软件架构模型与设计

Software Architectural Model And Design

2015-2016学年第二学期

主讲教师

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Class Time 周二 7-8节，周五 7-8节

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课程教学大纲

Major Topics

- 软件架构概念、主要架构类型、架构设计
- 软件架构模式与风格
- 架构模型要素、建模方法及工具
- 架构描述语言（ADL）
- 架构设计方法
- 模型驱动设计方法（Model-driven Development）
- 新软件架构体系：SOA、云计算、大数据计算

课程教学大纲

Textbook

李代平 等编著，《软件体系结构教程》，清华大学出版社 2008，ISBN 978-7-302-16856-0

Reading materials

Christopher Fox著，韩毅、罗颖译，《软件工程设计导论---过程、原理与模式（UML2.0版）》

Steven J. Metsker, William C. Wake著，《Java设计模式（第2版）（英文版）》，人民邮电出版社 2007

Project Assignment

另见课程作业 (project) 任务书。

Grading Policy

Project	40%
Final Exam	60%
Grade	100%

Course Strategy

- Not a programming course
- Assume you have basic knowledge in objected-oriented design and programming
- Hands-on design/development experience
- Open for discussion and communication
- Use but not read line-by-line of textbook

Lecture 1 Introduction

- Large-scale Software System
- Software Architectural Model
- Architectural Modeling Language
- New Trends in Software Development

软件架构模型简介

Large-scale Software Systems

- number of lines of code (> million)
- number of people involved (> 100)
- amount of data stored, processed and manipulated
- number of hardware components
- heterogeneous platforms
- distributed (decentralized) environment

软件架构模型简介

Mission-critical Requirements

- Consequence of failure is unacceptable
- Timeliness is critical (real-time, responsiveness)
- High availability (7 x 24 operation time)

Key Aspects of Large-scale Software Systems

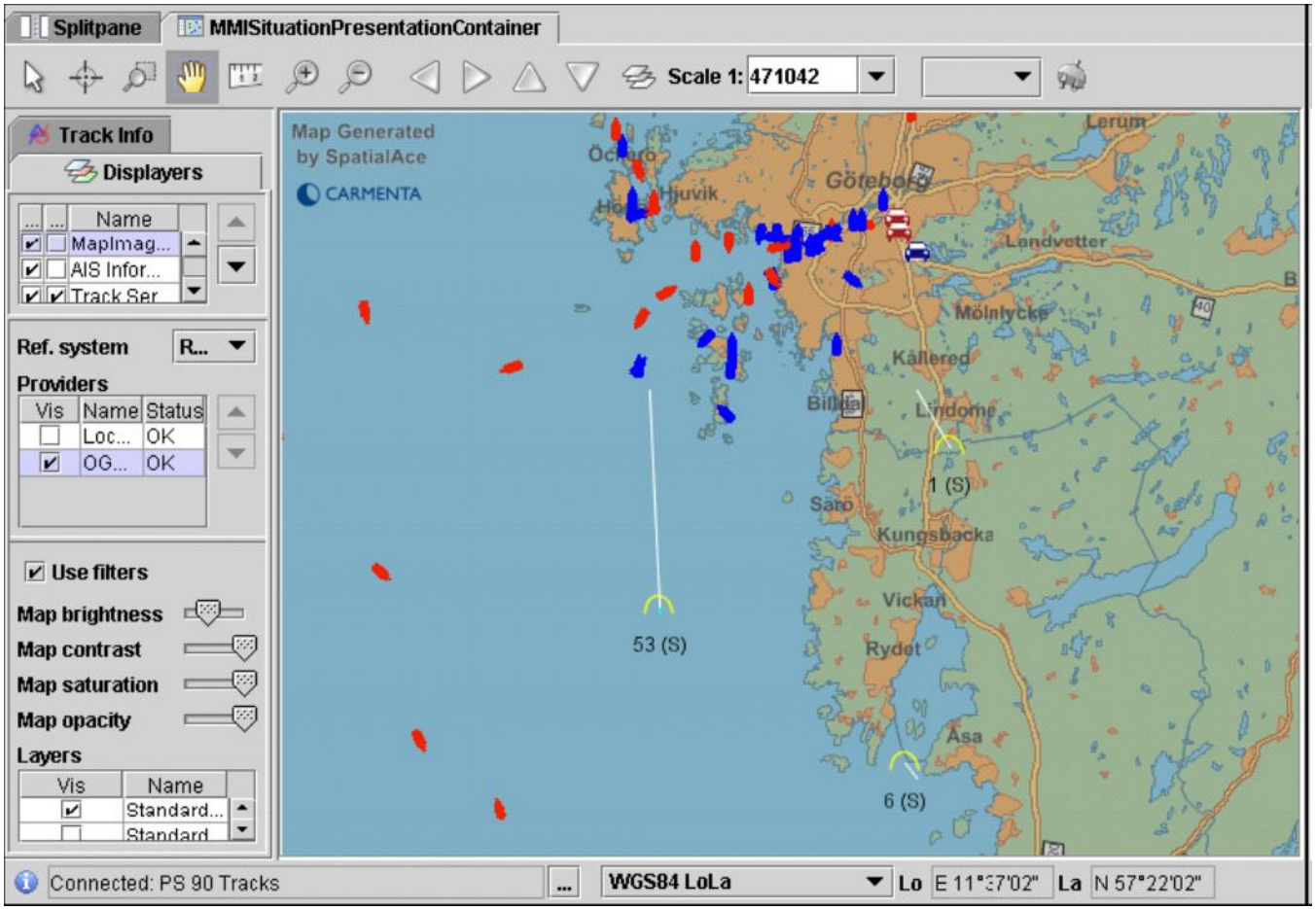
- Decentralization/Decomposition
- Importability
- Scalability
- Manageability
- Security
- Sustaining Engineering/Evolution

Application Domain

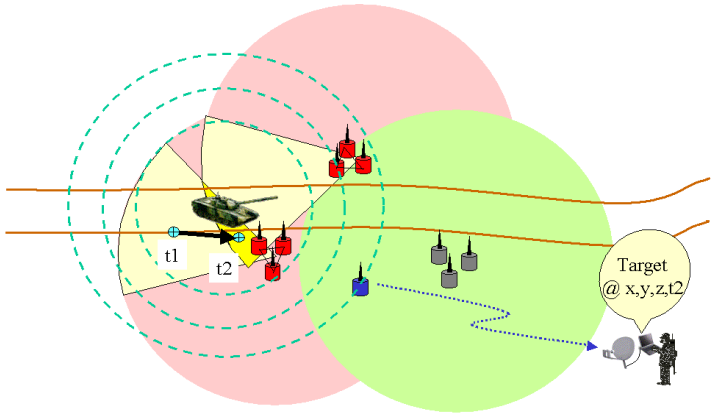
- Aerospace control/command system
- Satellite data processing system
- Global climate/environment modeling and monitoring system
- Complex combat applications
- Large-scale financial processing system
- Extremely high load web portals (such as Google's distributed search engine)

软件架构模型简介

SensorNet Based Battlefield Surveillance System

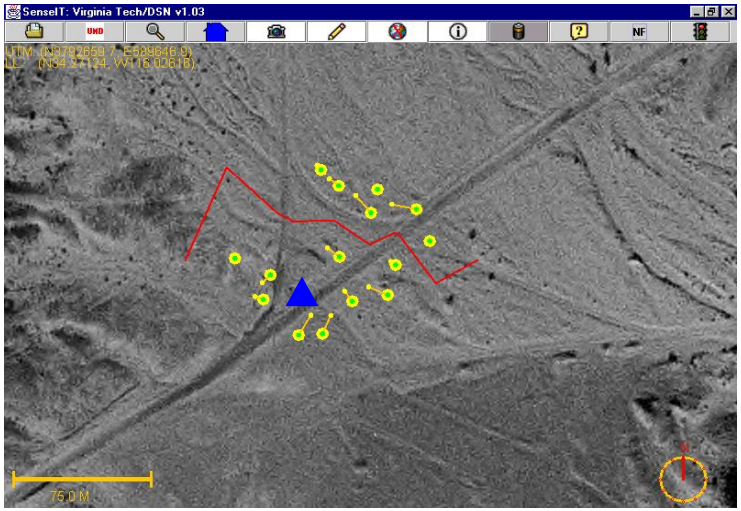


软件架构模型简介

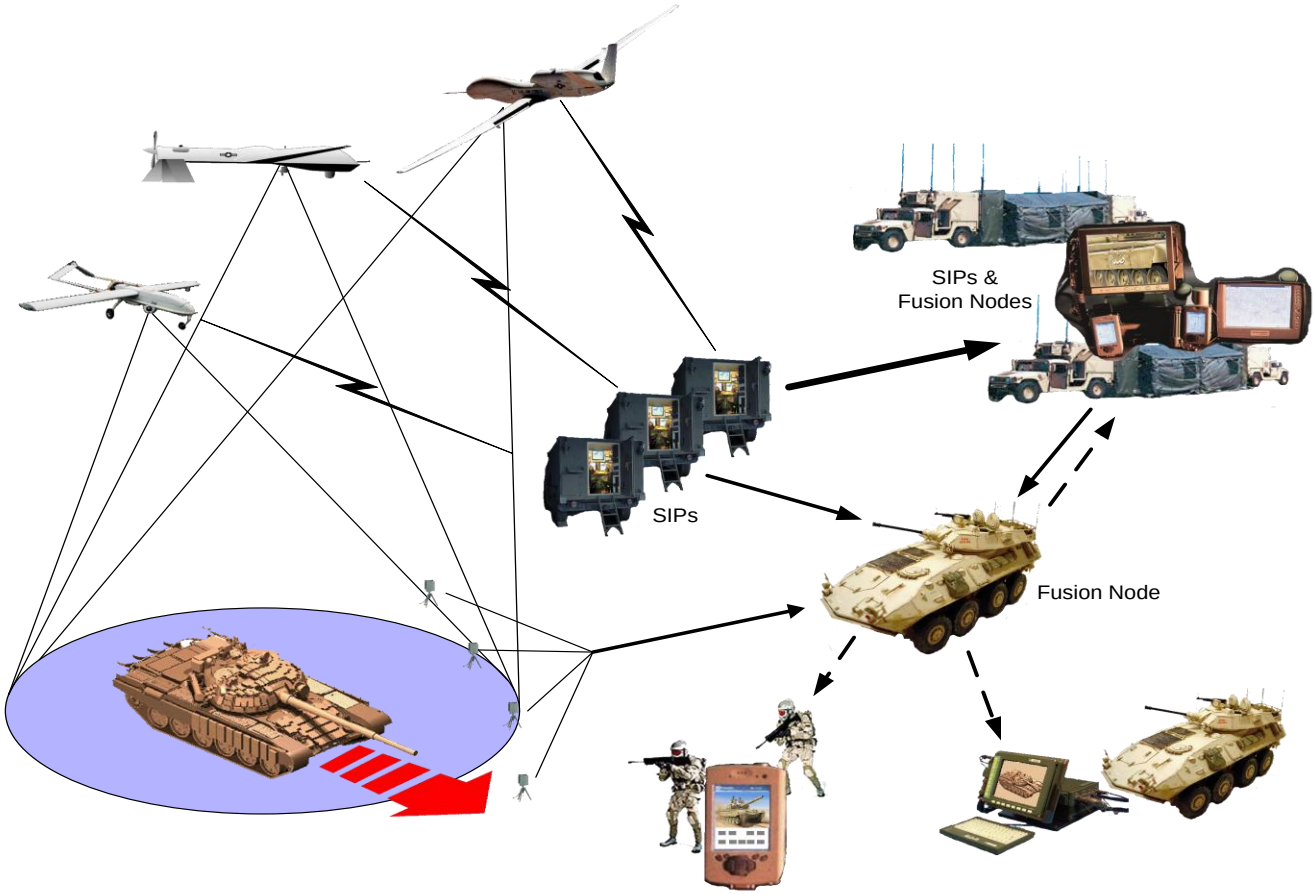


At Base Camp:

- GUI display on laptop of node locations, tracks, and live GPS ground truth (over 802.11 LAN).
- Live video feed on wireless IPAQ PDA (from sender laptop in field).

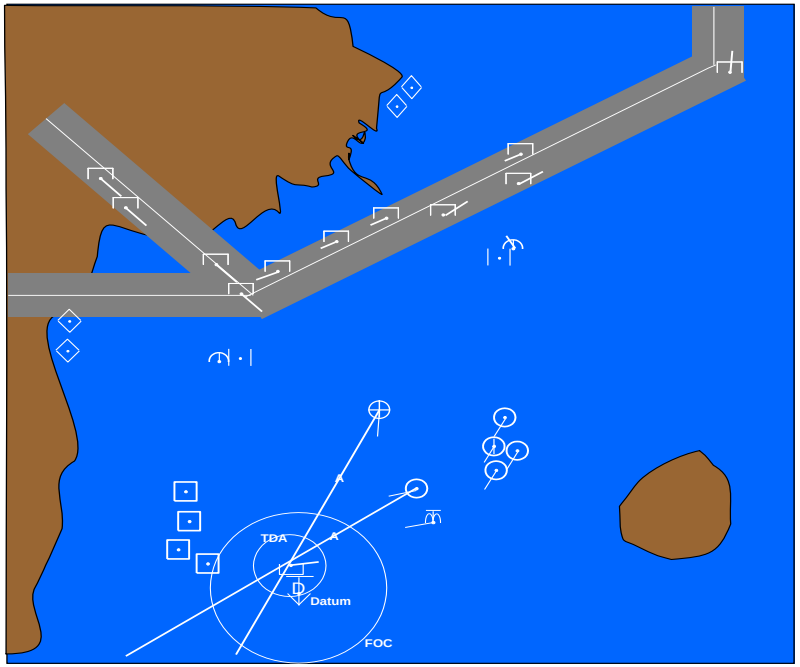


Precision Strike: Sensor-to-Shooter Approach



软件架构模型简介

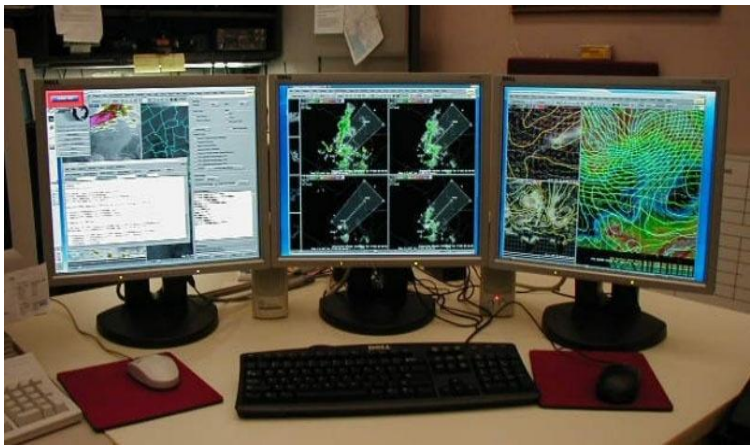
Aegis Q-70 Tactical Display Console

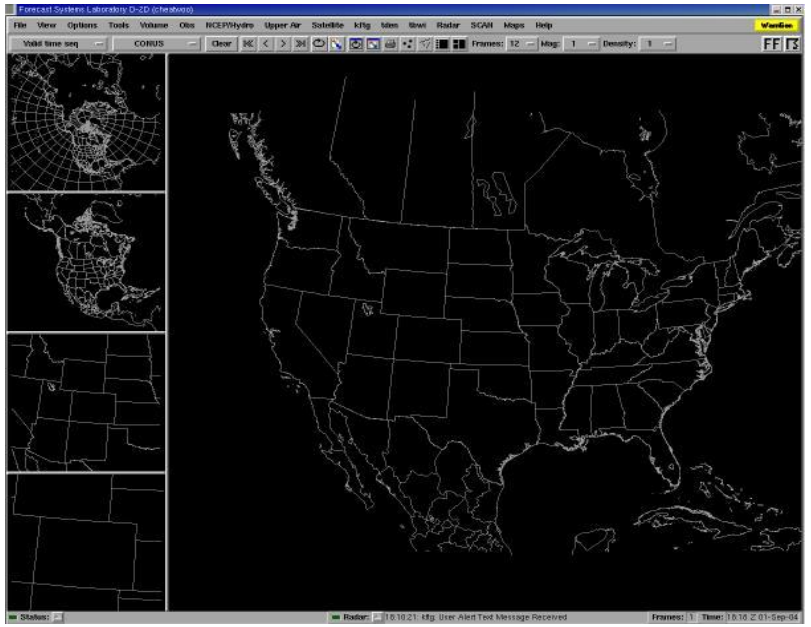


软件架构模型简介

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

AWIPS (Advanced Weather Interactive Processing System)





软件架构模型简介

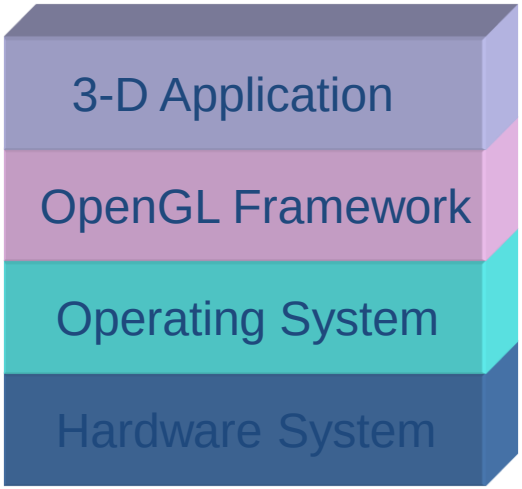
Disaster/Incident Situational Display

软件架构模型简介

Software

A set of instructions, data structures, subroutines, and documents that operate and control the machines (hardware) it is running on.

Software Layers



Application Software (word processor, database app.)

Middleware (API, framework, SDK, environment)

System Software (O/S, device driver, firmware, etc.)

Hardware Layer (system, architecture, processor)

软件架构模型简介

Software Engineering

A systematic approach to the development, operation and maintenance of software.

Software Model

A conceptual description and abstraction of software structures, components, interface and functions.

- Architectural Model (design)
- Development Model (methodology)

Software Architecture

IEEE610.12-1990软件工业标准词定义：

Architecture={构件，连接件，环境，原理}

软件体系结构是以构件、构件之间的关系、构件与环境之间的关系为内容的某一系统的基本组织结构，以及指导上述内容设计与演化的原理。

David Garlan和Dewne Perry(1995)在IEEE软件工程学报中定义：

软件体系结构描述一个程序/系统各构件的结构、它们之间的相互关系以及进行设计的原则和随时间演化的指导方针

Software Architecture

A high level abstraction and description to the structure and organization of software system, also a blueprint for software development and evolution.

Software Architectural Model

An expression of the viewpoint of software architecture, which is a rich, rigorous, and structural description on the software system's elements, functions and interface.

Software Architecture（cont'd）

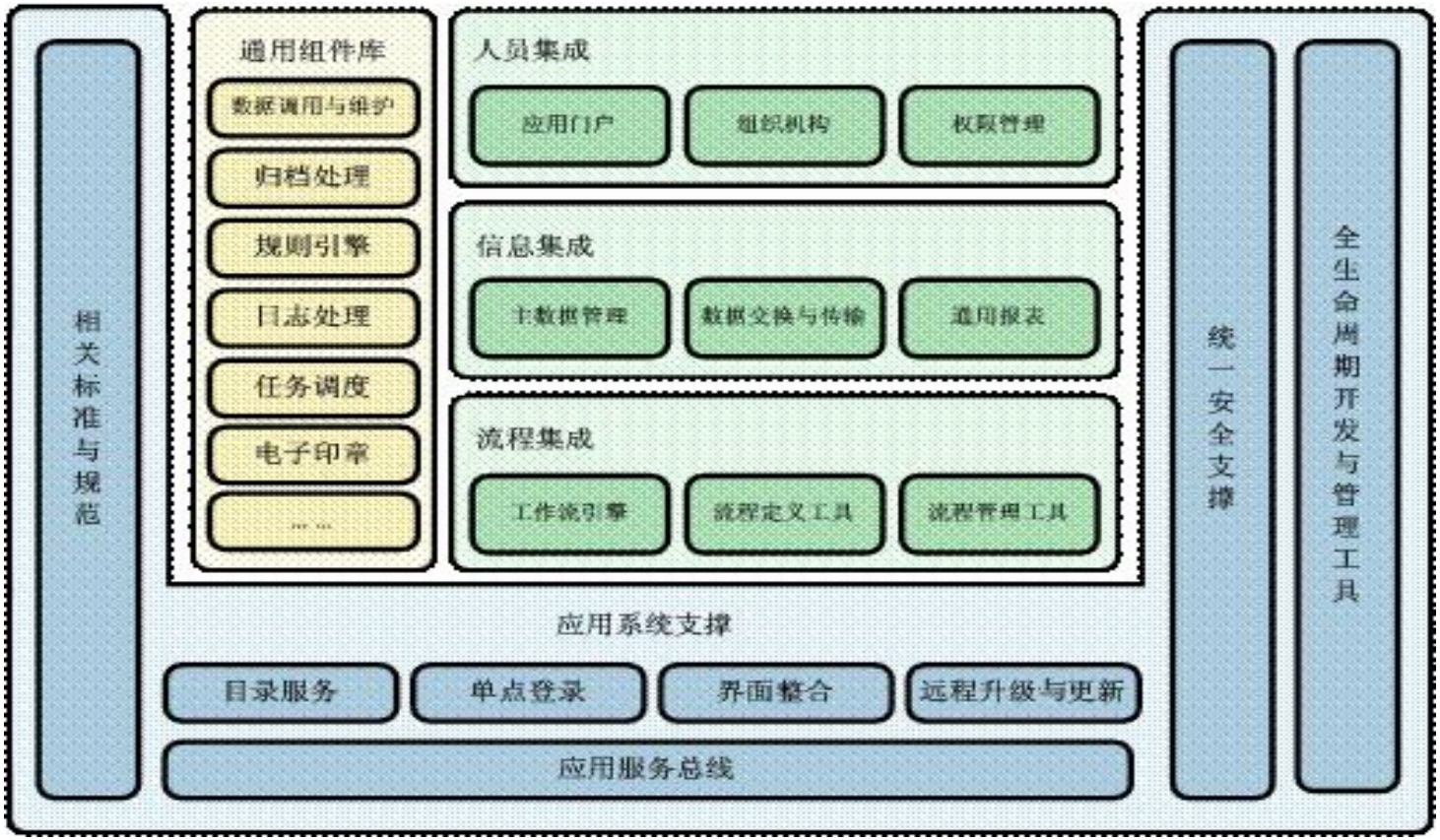
Bass，Clements，Kazman(1997)在《Software Architecture in Practice》书中的定义：

一个程序或计算机系统的软件体系结构包括一个或多个结构，包括软件构件、构件外部可视特性及其相互关系；

软件外部可视特性是指软件构件提供的服务、性能、特性、错误处理、共享资源使用等

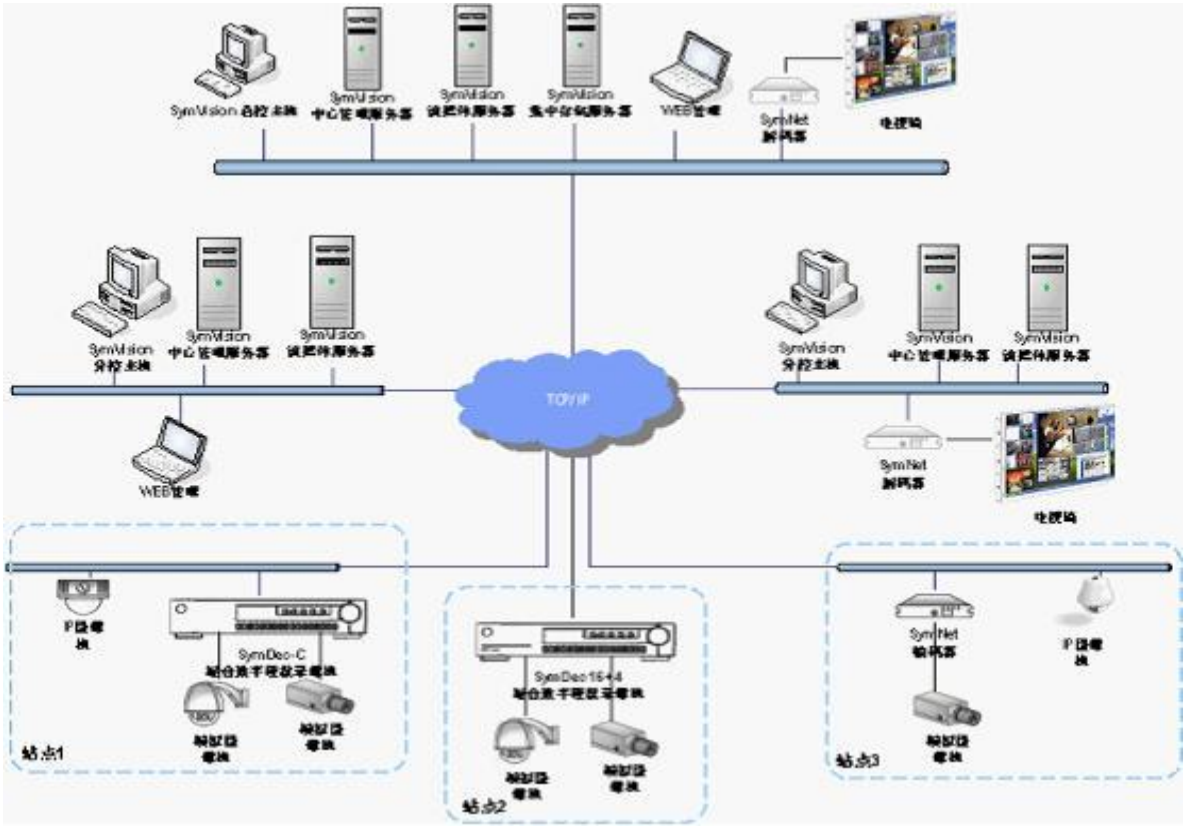
Logic Architecture（Functional Architecture）

Description of logic/functional relationship among the software components, such as the UI, database, external system, business unit, etc.



Physical Architecture（System Architecture）

The mapping of software units to hardware nodes to describe the deployment of software systems in execution environment.



Technological Architecture

Description of SDK, development technology, technological standards related to the design of software systems.

Software Architectural Model

- A logic abstraction of real design tasks, in which the key attributes of software architecture are presented without too much unrelated details
- Software architecture modeling is the methodology and process of establishing such a logic abstraction of software systems.
- SAM presents a systematic structure of software framework and architecture
- SAM helps s/w designers to understand and master the overall structure of the s/w systems.

Software Architectural Model (cont'd)

- Structural Model： describes the system architecture based on the concepts of component, connector as well as their logic relationship.
- Framework Model： similar to Structural Model, but focuses more on the overall architecture of software systems, without addressing the details.
- Dynamic Model： a supplemental description to the behavior of software units or subsystems, during the process of re-deployment or scenario changing.

Software Architectural Model (cont'd)

- Process Model： describes the way of system building and step, normally can be presented in a scripts file.
- Functional Model： describes the s/w system as a group of functional components, in which they are presented in a layered structure with the lower layer components providing functions/services to the upper layer ones.

  Can be considered as a special type of Structural Model.

软件架构模型简介

Architectural Model Classification

- structural model
- Use Case model
- component model
- class model
- communication/interaction model
- deployment model

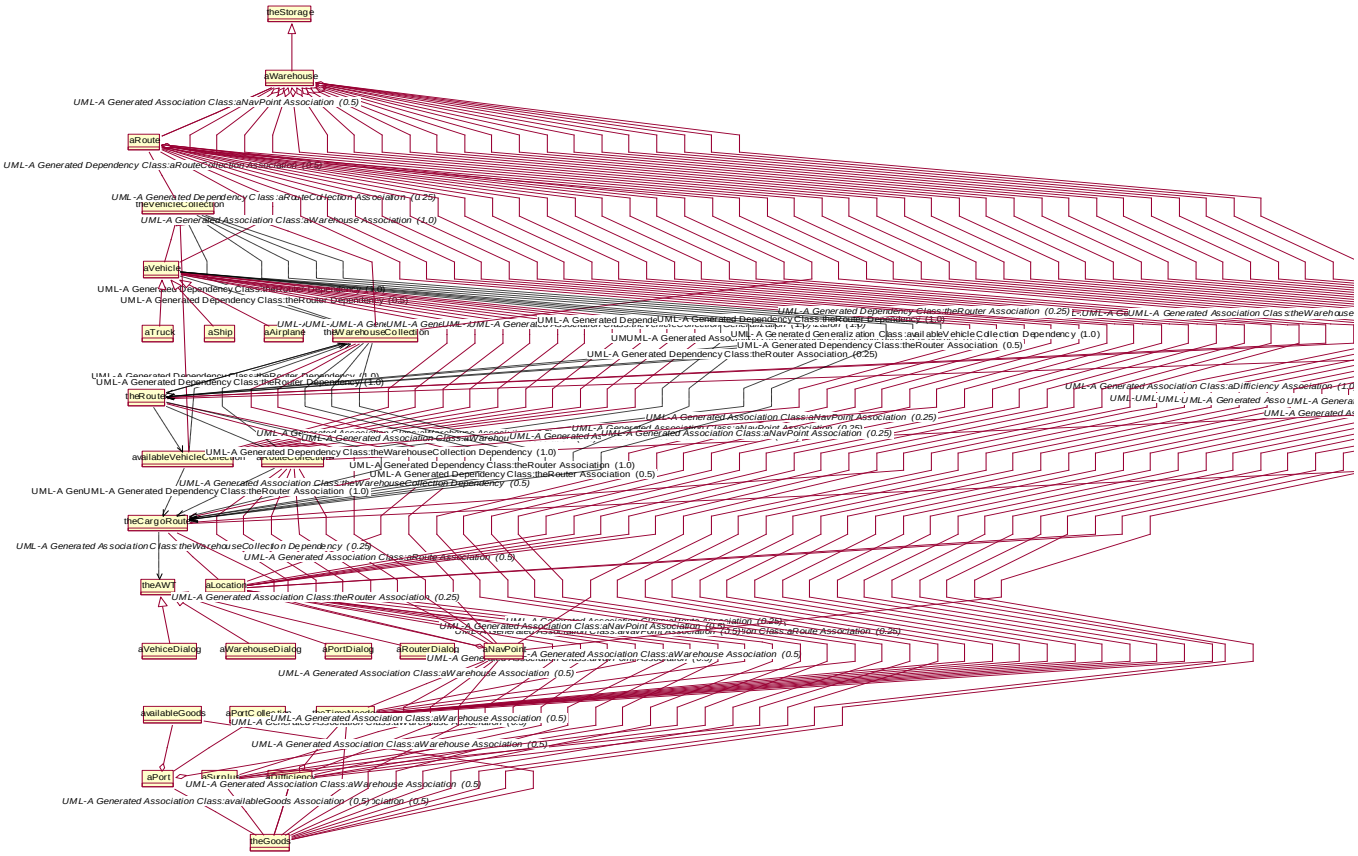
软件架构模型简介

Major Architectural Patterns

- Client-Server
- MVC (Model-View-Control)
- PAC (Presentation-Abstraction-Control)
- Pipe and Filter
- Remote Procedure Call (RPC)
- Layered
- Distributed
- Object-Oriented Architecture
- Service-Oriented Architecture
- Multi-tier Architecture

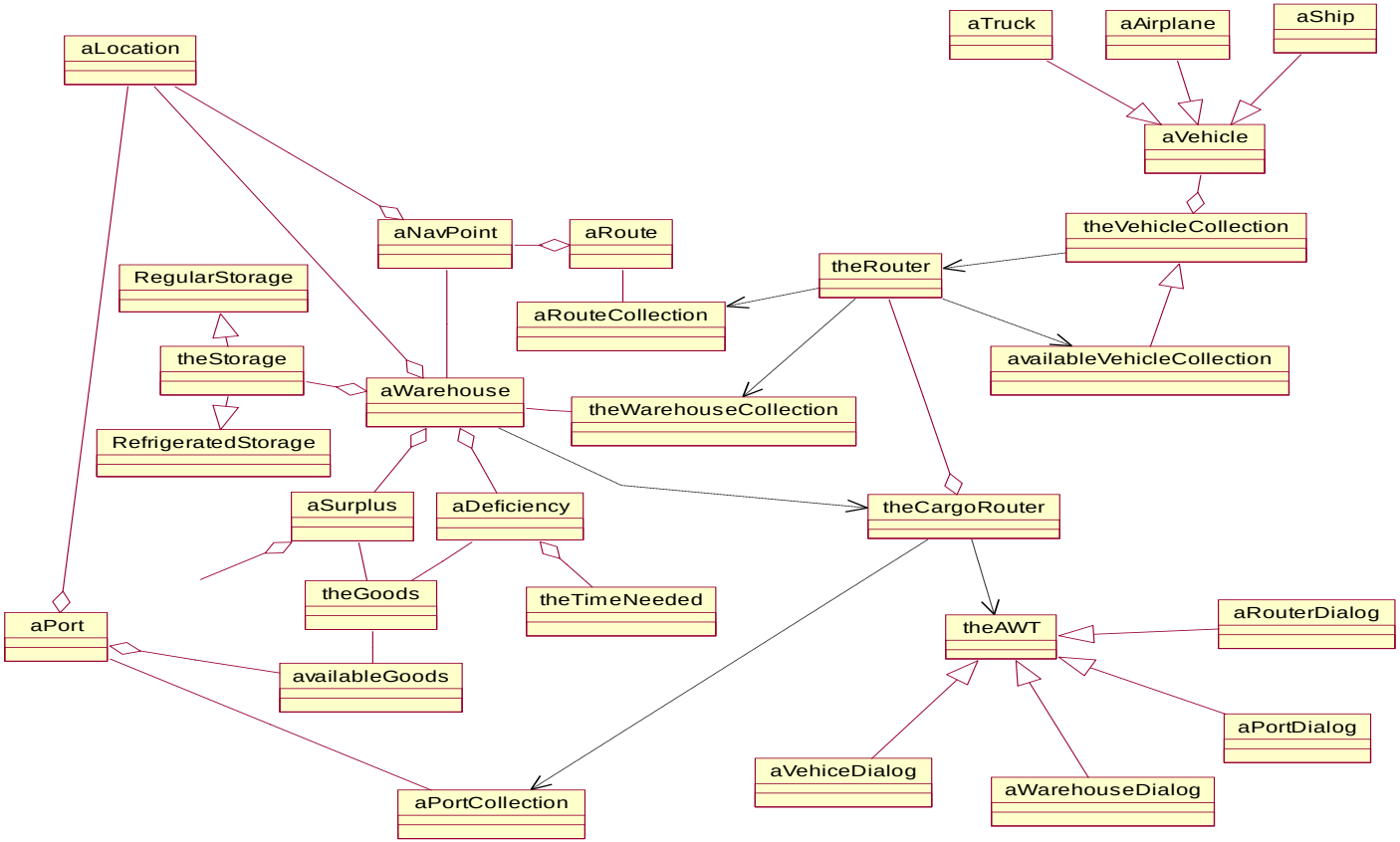
软件架构模型简介

Class Model - what a mess!



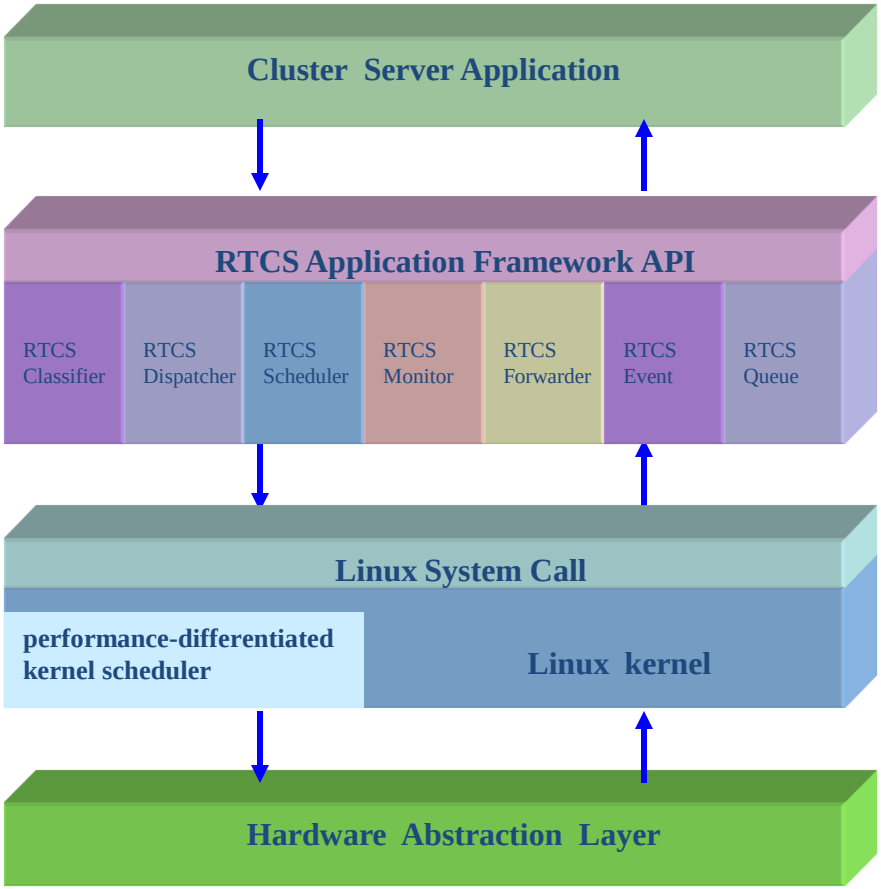
软件架构模型简介

Class Model – is it better?



软件架构模型简介

Layered Model – much better



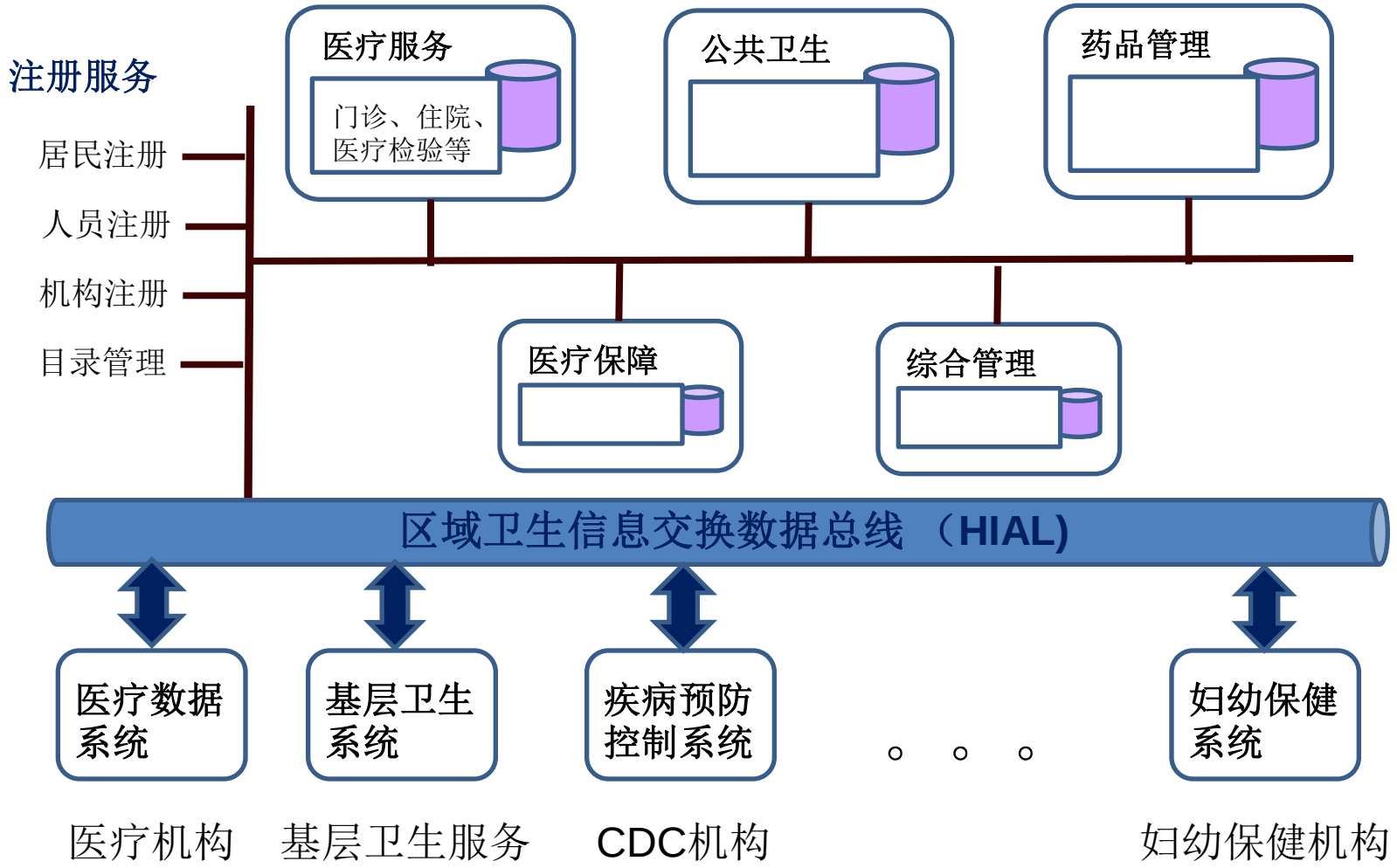
Application Layer

Middleware Layer

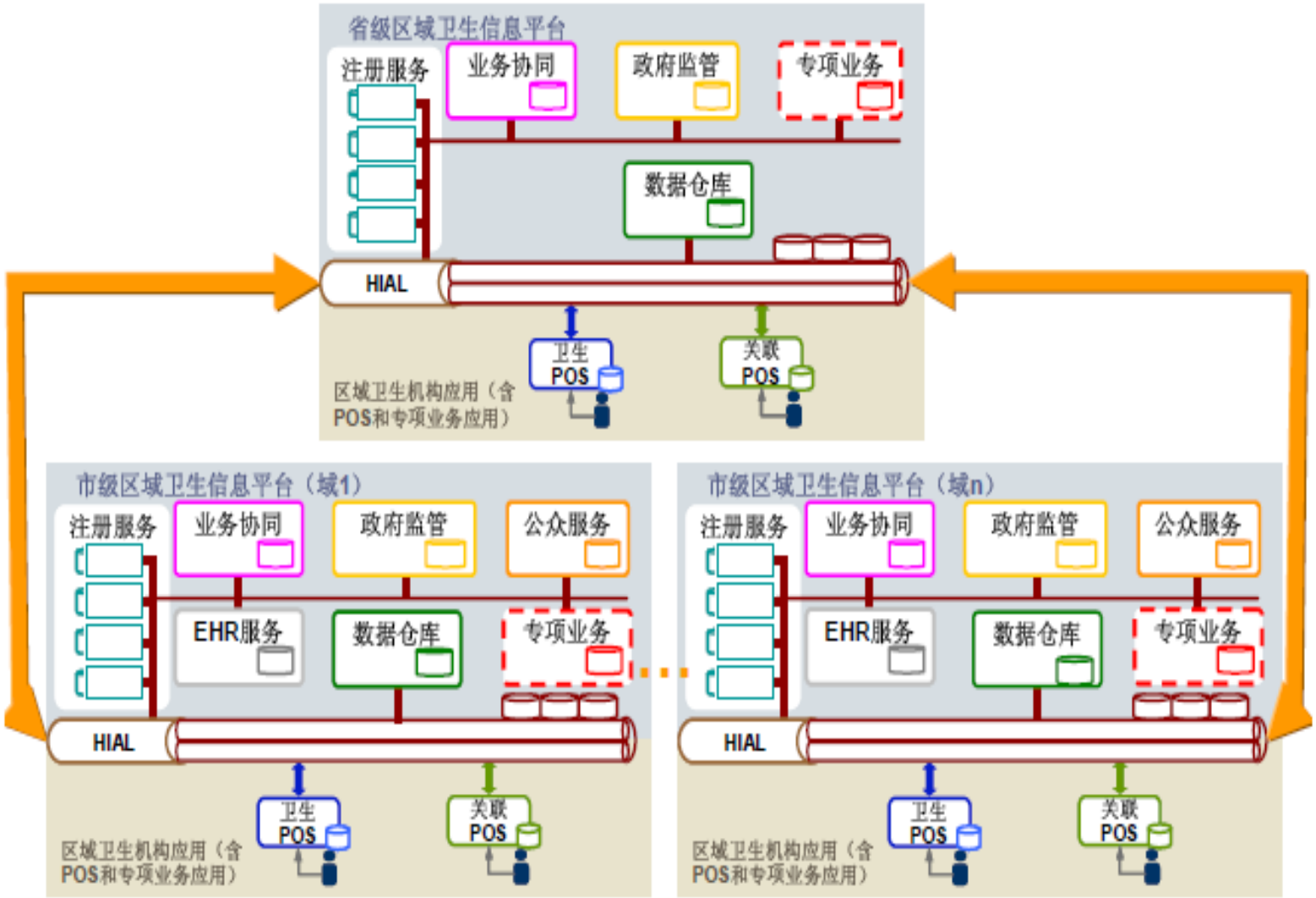
O/S Kernel Layer

Hardware Layer

软件架构模型简介


注册服务
居民注册
人员注册
机构注册
目录管理
医疗服务
门诊、住院、
医疗检验等
公共卫生
药品管理
医疗保障
综合管理
区域卫生信息交换数据总线 （HIAL)
医疗数据
系统
基层卫生
系统
疾病预防
控制系统
。 。 。
妇幼保健
系统
医疗机构
基层卫生服务
CDC机构
妇幼保健机构

软件架构模型简介


省级区域卫生信息平台
注册服务
业务协同
政府监管
专项业务
数据仓库
HIAL
卫生 POS
关联 POS
区域卫生机构应用（含POS和专项业务应用）
市级区域卫生信息平台（域1）
注册服务
业务协同
政府监管
公众服务
EHR服务
数据仓库
专项业务
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关联 POS
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软件架构模型简介

New Trends in Large-scale Mission-critical Software System Development

- Distributed environment
  - RMI, CORBA, .Net architecture
  - multiprocessing/multithreading
  - Synchronous vs. asynchronous
- Middleware approach
  - cross-platform, importability
  - application framework

New Trends (cont'd)

- Open Architecture and Open Standard
  - COTS products (processors, networks)
  - open Standard (POSIX, XML, etc.)
  - open source software (Linux, GNU, etc.)
- System Scalability
  - hardware expandability
  - software scalability

软件架构模型简介

New Trends (cont'd)

- Model-driven Architecture (MDA)
- Middleware Approach
- SOA (Service-Oriented Architecture)
- Cloud Computing Architecture
- Mobile Application Architecture
- Big Data Computing Architecture

End of Lecture