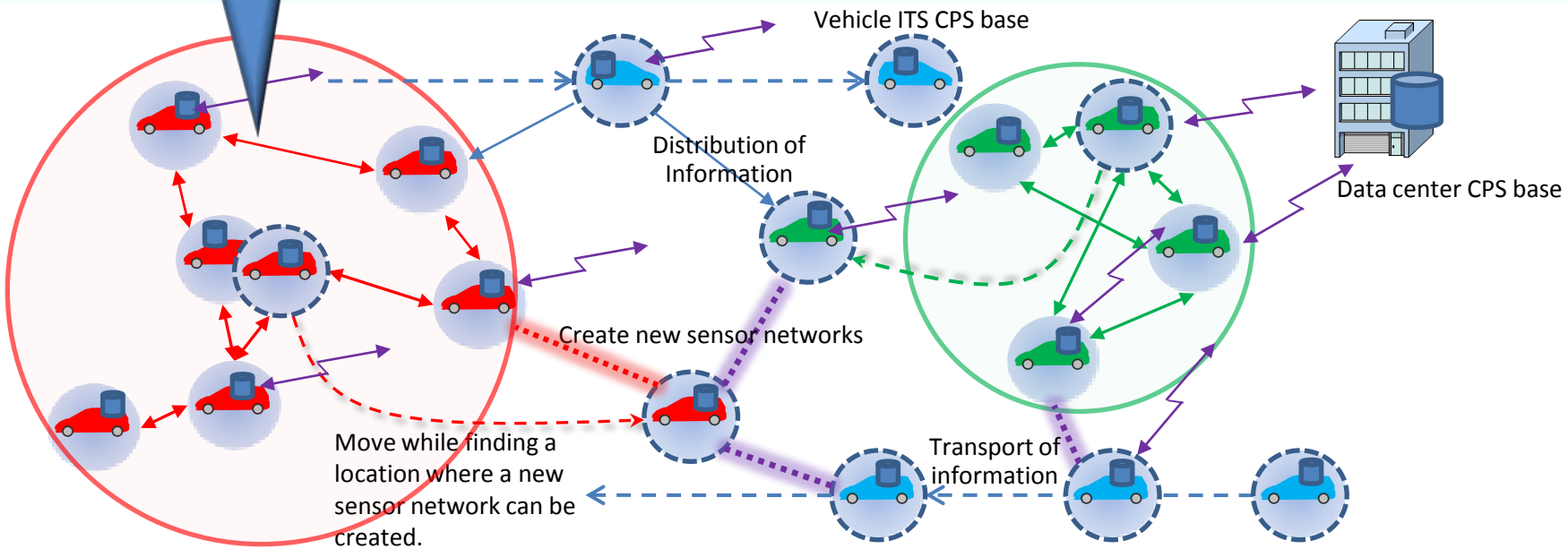


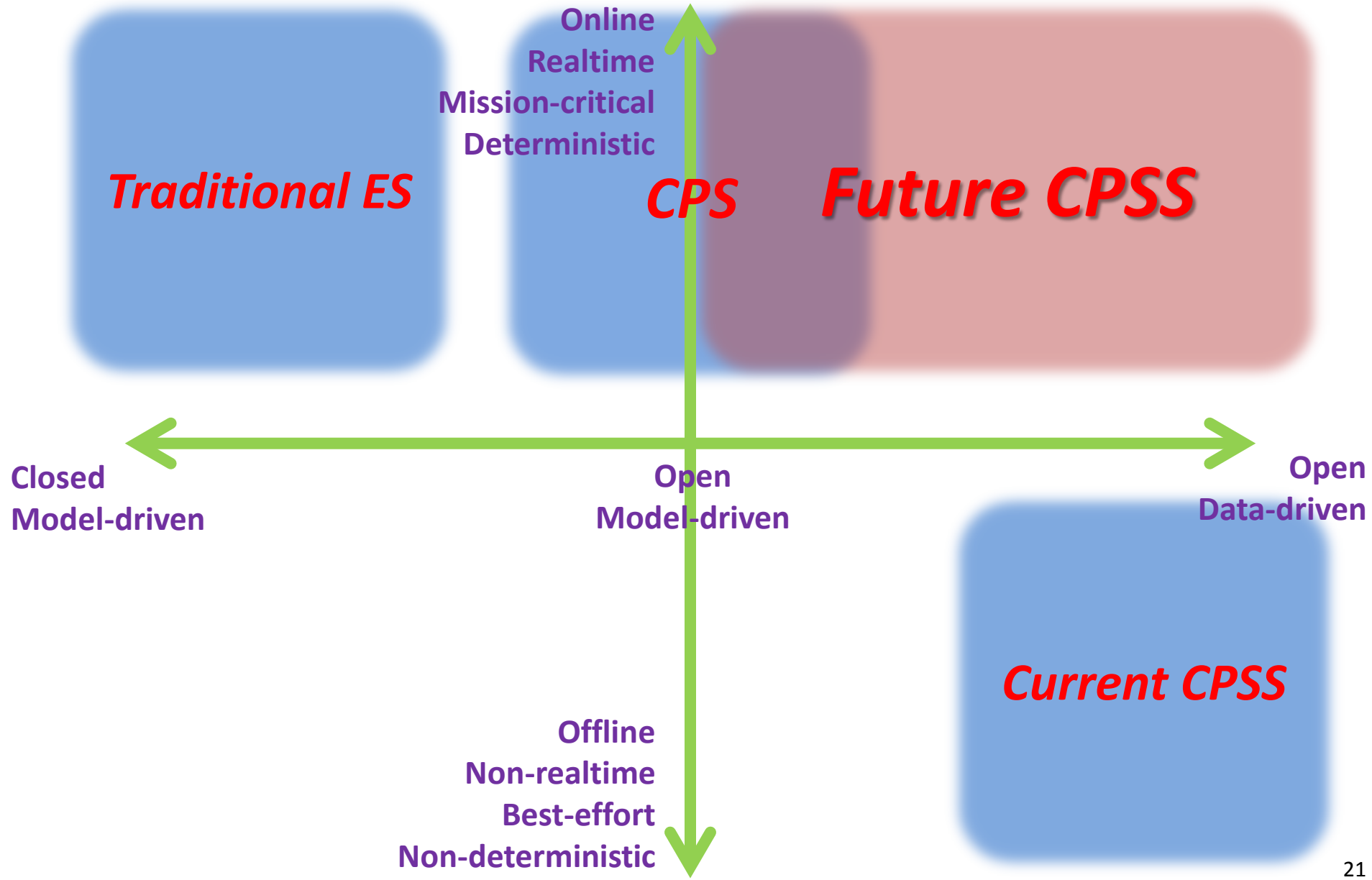
Vehicle sensing data: location, velocity, acceleration, load condition, temperature, rainfall, visual image, battery/fuel condition

Our Vision and Mission

Vision: Optimize the whole earth by means of “CPSS” systematically!

Mission: Develop technologies enabling future “CPSS”!

Classifying ES, CPS, and CPSS



Technologies Enabling Future CPSS

① Application/System Codesign

- Requirement engineering

Future CPSS

② CPSS Architecture

- Platform architecture & architectural framework
  - Cloud data/supercomputer center
  - Sensor/actuator network
  - Software stack
  - Standard interfaces
- Hybrid model&data-driven control theory
- HPC4CPSS (Supercomputer for CPSS)
  - Online realtime simulation

③ Design Methodology

- MDD (Model-Driven Design)
- MBD (Model-Based Development)
- Formal design method for CPSS

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Hybrid Model&Data-Driven Control Theory

Hybrid Model & Data-Driven

Model-Driven

- Traditional control theory
  - Feedback
  - Feedforward
- Simulation

Data-Driven

- Data mining
- Data assimilation

Technologies Enabling Future CPSS

① Application/System Codesign

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