

2011年 中国**嵌入式**暨物联网教育发展高峰论坛

物联网环境下智能机器人 技术及其应用

北京航空航天大学 机械工程及自动化学院
中国电子学会嵌入式系统专家委员会

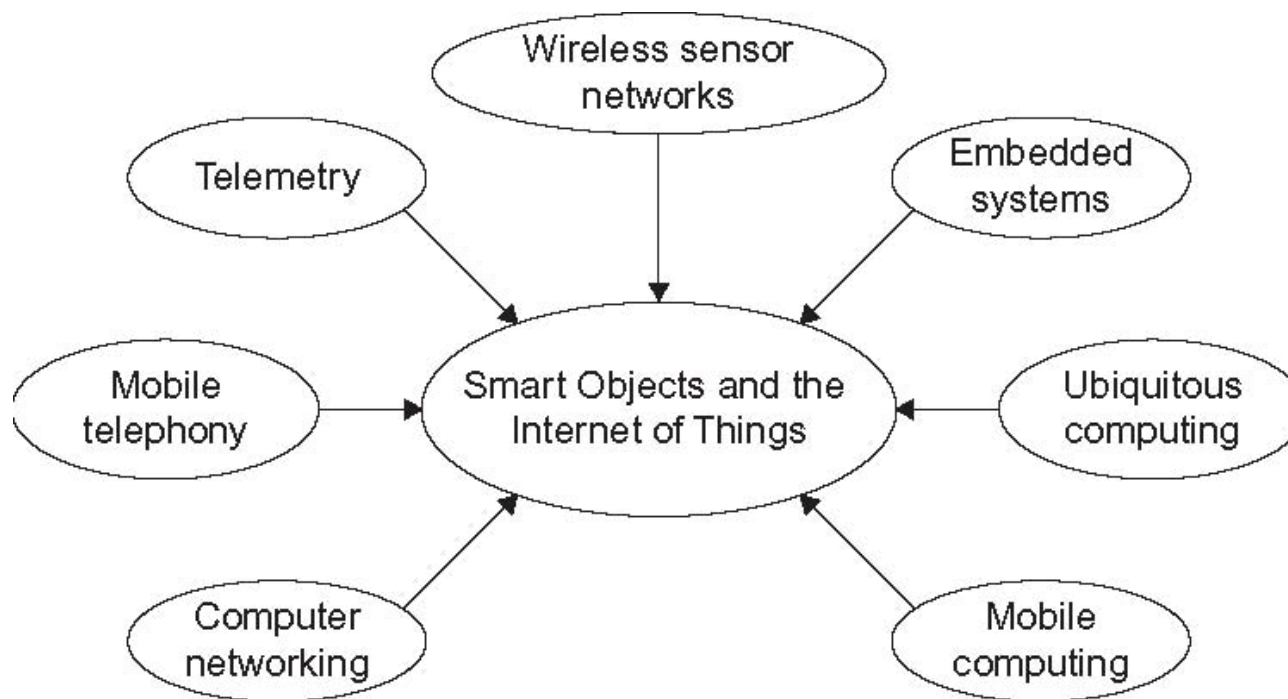
魏洪兴
2011年7月





- 1 物联网与IPv6
- 2 物联网体系的机器人平台技术
- 3 应用案例

- 物联网是把大量的智能对象（Smart Object）通过私有网络或Internet连接起来构成各种应用，包括智能标签（RFID），智能传感器，智能驱动器及任何上述组合构成的其它对象。



An endless number of applications



Healthcare



Defense

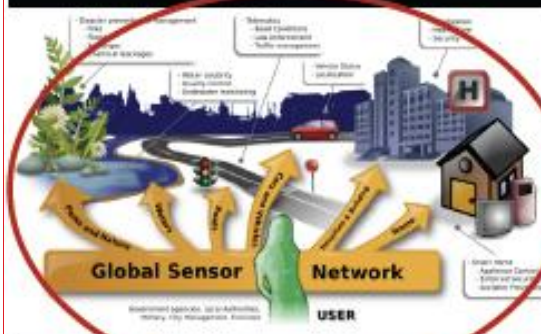


Predictive maintenance

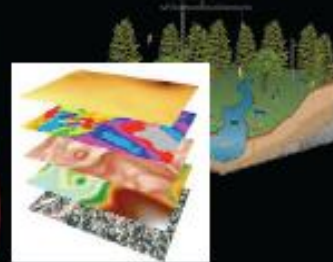
Energy Saving (I2E)



Improve Productivity



Smart Cities



New Knowledge



Intelligent Building



Agricultural



High-Confidence Transport and assets tracking



Industrial Automation



Smart Grid



Smart Home

- 存在大量的不开放或半开放的无线网络协议：Zigbee, Z-Wave, Xmesh, SmartMesh/TSMP等。… 在不同的协议层(physical, MAC, L3)大多数芯片供应商只与自己的标准兼容；
- 很多缺乏互操作性的解决方案存在很多问题：
 - 不同的体系结构
 - 不同的协议栈



- 开放的标准: The Internet Engineering Task Force
- 应用灵活性:
 - 支持各种接入方式: FR, ATM, Ethernet, Wireless, Optical ...
 - 从移动设备到高速路由器
- Always favor global than local optimum:
- “IP is good enough for everything: from email to video to real time protocols”
- 安全性已得到验证
- 十亿以上的IP联网设备

- IP for Smart Objects Alliance (IPSO)
 - 促进全球智能物体的联网技术；
 - IP可以直接实现传感器与其它简单网络访问连接到的通道 Internet，不需要网络协议转换；
 - 由于使用了轻量级的IP协议，可以有效地降低对处理器速度与内在的要求（如4 Kbytes RAM and 32 Kbytes）；
 - 基于IP的无线传感网络技术，如[6LoWPAN](#)（the Internet Engineering Task Force standard for running IPv6 over IEEE 802.15.4 nets）
 - 低能耗自动路由技术（被 Internet Engineering Task Force ）
 - IPv6 可以基于IEEE 802.15.4 网络实现高可靠的自动路由，同时保证较低的功耗。

IPSO IP for Smart Object alliance



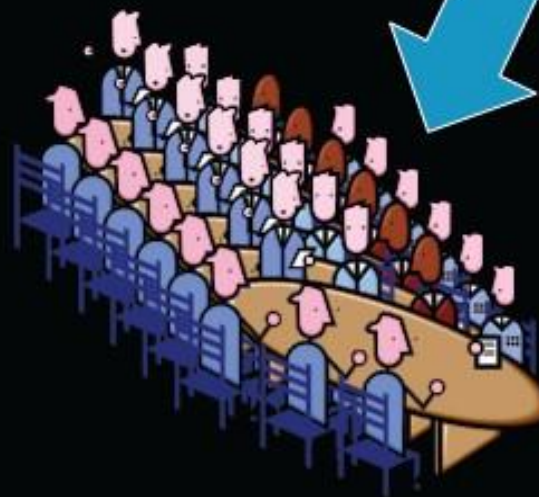
September 2008: Alliance launch
27 founding companies



May 2009: 50 members



April 2008: 3 persons
Patrick, JP and Roland



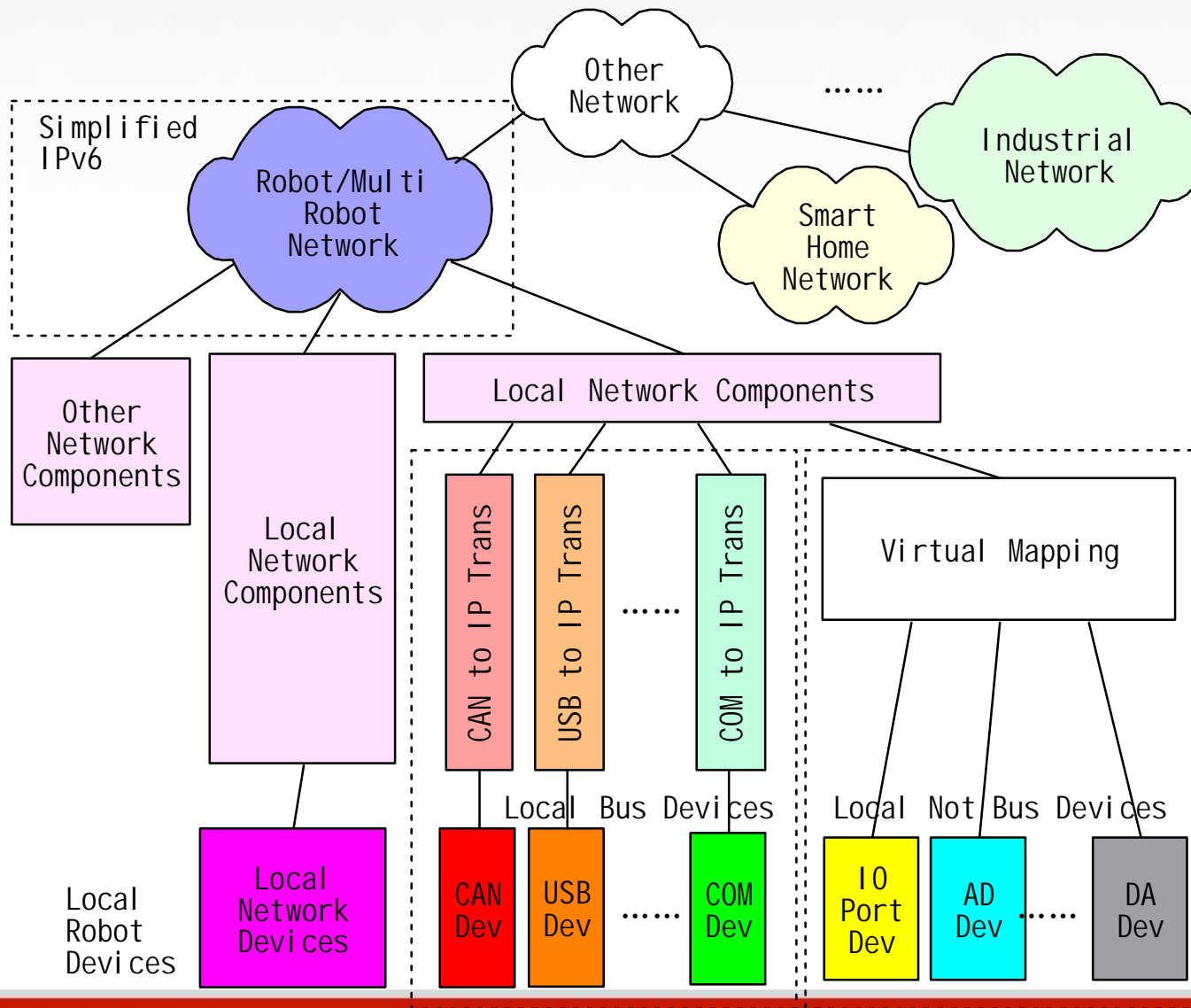
- | | |
|----------------------|----------------------------------|
| Arch Rock | SAP |
| Atmel | Sensinode |
| Bosch | SICS |
| Cisco | Sun Microsystems |
| Duke Energy | Tridium |
| Dust Networks | Watteco |
| EDF | Zensys |
| ECE | Centria |
| Eka Systems | Clometrics |
| Ericsson | ELIKO |
| Freescale | Emerson Climate Technologies |
| Galnspan | IAR Systems |
| Jennic | IP Infusion - An ACCESS Company |
| Johnson Control | Kitworks |
| Intel | Landis & Gyr (Cellnet) |
| INRIA | Lulea University of Technology |
| Kinney Consulting | Mocana |
| National Instruments | ROAM / Acuity |
| Nivis | SilverSpring Networks |
| PicosNet | SmartSynch |
| Primex Wireless | Tampere University of Technology |
| Proto6, LLC | Texas Instruments |
| | TZ |



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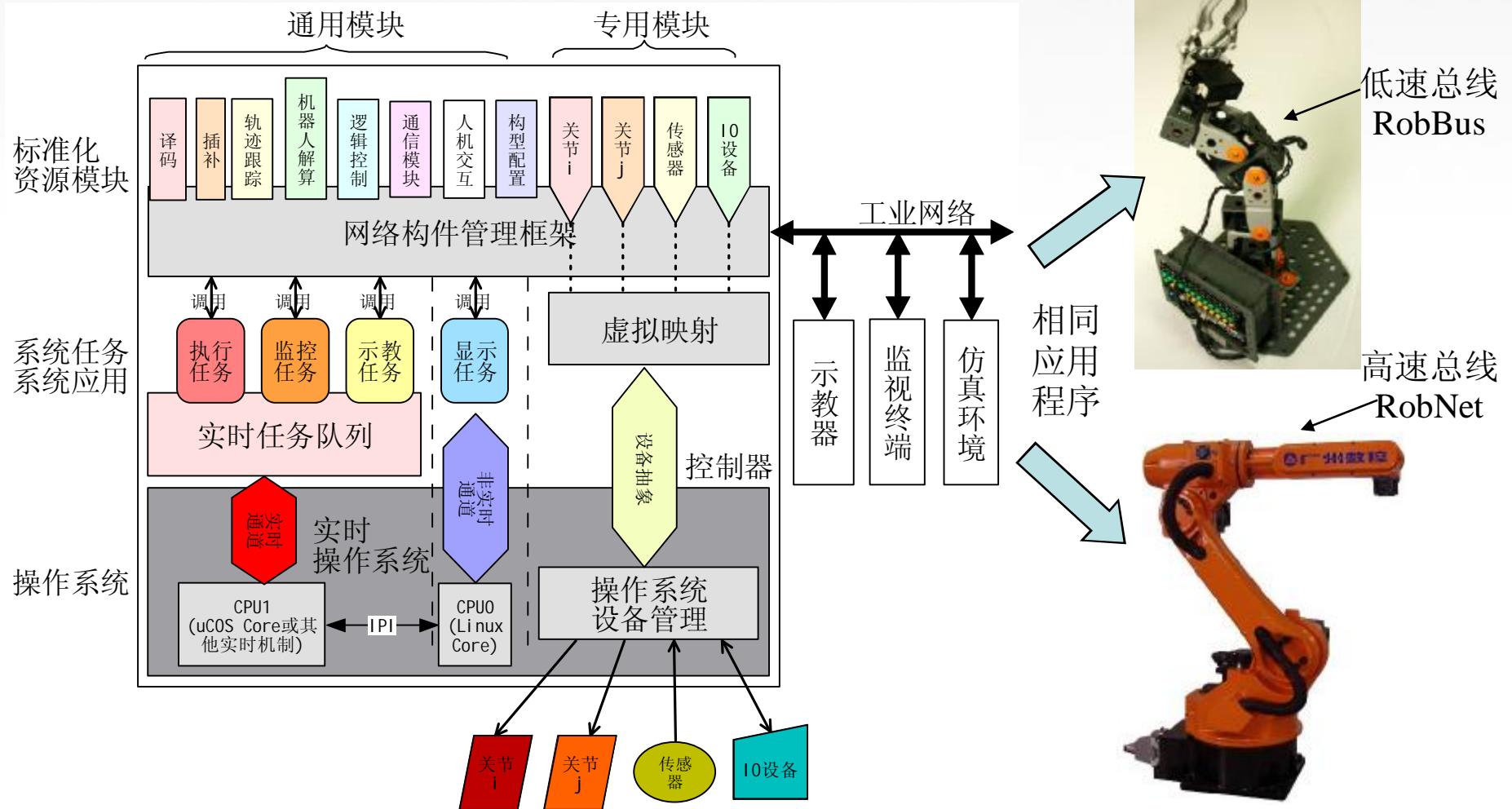
基于IP的机器人物联网体系结构

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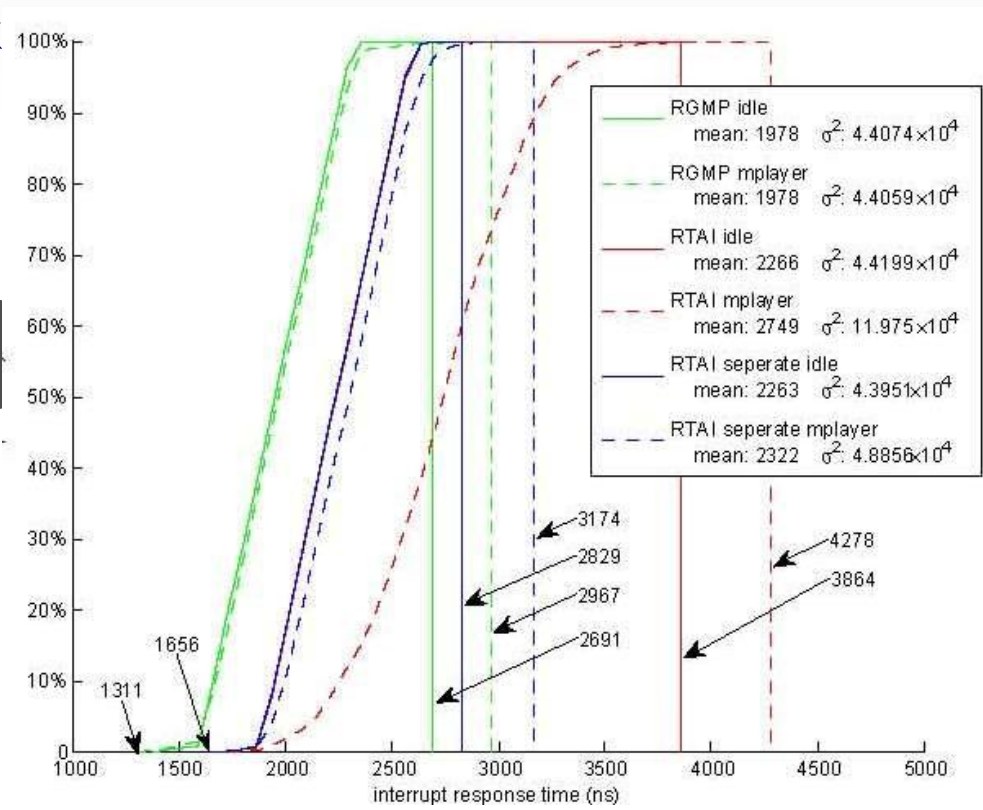
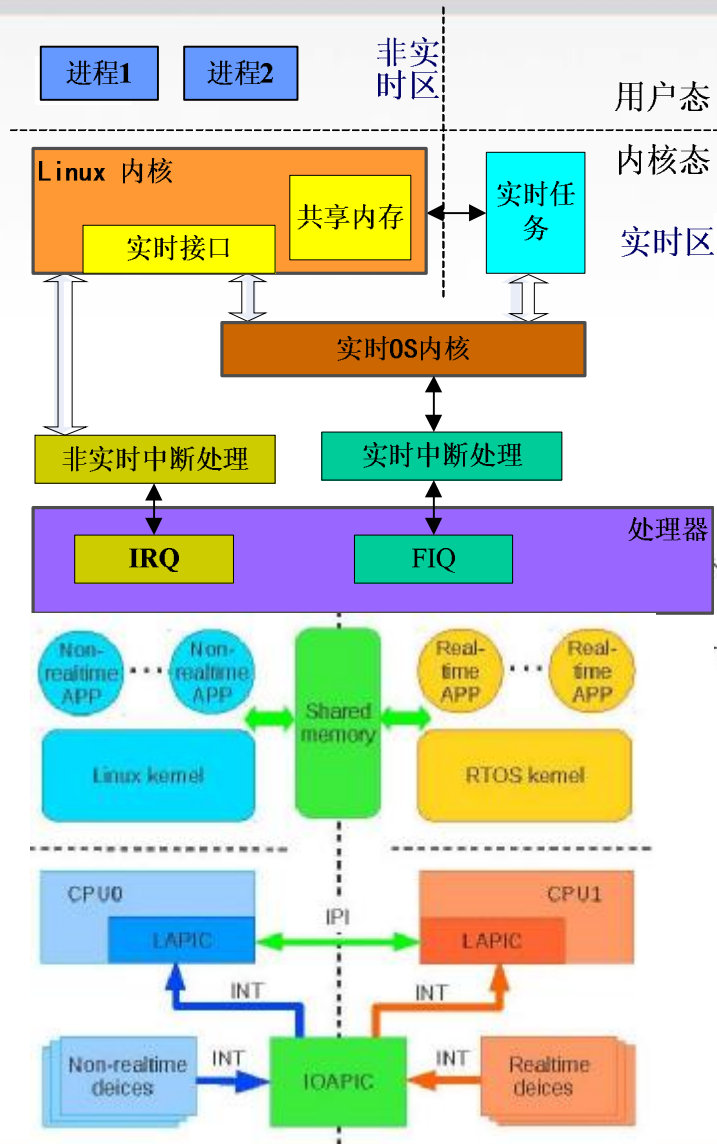
机器人模块化软件体系结构

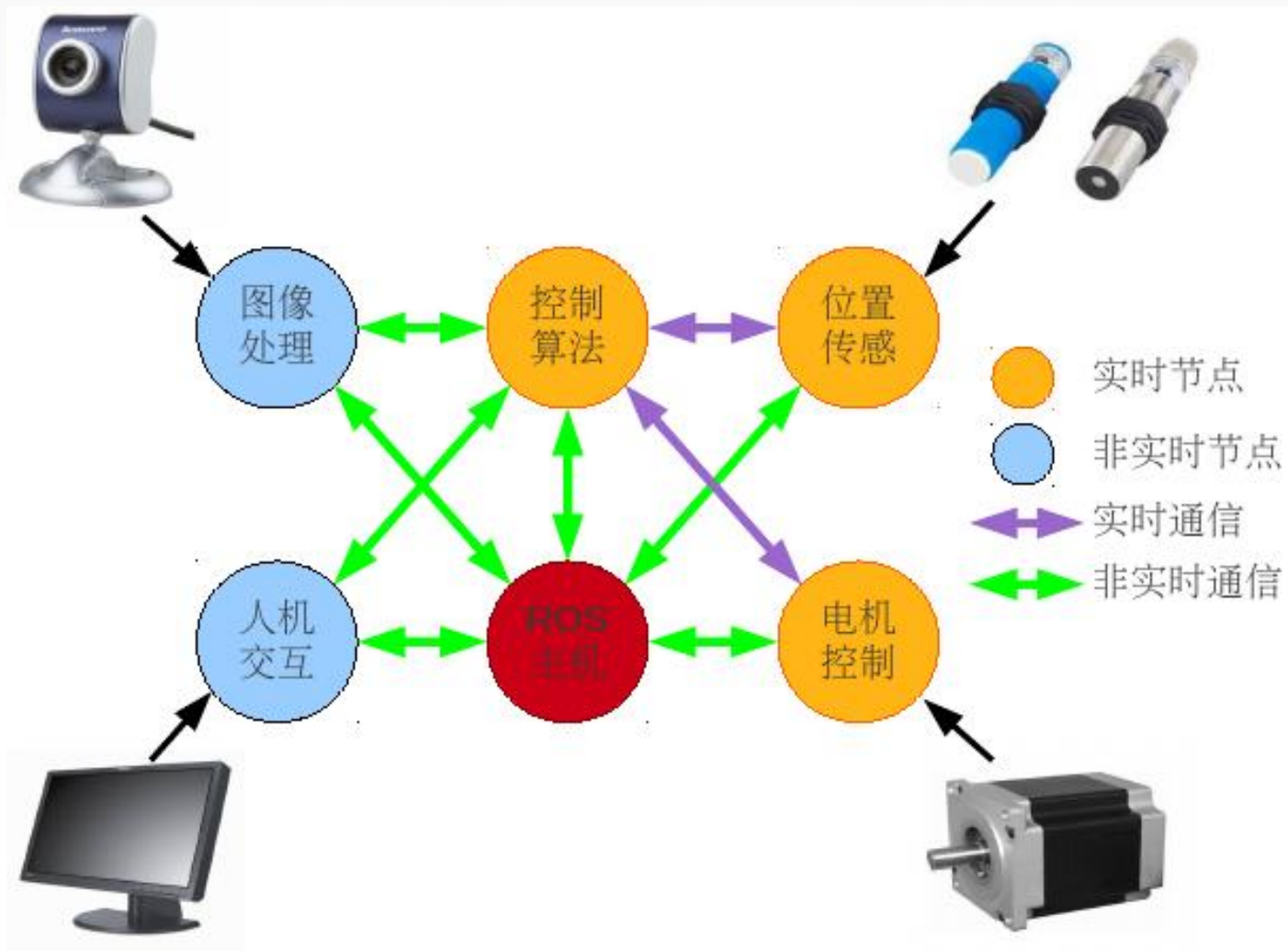
2011年中国**嵌入式**暨物联网教育发展高峰论坛



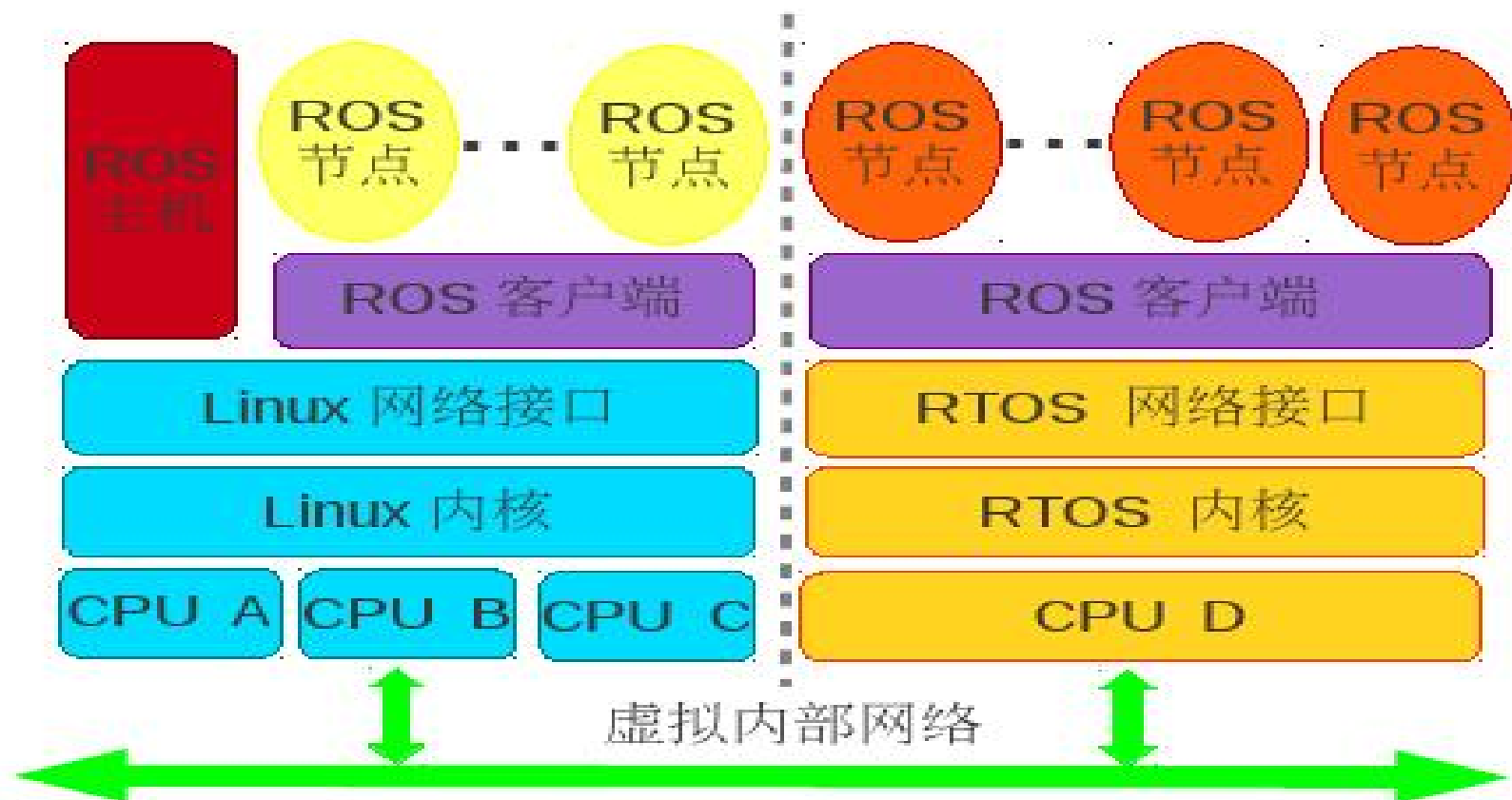
*演示模块化功能部件、标准化、互换性

我国的机器人操作系统研究-RobOS 2011年中国嵌入式暨物联网教育发展高峰论坛





- 利用多核实时操作系统RobOS在单计算机上同时运行实时ROS节点和非实时ROS节点





1 物联网与IPv6

2 物联网体系的机器人平台技术

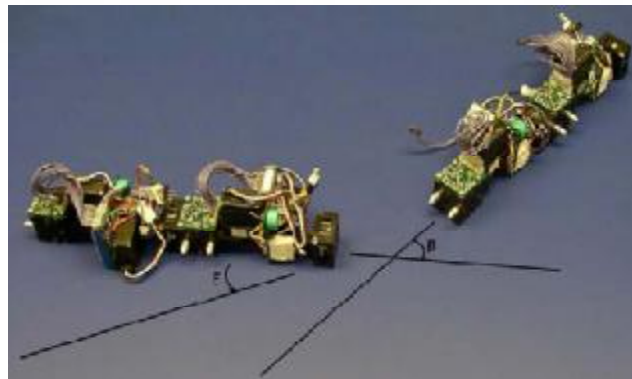
3 应用案例

- Docking of Self-reconfigurable robots



M-TRAN

(by AIST)



CONRO

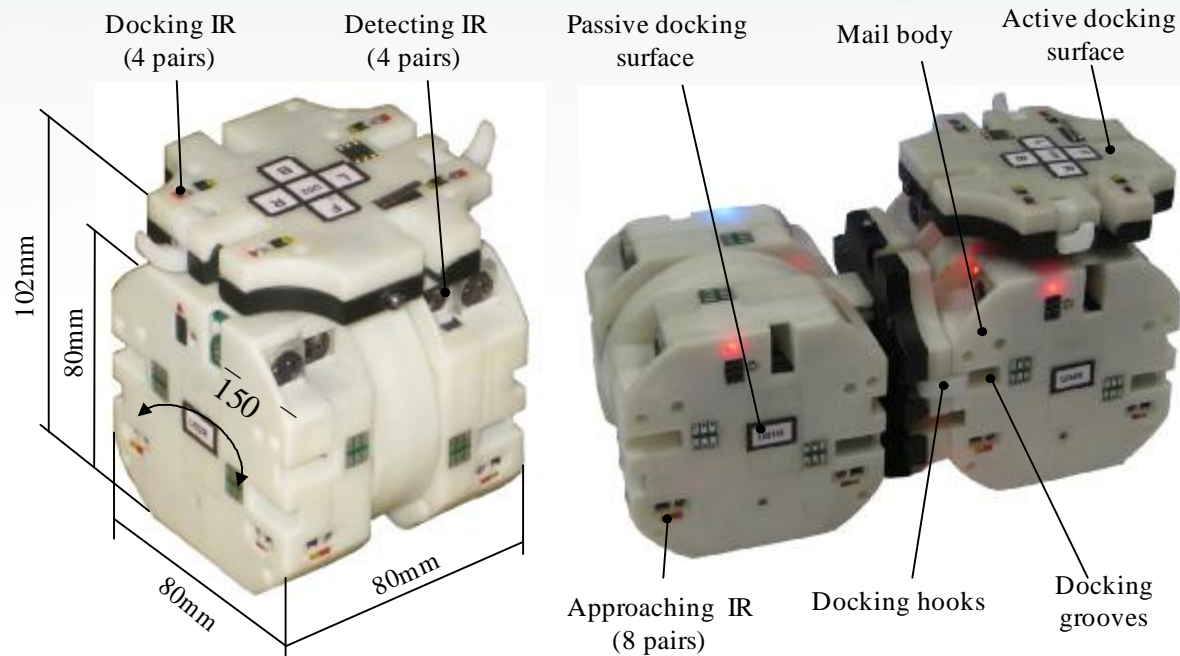
(By Yim)



ATRON

(by Kasper Stoy)

- **Single module can't move or move limitedly**
- **Auto Docking between a few modules**



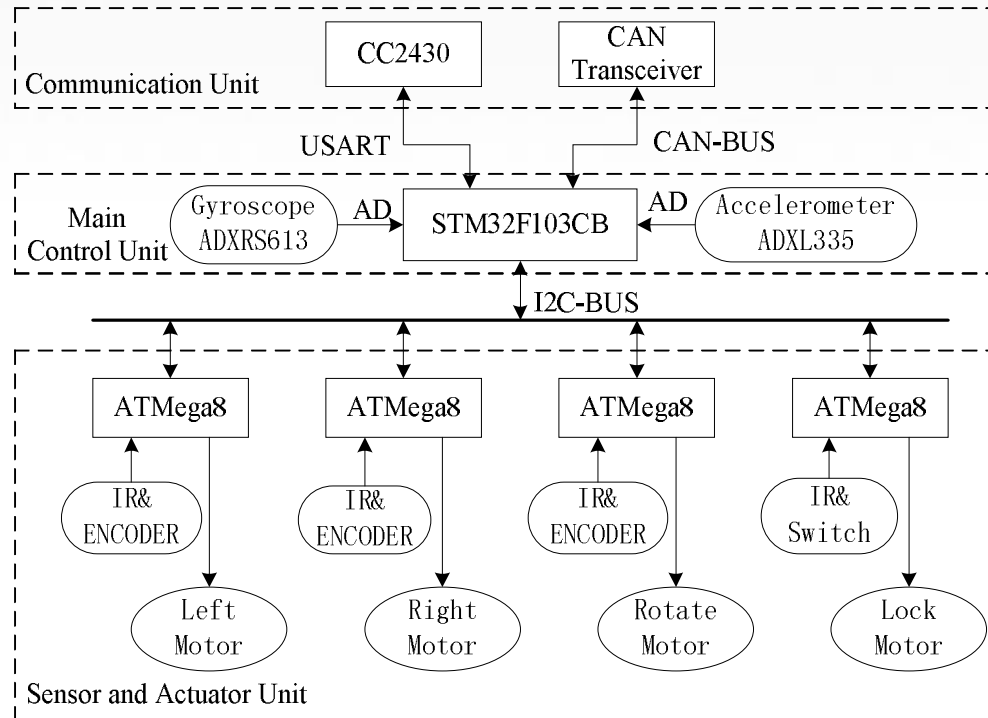
- **Stand-alone: size: $80 \times 80 \times 102$ mm, weight: 400 g**
- **Auto-dock: 1 active interface and 4 passive interface**
- **Auto mobile robot**

H. Wei, etc. Sambot: a self-assembly modular robot system. *IEEE Transactions on Mechatronics*

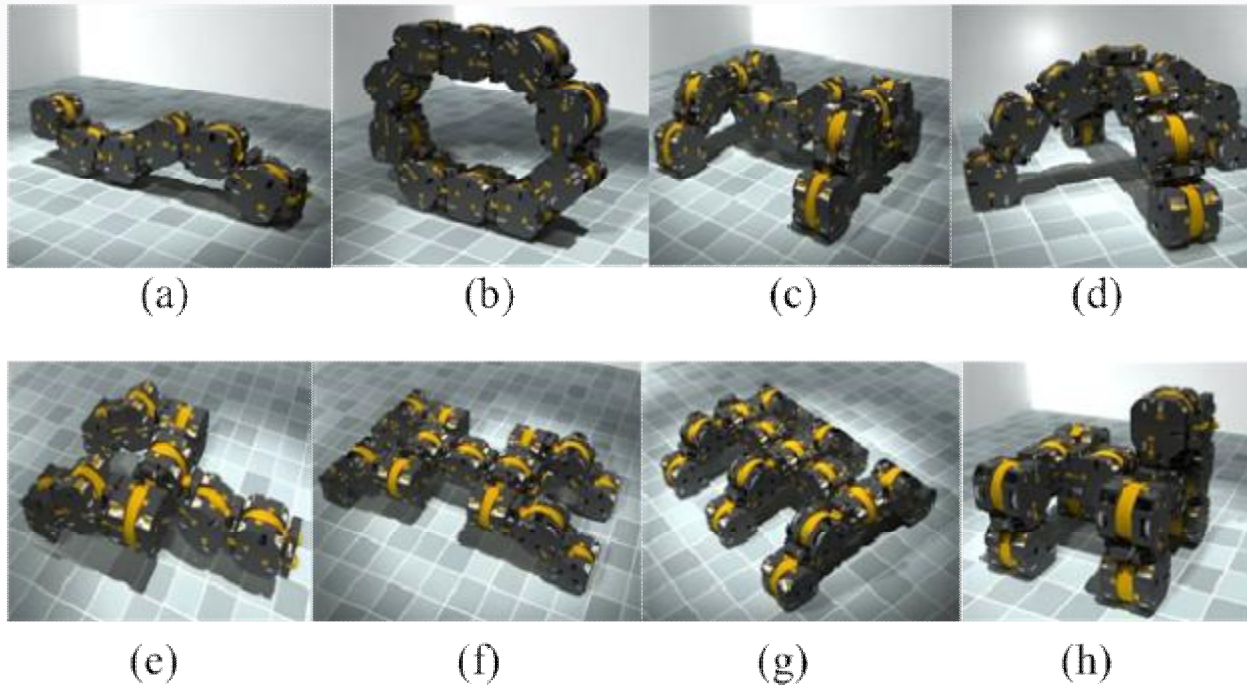
H. Wei, etc. Swarm robot: from self-assembly to locomotion. *The Computer Journal*.

H. Wei, etc. Sambot: a self-assembly modular robot for swarm robot, *ICRA 2010*

H. Wei, etc. The Distributed Self-assembly Control and Experiments for Swarm Robots. *IROS2010*

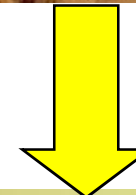
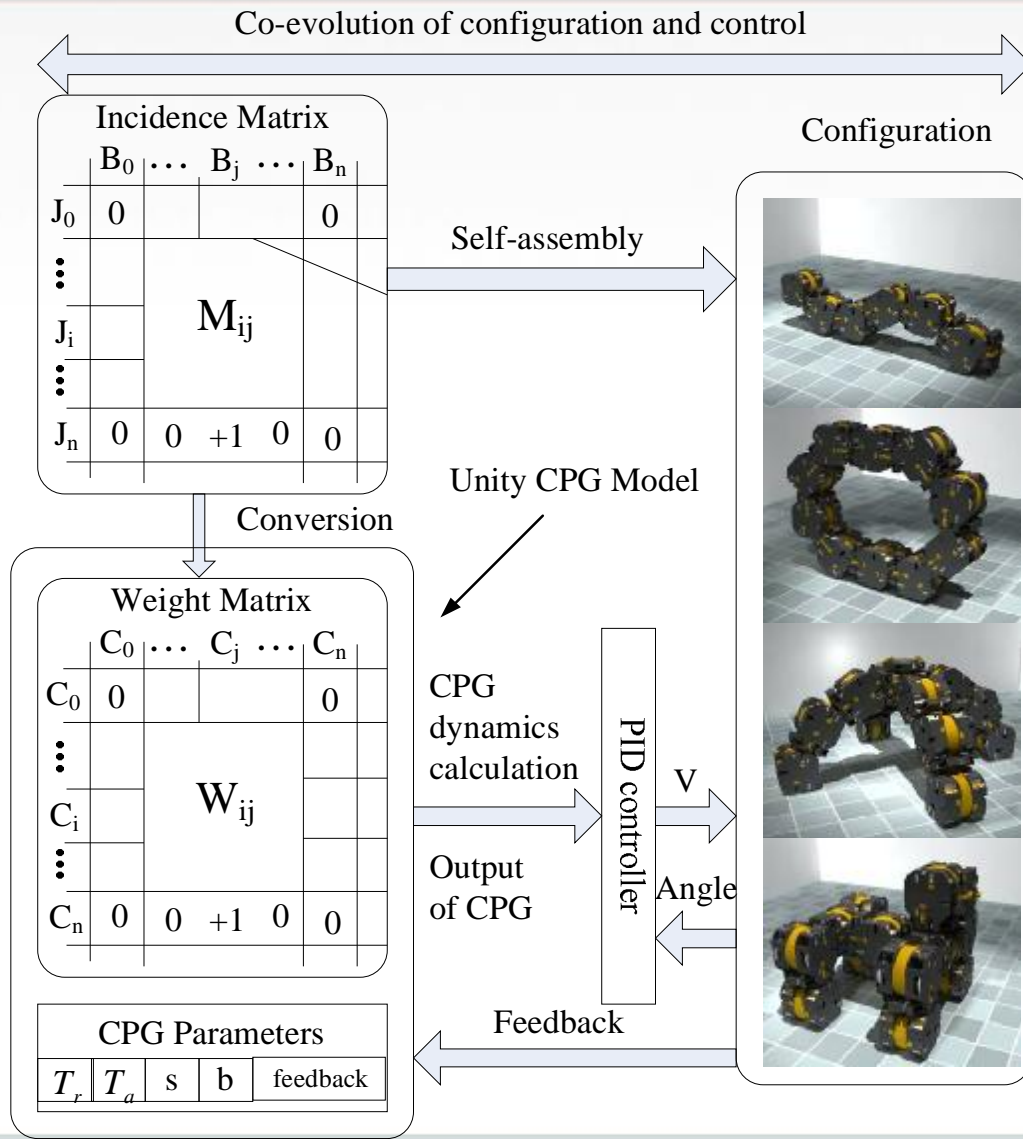


- **Distributed: 1 ARM and 4 ATmega8**
- **Communication: ZigBee (disperse) and CAN(connect)**



- **Linear: snake like and track**
- **Multi-legged: tripod, quadruped, hexapod**

多细胞协同进化控制



Q&A

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