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

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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 -

Cyber World

Network/Internet

Physical World

Social World

Computational Elements

Inputs

Outputs

Human Being

Physical Elements
An Origin of CPSS
- ES (Embedded System) -

Cyber World

Computational Element

Physical World

Input
Sensors

Output
Actuators

Physical Elements
Another Origin of CPSS
- CPS (Cyber-Physical System) -
# Classifying ES, CPS, and CPSS

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Classifying ES, CPS, and CPSS

- **Traditional ES**
  - Closed
  - Model-driven
  - Offline
  - Non-realtime
  - Best-effort
  - Non-deterministic

- **CPS**
  - Online
  - Realtime
  - Mission-critical
  - Deterministic

- **Future CPSS**
  - Open
  - Model-driven
  - Data-driven

- **Current CPSS**
  - Closed
  - Model-driven
  - Offline
  - Non-realtime
  - Best-effort
  - Non-deterministic
How Do We Optimize the Whole Japan?
- Japan National-wide CPSS-
How Do We Optimize the Whole Japan?
- Japan National-wide CPSS-

Ambient SoC

Cloud Data/
Supercomputer Center

Sensor Network

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

Ambient SoC
Optimize the Whole Earth by means of CPSS Systematically

Smart ITSS

Preventive Medical Service System

Smart Grid

Smart Cities
Preventive Medical Service System

- Electric medical record
- Electric critical path information

Traditional medical treatment

Precise disease risk control

Realtime information medicine(*)

Blood Oxygenation level
- Breathing rate
- Sleep state
- Temperature
- Humidity

Electrocardiogram

Blood Pressure
Weight
Blood-sugar
Behavior discrimination

Physical & Social Space

Sensor network

Medical information network

Prediction of individual fluctuation

Growth type feedback

Cyber Space

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

Ambient SoC

- Electric medical record
- Electric critical path information

Traditional medical treatment

Prediction of individual fluctuation

Medical information network

Precise disease risk control

Realtime information medicine(*)

Physical& Social Space

Cyber Space

Sensor network

Blood Oxygenation level
- Breathing rate
- Sleep state
- Temperature
- Humidity

Intensity of illumination
- Noise

Blood Pressure
Weight
Blood-sugar
Behavior discrimination
Electrocardiogram

Growth type feedback

Blood Pressure
- Weight
- Blood-sugar
- Behavior discrimination
- Electrocardiogram

(*) 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
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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

Traditional ES

CPS

Future CPSS

Current CPSS

Closed
Model-driven

Open
Model-driven

Open
Data-driven

Online
Realtime
Mission-critical
Deterministic

Offline
Non-realtime
Best-effort
Non-deterministic
Technologies Enabling Future CPSS

① Application/System Codesign
- Requirement engineering

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
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