

SPLC 2013 Panel

Scale changes everything, but . . .

Why does it change?

How does it change?

From SPL to Dynamic Ecosystems

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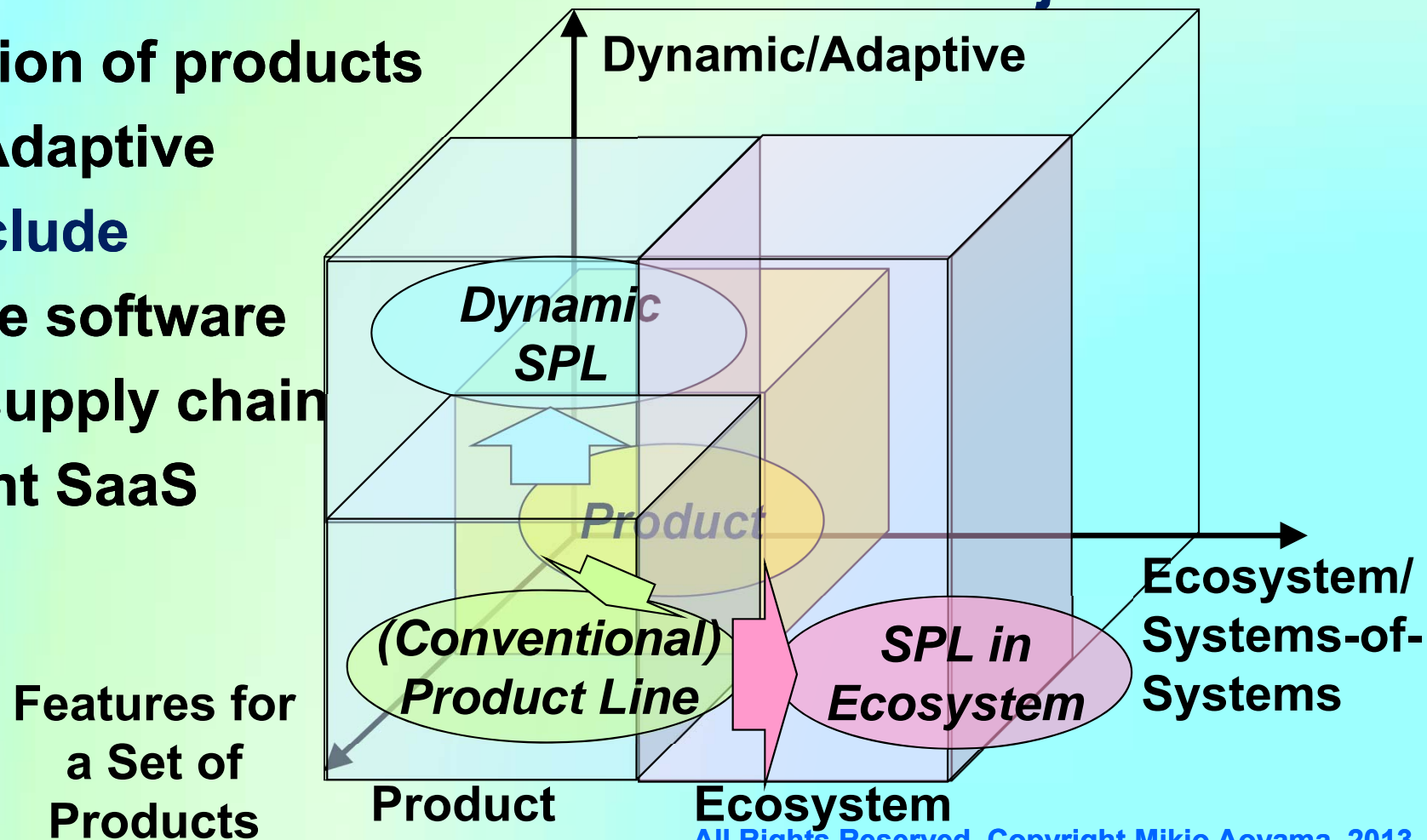
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Tokyo, Japan

Evolution of SPL on the Connected World

From SPL to Dynamic Ecosystems

- ➡ **Conventional SPL focuses on functionality of a set of products**
 - 👉 **Rich functionality with lower cost and shorter time-to-market**
- ➡ **Real systems are much more diverse and multi-objective**
 - 👉 **Collaboration of products**
 - 👉 **Dynamic/Adaptive**
- ➡ **Examples include**
 - 👉 **Automotive software**
 - 👉 **Software supply chain**
 - 👉 **Multi-tenant SaaS**



Automotive Software: Why?

Many Product(-Line)s in an Automobile

➡ Increasing no. of controllers/product-lines and size of software

👉 No. of controllers (ECU: Electronic Control Unit): 50 ~ 100+

➡ Increasing collaboration/interaction among product(-line)s

Engine and Power Train

ACC (Adaptive Cruise Control)
ECT (Electronic Controlled Transmission)
EFI (Electronic Fuel Injection)
HVC (Hybrid Vehicle Control)

Comfort and Pleasure

Back Guide Monitor
Climate Control: Air Conditioner
Door Lock Control, Immobilizer
Power Seat, Power Window
Remote Engine Start (Keyless)

Communication

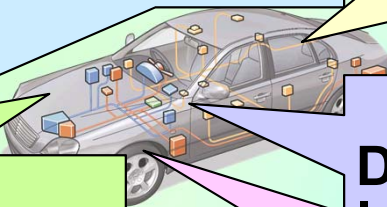
DCM (Data Communication Module)
In-Vehicle Network: CAN, LIN, MOST,
FlexRay, TTEthernet, Bluetooth

Chassis and Safety

AFS (Adaptive Front-lighting System)
ACS (Active Control Suspension)
ABS (Antilock Brake System)
ESC (Electronic Stability Control)
PCS (Pre-Crash Safety)
TRC (TRaction Control)
VDM (Vehicle Dynamics Management)

Human Interface and Support

Car Navigation System
LCD Instrument Panel, Touch Panel,
HUD (Head Up Display), Speech
Recognition System, Haptic Interface



Ref.: M. Aoyama, Computing for the Next-Generation Automobile,

³ IEEE Computer, Vol. 45, No. 6, Jun. 2012, pp. 32-37. All Rights Reserved, Copyright Mikio Aoyama, 2013

Automotive Software: How?

Collaboration of Distributed Products over Physical Body

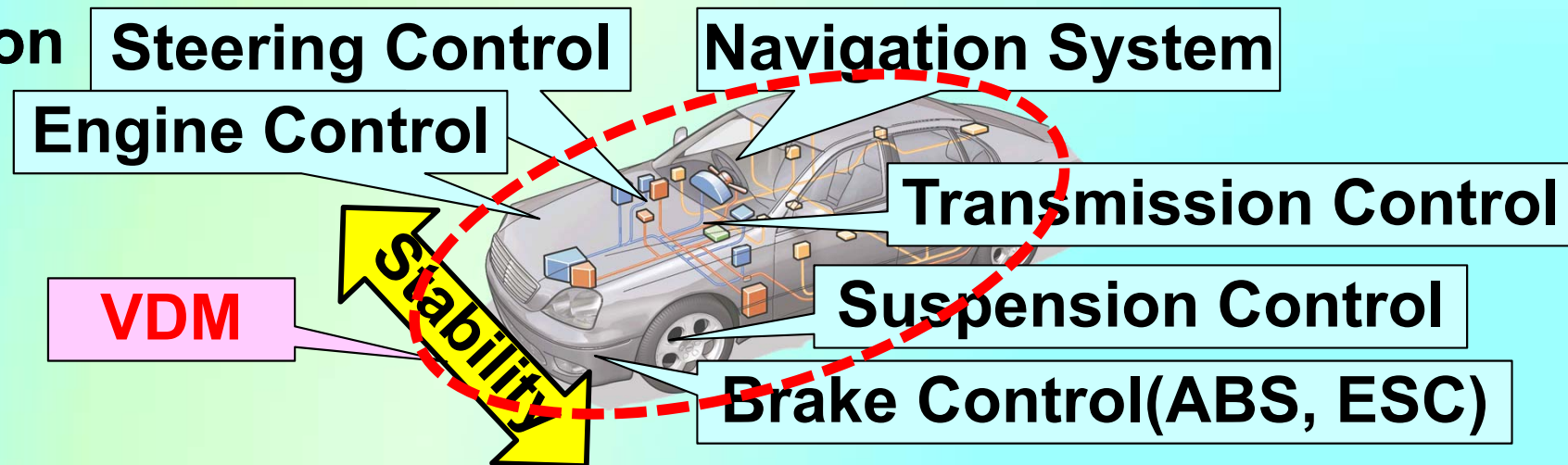
➤ **Scope of current product-line: component on standard platform**

➤ **engine control, brake control (ABS/ESC)**

➤ **Value added by system-wide collaboration of multiple SPLs**

➤ **VDM (Vehicle Dynamic Management system) for stability**

➤ **Collaboration of engine, transmission, brake, steering, suspension**

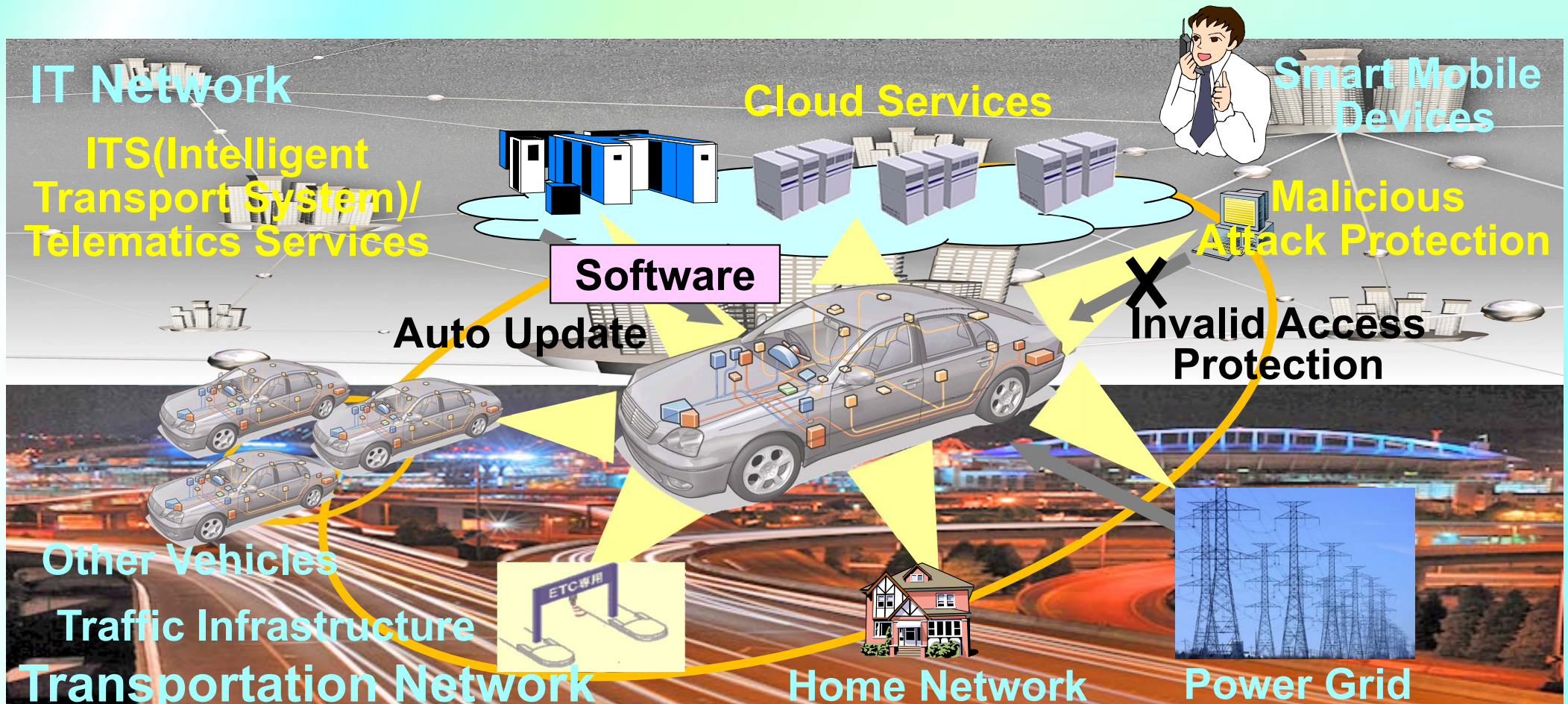


➤ **HEV (Hybrid Electric Vehicle) for economy and performance**

➤ **Collaboration of engine, motor/generator, brake, battery, transmission**

Automotive Software: IT Network, Transportation Network, and Social Network

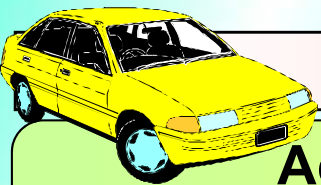
- Optimization as an eco-system: IT network, transportation network and social network (and, power grid)
- IT network over the transportation network



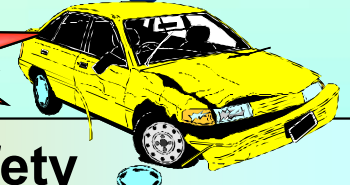
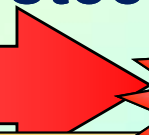
Automotive Software: How?

Dynamic/Adaptive Collaboration for Safety Context

- 👉 Real-time adaptive optimization of features collaboration
- 👉 From passive safety to active safety: assistance/automation
- 👉 Advanced automate systems: braking, steering, driving



Driving Status



Active Safety (Assist/Automation)

Drive Assist

Avoidance

Passive Safety

Protection of Passengers & Pedestals

Normal Status
(Easy to Drive)

VDM (Vehicle Dynamic Management system)

ACC (Adaptive Cruise Control)

Lane Keeping

Parking Assist

360 Degree Vision

Night Vision

Critical Status

ESC (Electronic Stability Control Including ABS)

Warning and Brake Assist

Automatic Braking

Automatic Steering

Unable to Avoid Crash

PCS (Pre-Crash Safety)

Seatbelt Pre-Tensioner

At Crash

Air-bug

After Crash

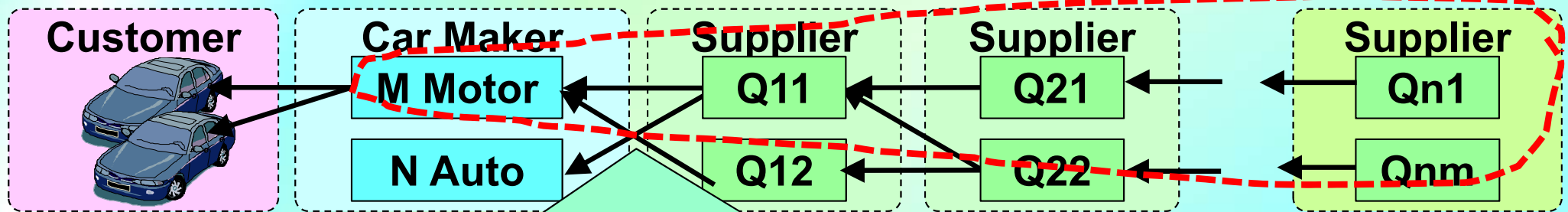
e-Call (emergency Call)

Release Door Lock

SSC (Software Supply Chain): Why?

SSC as Software Ecosystem

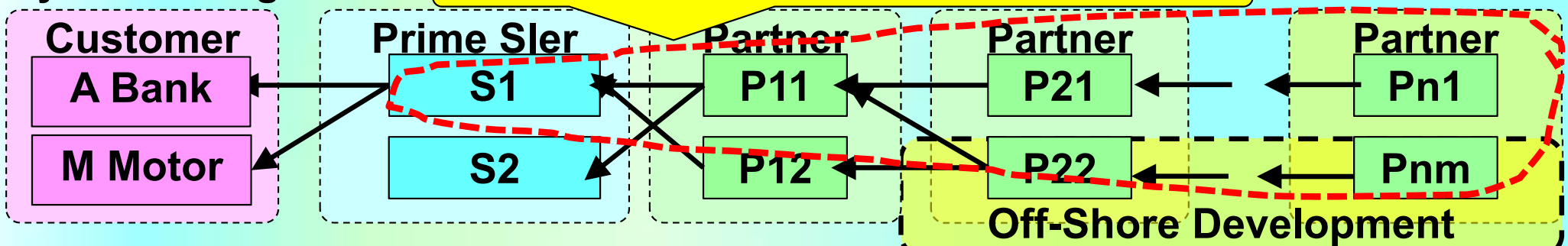
- ➡ **SSC: Collaborative development with multiple organizations**
- ➡ **SSC has been a common practice in Japan**
 - ☝ **Influenced by successful collaborative SCM in automotive**
 - ☝ **Unlike hardware, SSC is dynamic (project basis) and virtual**



Hardware Product Line via Supply Chain
 Learning from Success Supply Chain Model
 (Agility, Productivity and Quality)

SI: Systems Integration

Software Product Line via SSC

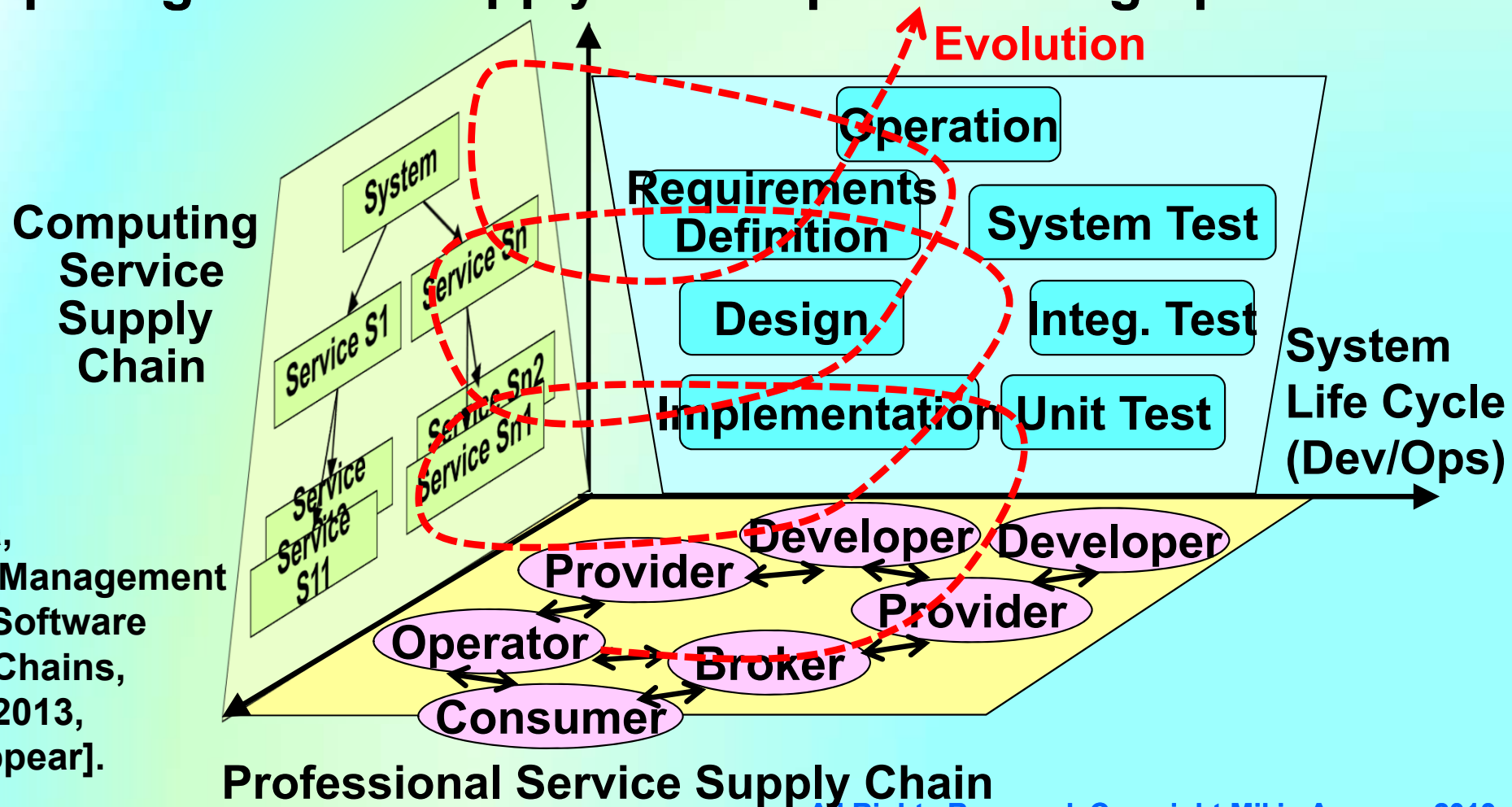


Off-Shore Development

SSC (Software Supply Chain): How?

Complex Supply Chain

- ➔ Fusion of multiple supply chains of Dev/Ops(provisioning)
 - 👉 Professional service supply chain: development
 - 👉 Computing service supply Chain: provisioning/operation

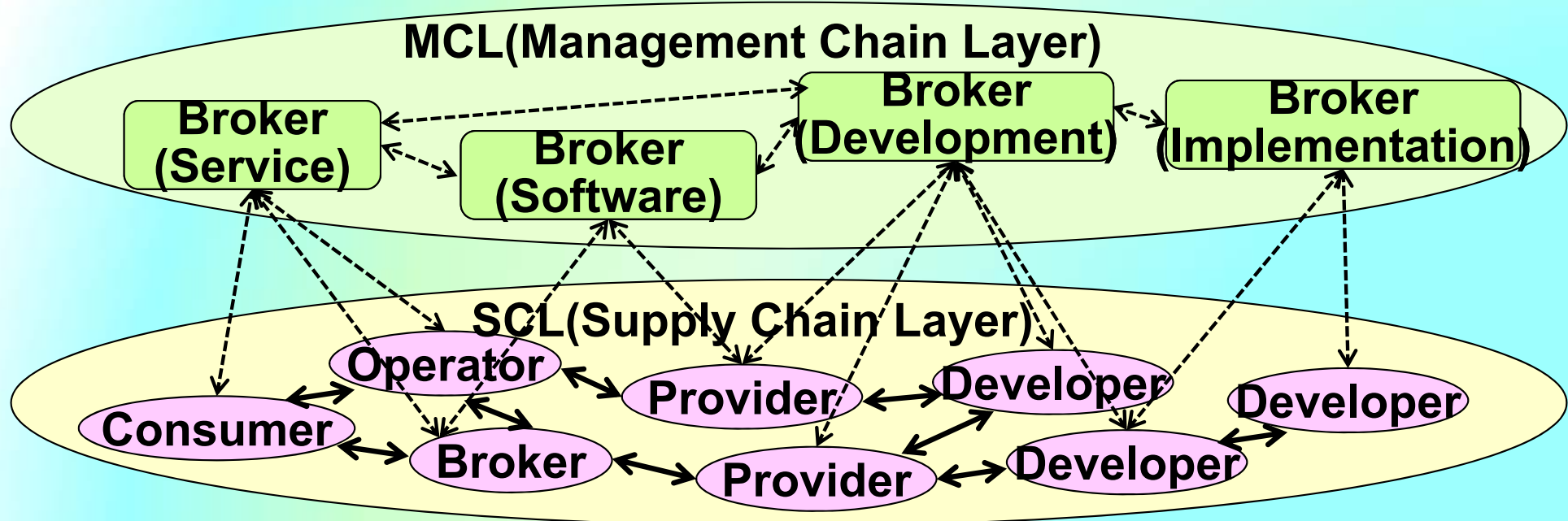


Ref.: M. Aoyama,
 A Model and its Management
 Architecture of Software
 Service Supply Chains,
 Proc. of ICServ 2013,
 Oct. 2013 [To Appear].

SSC (Software Supply Chain): How?

A New Architectural Style for SSC

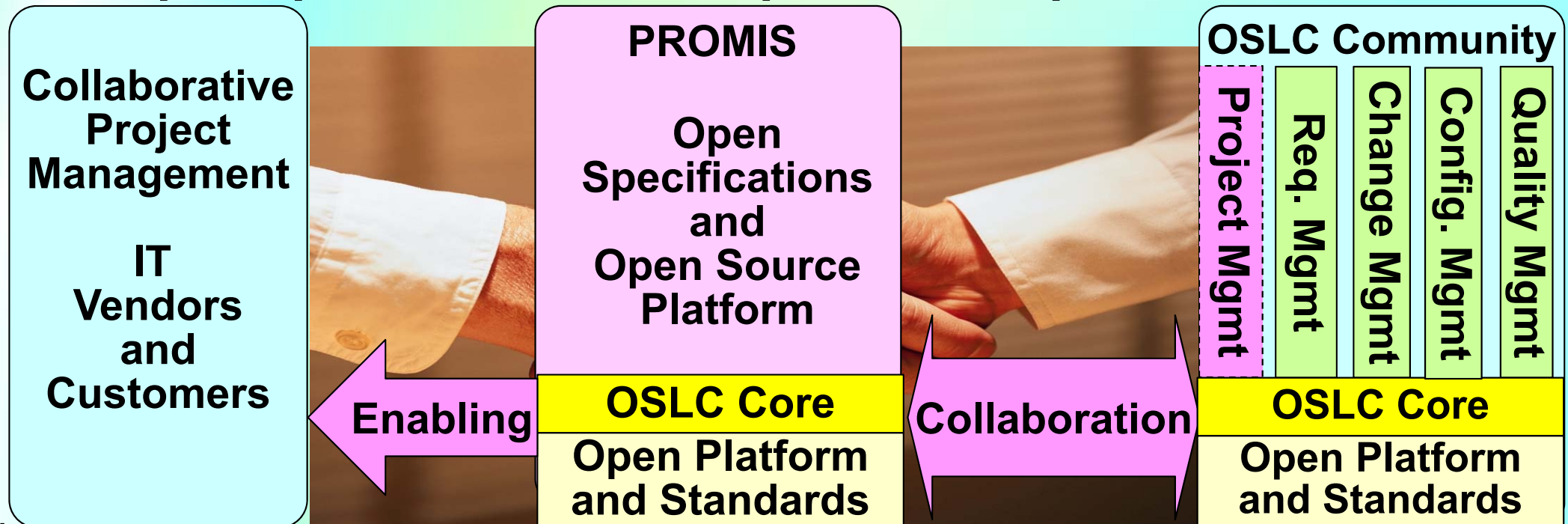
- An architectural style evolved from dynamic re-configuration/
self-adaptive
- Two-layer architecture
 - 👉 Meta-level: supply chain management
 - 👉 Base-level: service provisioning



SSC (Software Supply Chain): How?

PROMIS for Collaborative Management of SSC

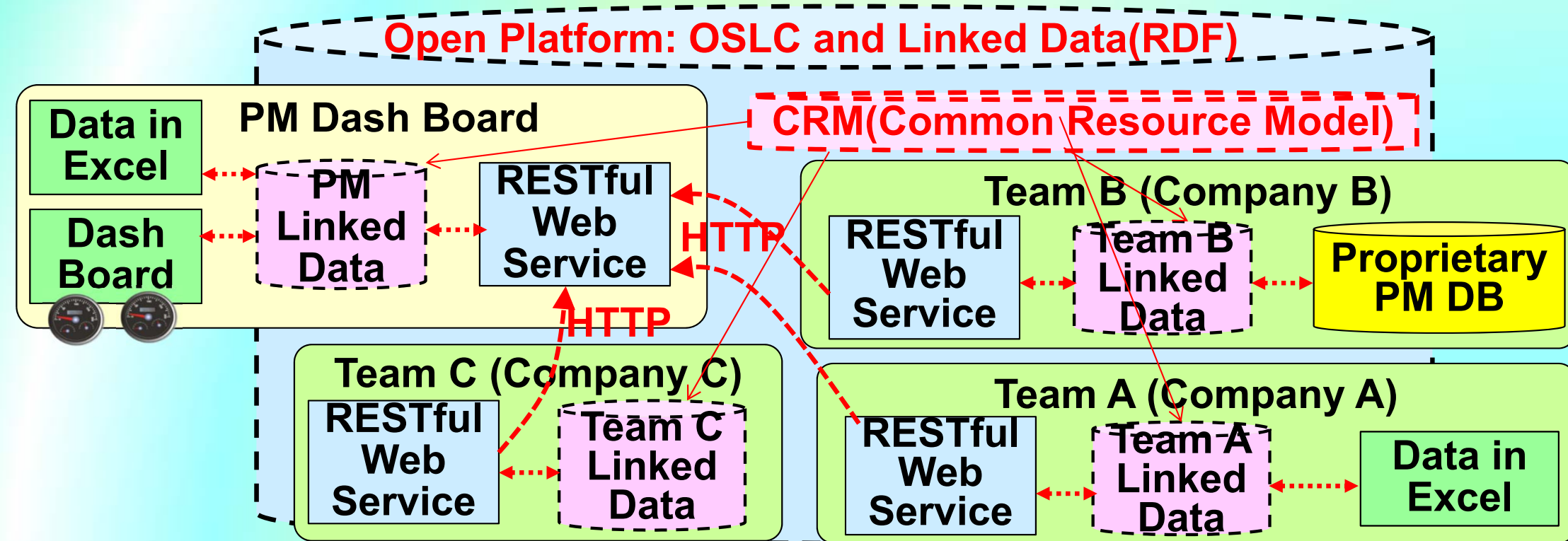
- PROMIS(**PRO**ject **M**anagement **I**nformation exchange **S**ervices)
- PROMIS Consortium: Nanzan University, IBM, Fujitsu, NEC, NTT DATA, Hitachi, NRI(Nomura Research Institute)
- PROMIS provides an open platform on top of OSLC (Open Services for Lifecycle Collaboration) core
 - Open specifications and open source platform



SSC (Software Supply Chain): How?

PROMIS (Project Management Information exchange Services) for Managing SSC

- ➡ PROMIS is a collaboration of
- ➡ Architecture for collaboration management of SSC based on
 - 👉 Common Resource Model for sharing management data
 - 👉 Open platform base on open standards: OSLC, Linked Data and REST



Ref.: M. Aoyama, et al., PROMIS: A Next-Generation Project Management Data Exchange Architecture, Proc. of ProMAC 2012, Oct. 2012, pp. 493-500.

SSC (Software Supply Chain): How?

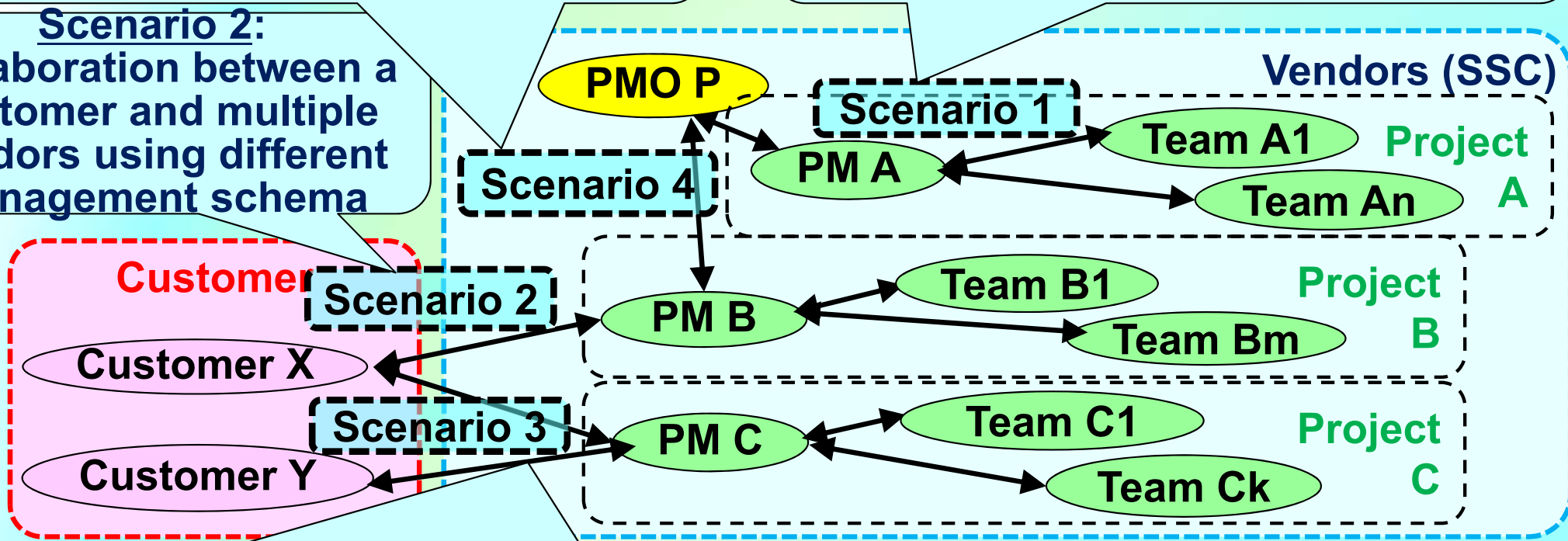
Use Cases and Practical Experiments

- Four supply chain scenarios comprising a SSC
- Conducting experience with each supply chain scenario

Scenario 4: Collaboration between a PMO and multiple projects using different management schema within a corporation

Scenario 1: Collaboration between PM and multiple teams Using different management schema within a project

Scenario 2: Collaboration between a customer and multiple vendors using different management schema



Scenario 3: Collaboration between a vendor and multiple customers (X, Y) using different management schema

Tomorrow of SPL

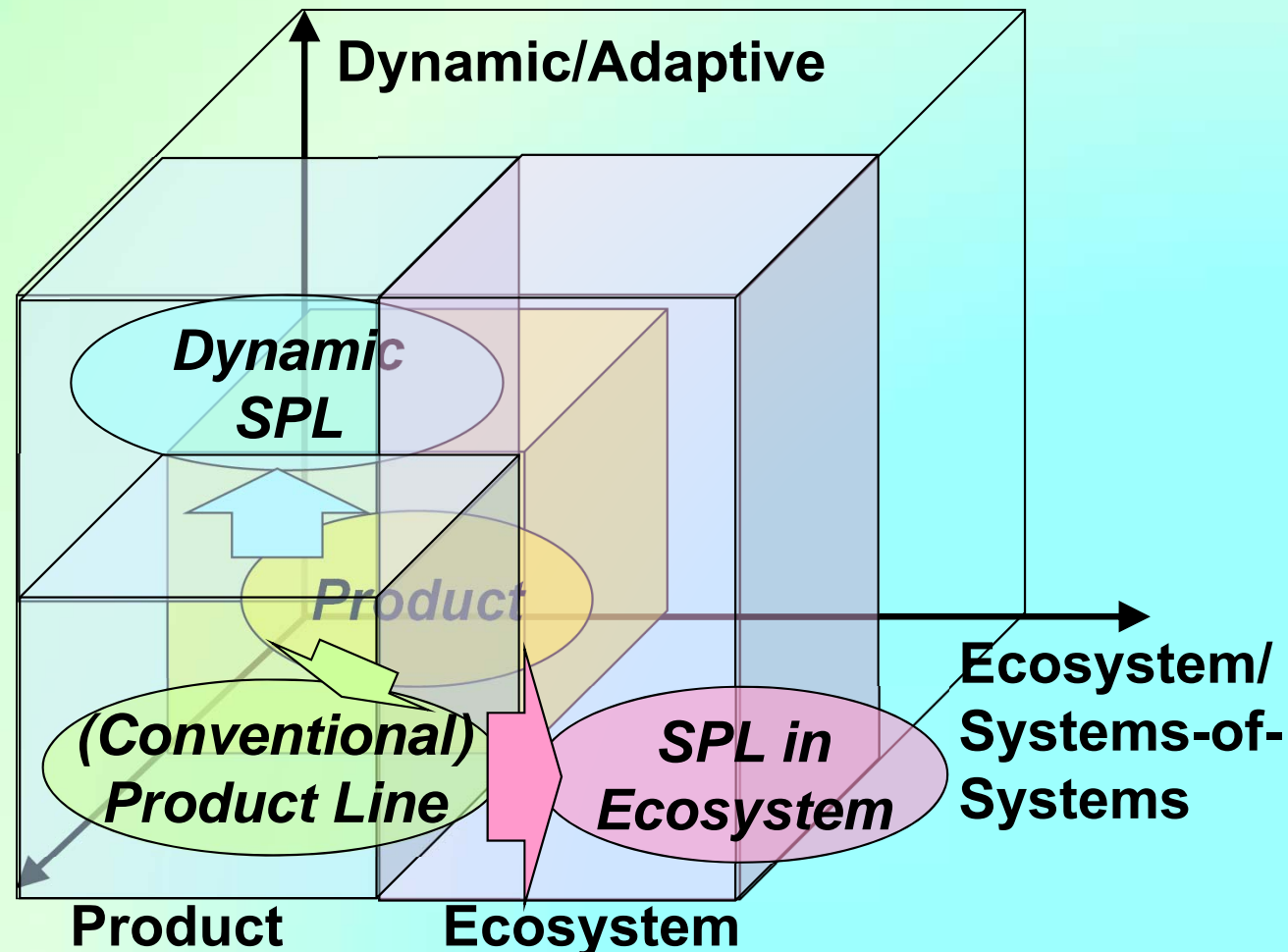
From Product to Dynamic Ecosystems

👉 Ecosystem is a natural evolution of SPL on the connected world

👉 It brings new challenges

- 👉 Feature interaction and design for collaboration
- 👉 Change propagation
- 👉 Self-organization and self-adaptation
- 👉 Co-evolution and co-adaptation
- 👉 Complex system lifecycle

Features for
a Set of
Products



PROMIS Architecture

PROject Management Information exchange Services Architecture

Thank You!

**Mikio Aoyama, Chair
PROMIS Consortium**

Nanzan University, IBM Japan, Ltd.

Fujitsu Limited, NEC Corporation, NTT Data Corporation

Hitachi, Ltd., and Nomura Research Institute, Ltd

