CORBA in Control Systems

The Use of Embedded Real-time CORBA in the Architecture of Control Systems: A Case Study

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Introduction

- The use of CORBA in a real-time control system in a feed-forward of feed-back path in a regulative capacity has to date not been thought possible.
- Researchers are now beginning to use RTCORBA constructs over highly predictable transports to just start to experiment with closed loop control using a CORBA interconnect.
- The presentation will introduce an esteemed team from Boeing that did just that.
- The creation of more and more sophisticated control system software placed in modern aircraft, cars and ships in a distributed fashion makes CORBA based models an attractive solution.
- Real-time CORBA offers powerful heterogenous, multi-language, open extensible attraction to the control systems software designer

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Importance of CORBA in control systems implementation

- Dependable
- Maintainable
- Scalable
- Configurable and re-configurable.

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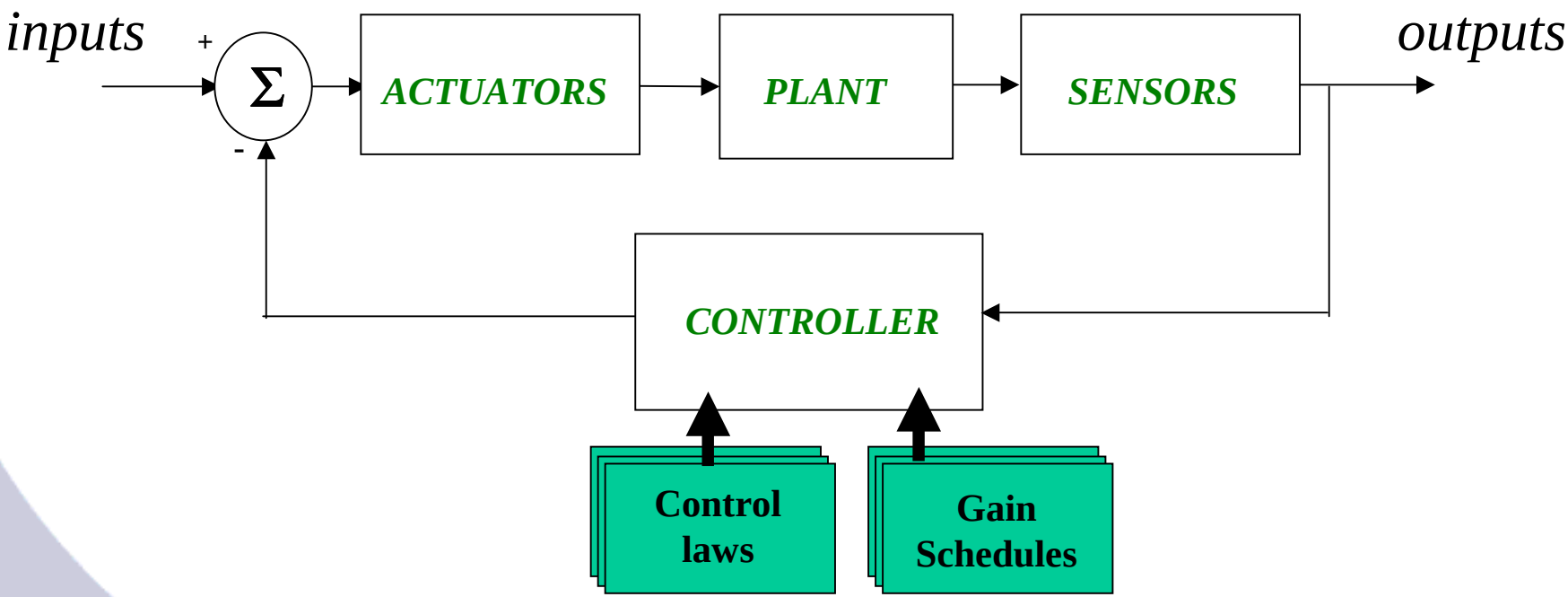
The classical control system model



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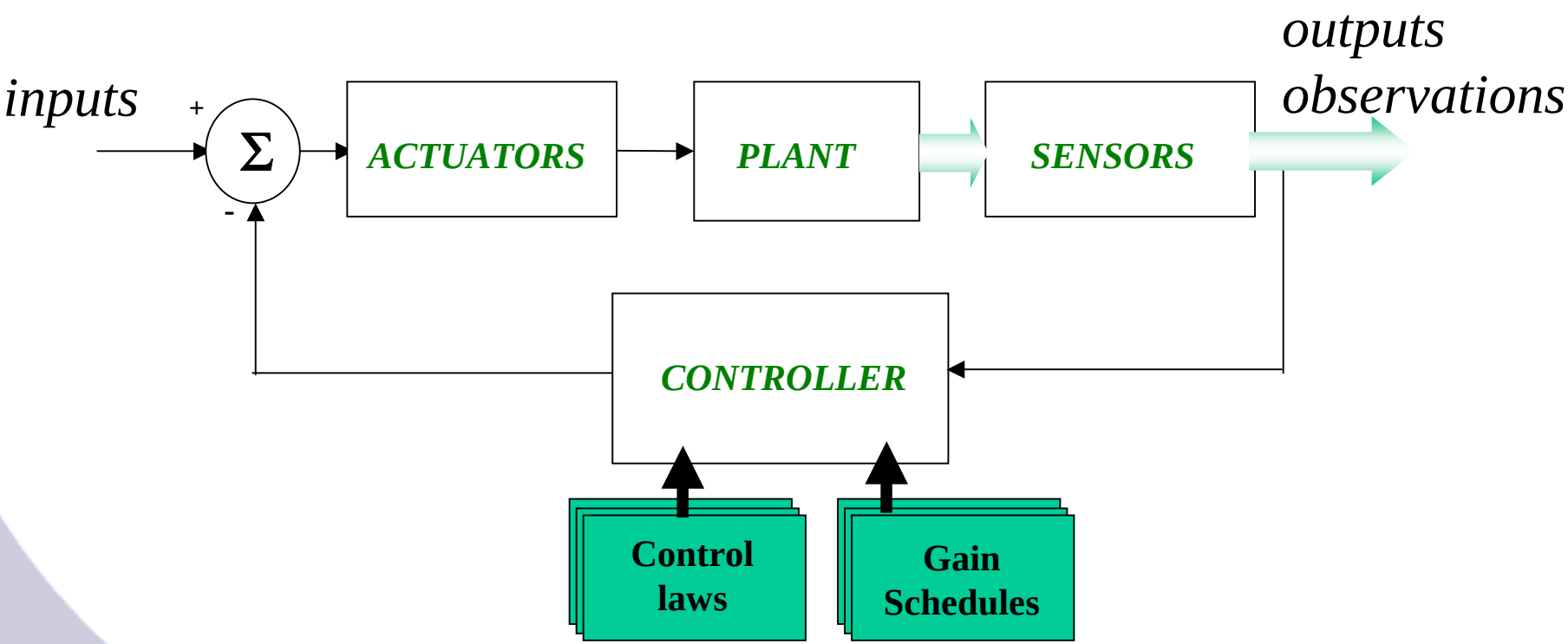
The classical control system model
using some CORBA interconnects



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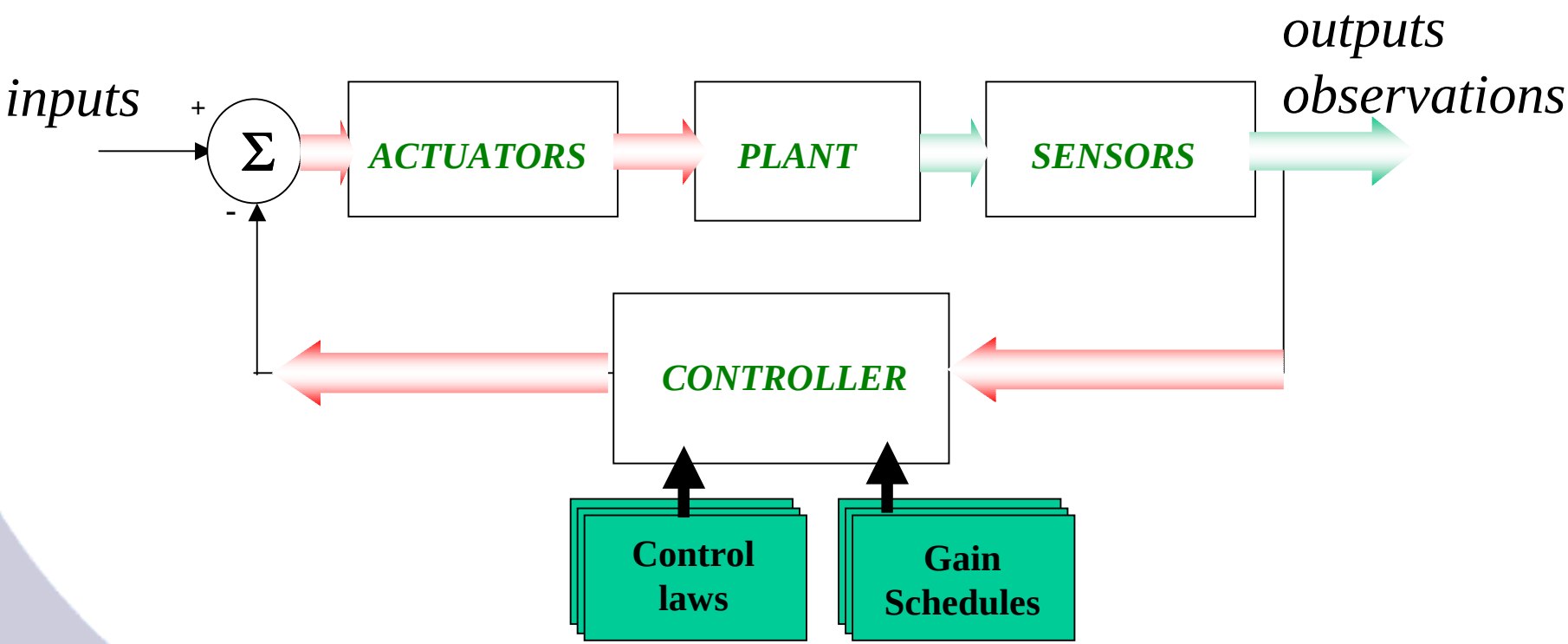
CORBA almost never used in feedback path in control critical loop paths



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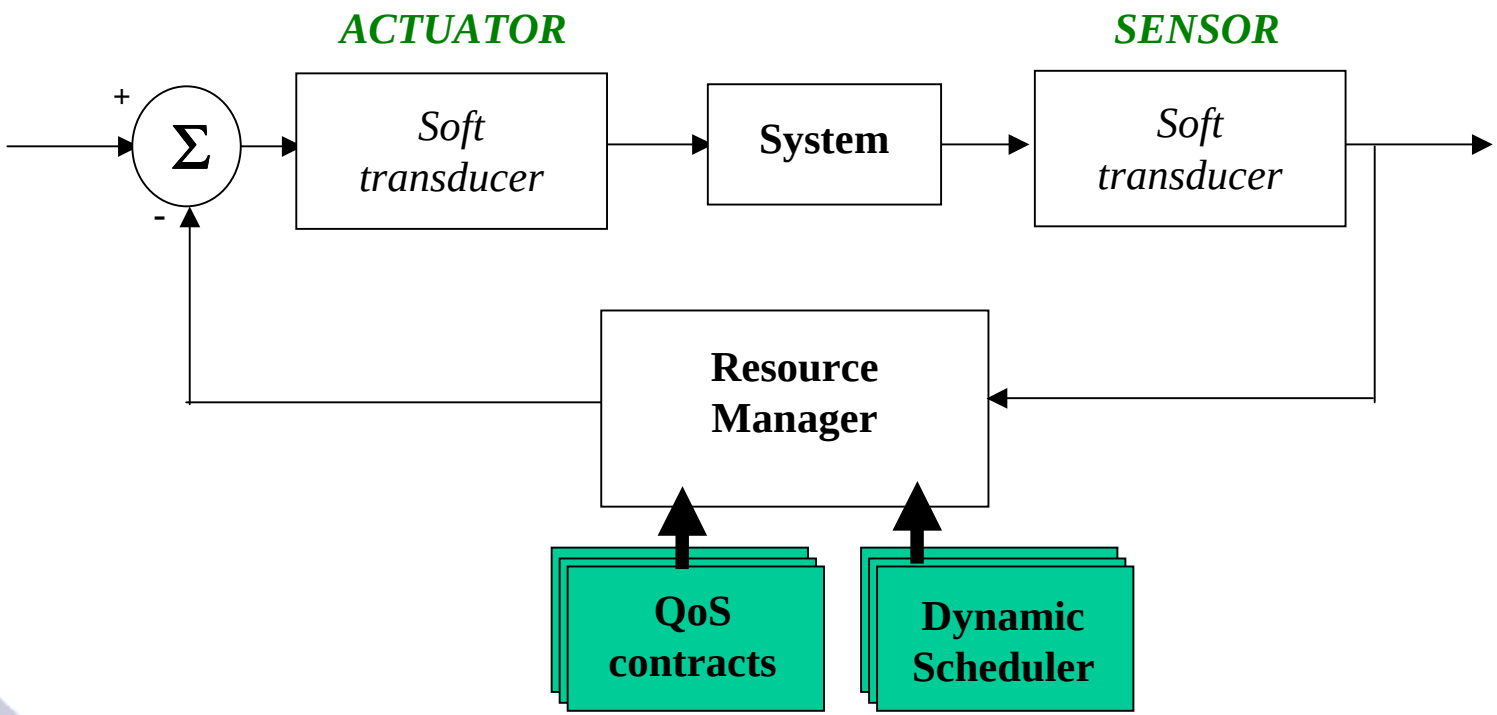
An alternative approach – a software component based model



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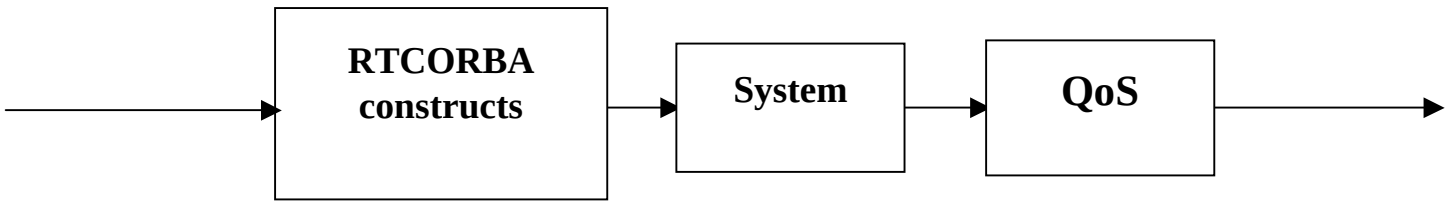
Current generation use of RTCORBA -



Open-loop system. Absence of feedback loop with a-priori design

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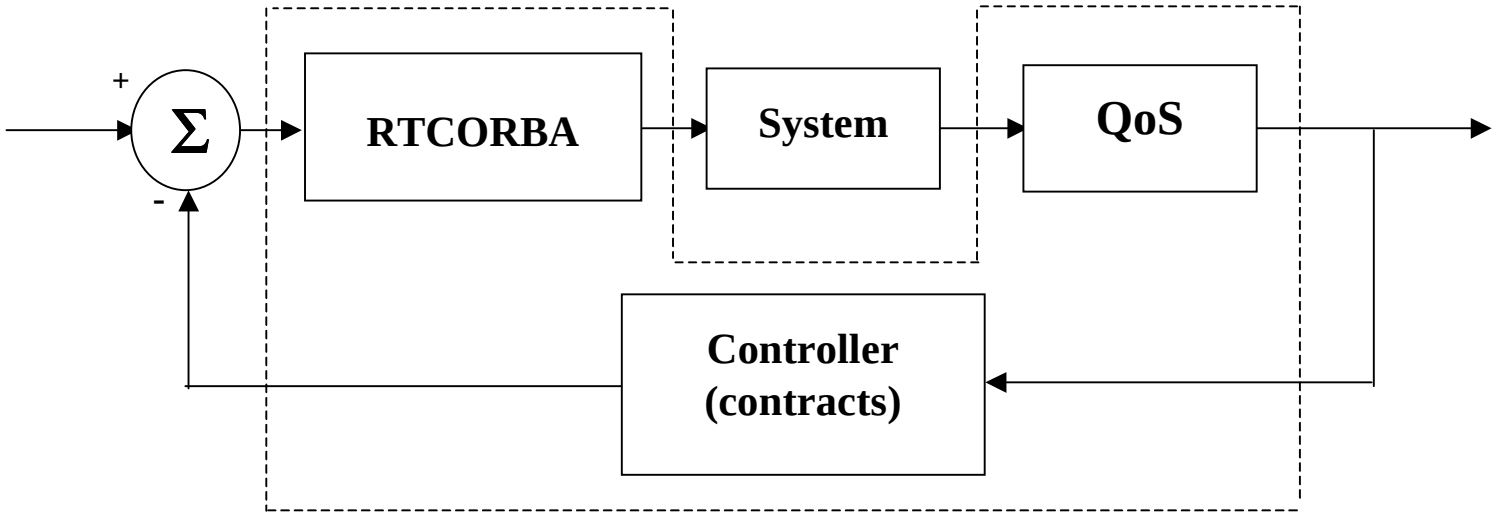
Adaptive use of RTCORBA – building towards FT-RT CORBA



Intelligent middleware – self-regulating

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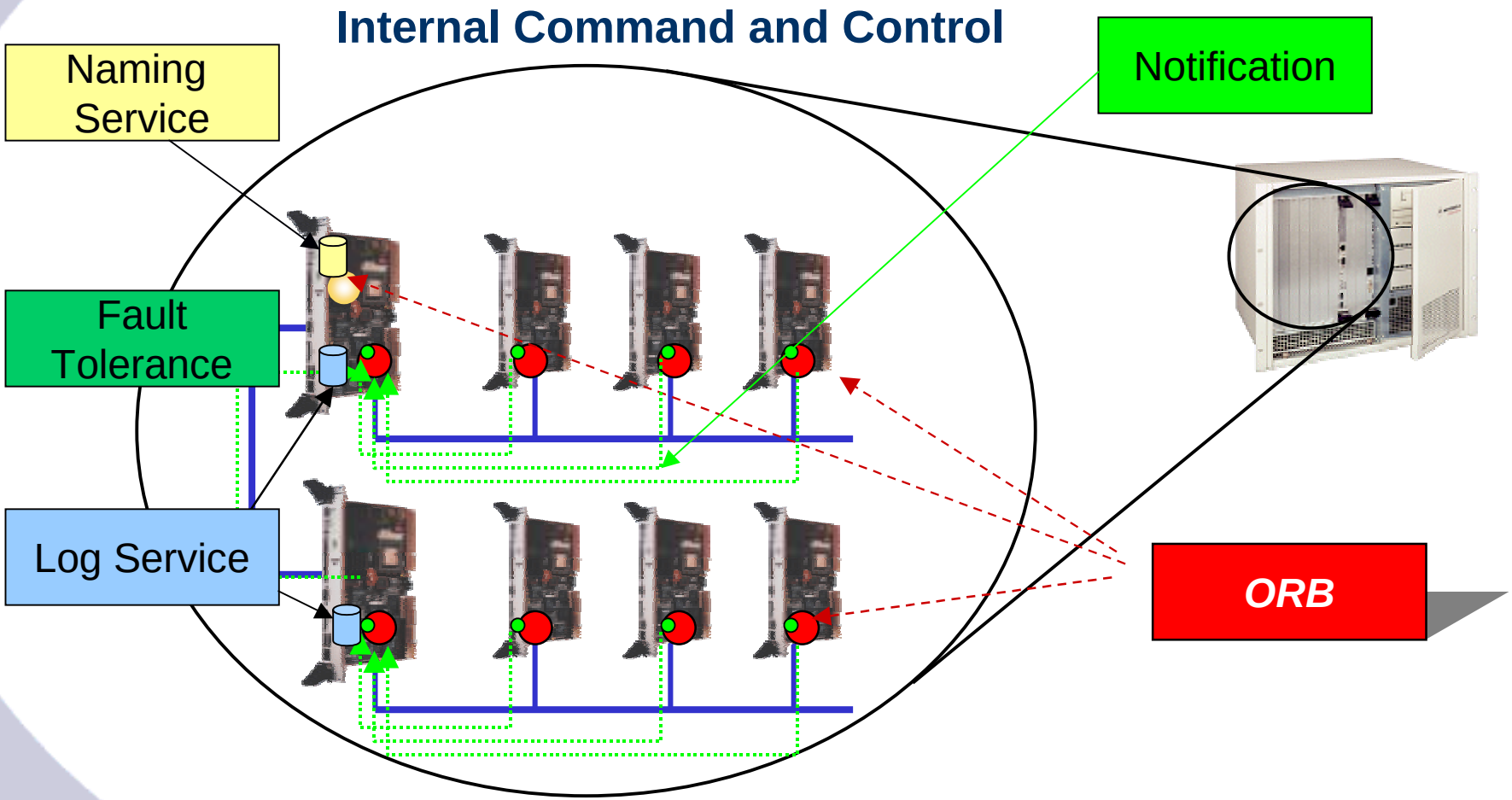
Historical and continued permeation of myths

- CORBA is too slow, and heavyweight for use in microcontrollers, PLC and so on.
- CORBA lacks the hard real-time capability to facilitate use in mission critical control paths – even RT CORBA !
- CORBA lacks dependability semantics that would be required to say build a control system for an aircraft.
- RT-CORBA, and FT-CORBA are immiscible and so its use in flight control, or such critical control arenas in never going to be possible.
- All types of CORBA lack the semantics to effectively build very large scale embedded real-time fault tolerant structures.
- CORBA is synchronous, event driven RPC, and cannot grow to meet either an asynchronous real-time world or more importantly it and Time-triggered systems are at odds with one another !

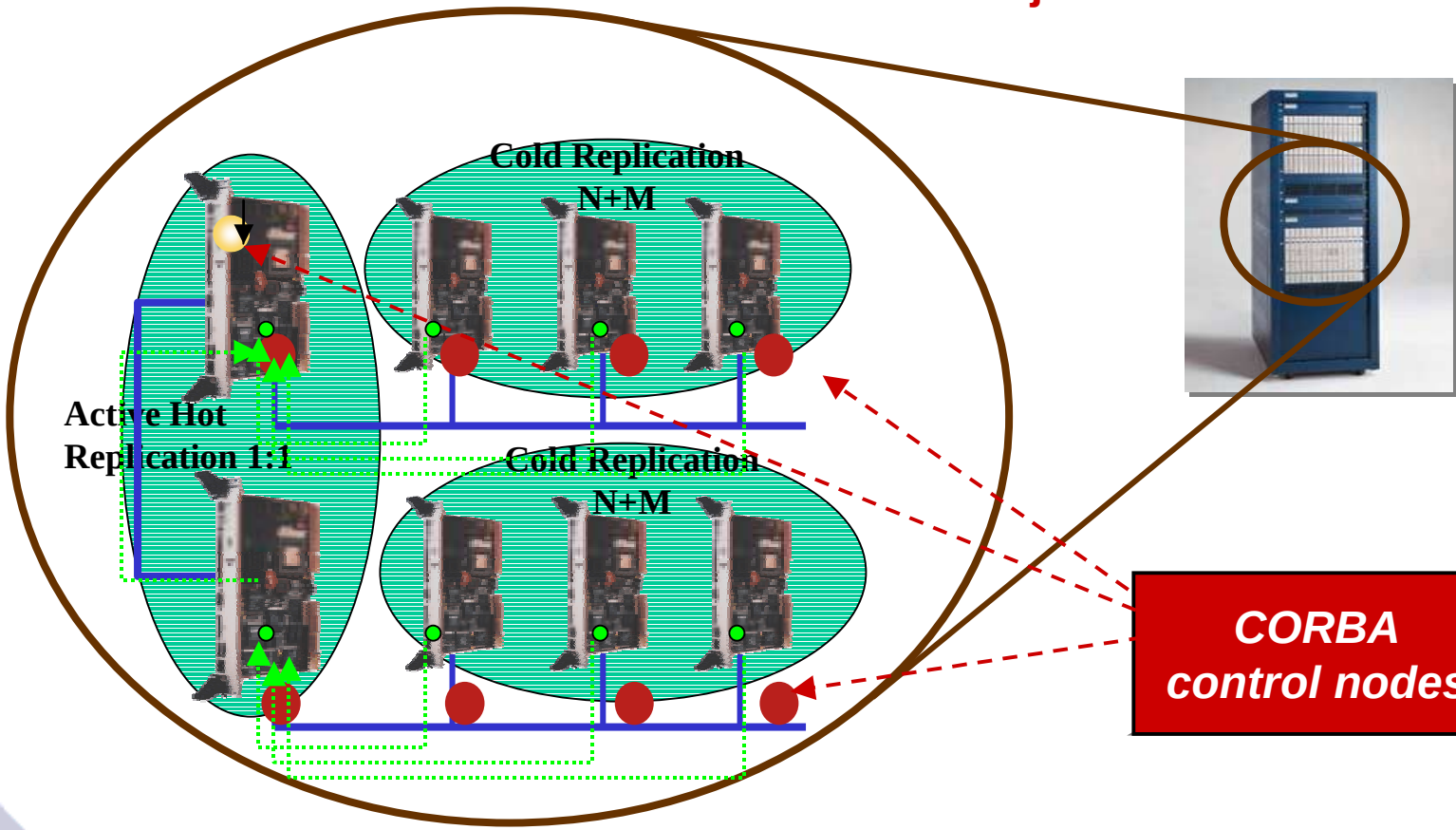
Example closed loop control systems using CORBA in their control plane.

Simple sensory data reporting in Telecommunications



Control of Service availability

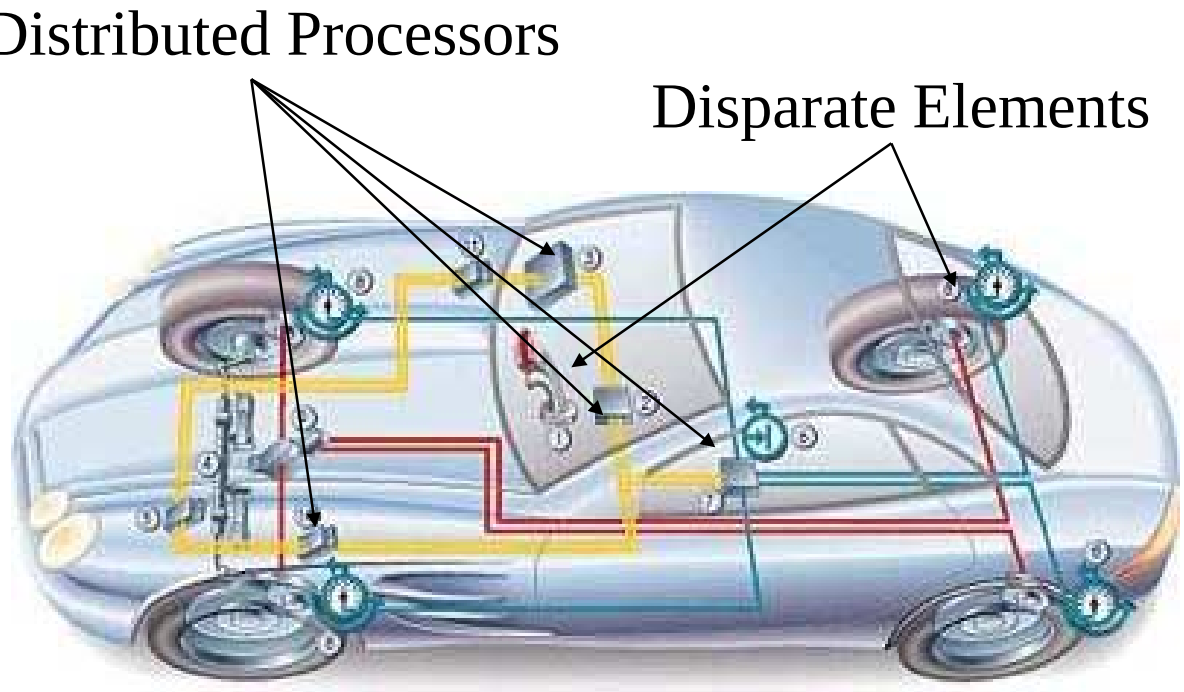
In Next Generation Switching Equipment , ORB Communication Project and FT



Control of waveform stability on SDR

- SDR demonstrates that CORBA can be effectively applied to control and regulate the operation of a soft radio
  - e.g. The General Dynamics DMR is successfully executing during independent Navy shipboard Technical Evaluation
  - The DMR SATCOM waveform is nearing successful completion of US Government Joint Interoperability Test Command (JITC) authorization

Control of automotive sensory information



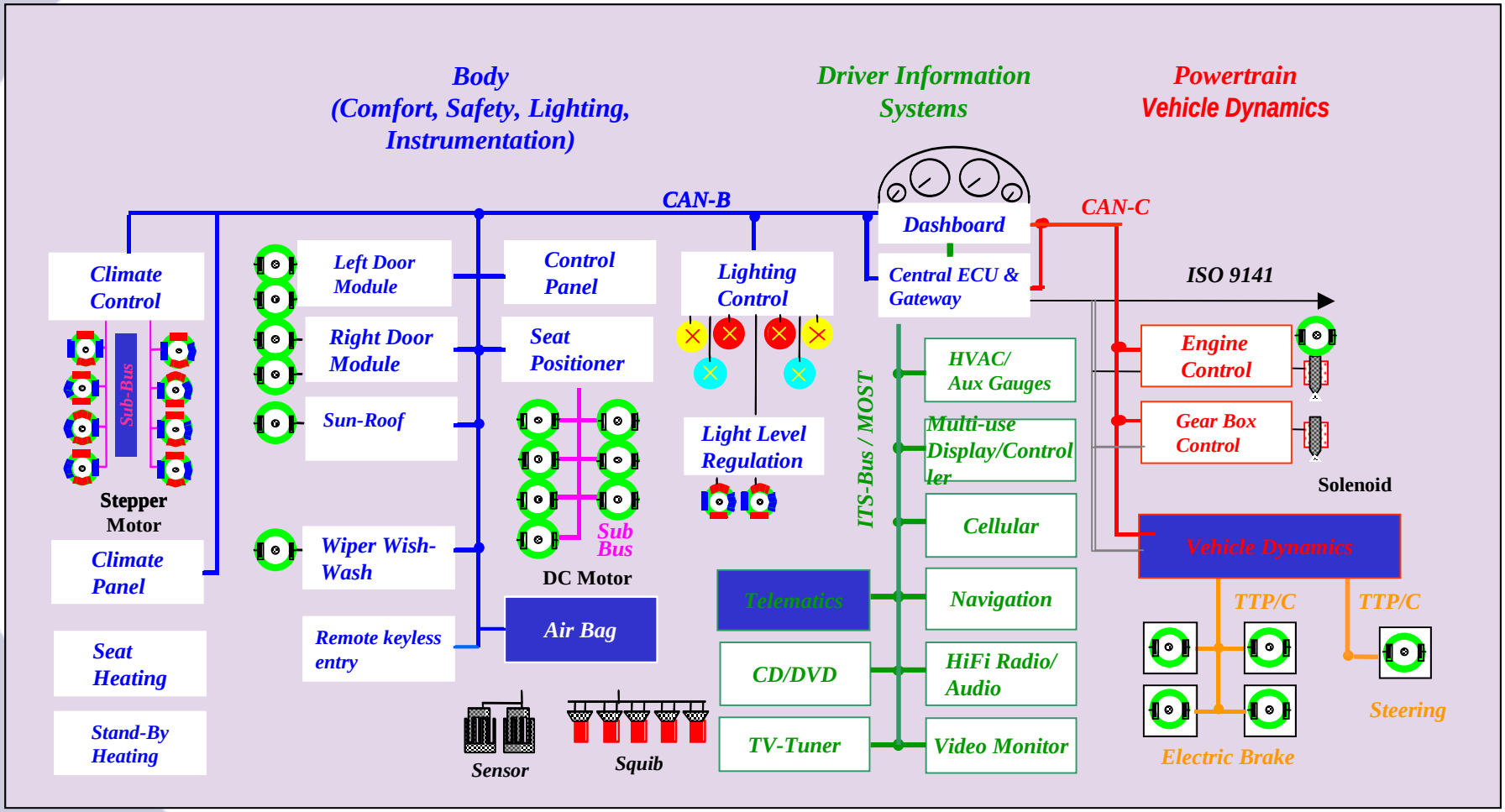
- Internet and Wireless communications
- System integration
- Drive-by-wire technology

http://www.daimlerchrysler.de/index_e.htm

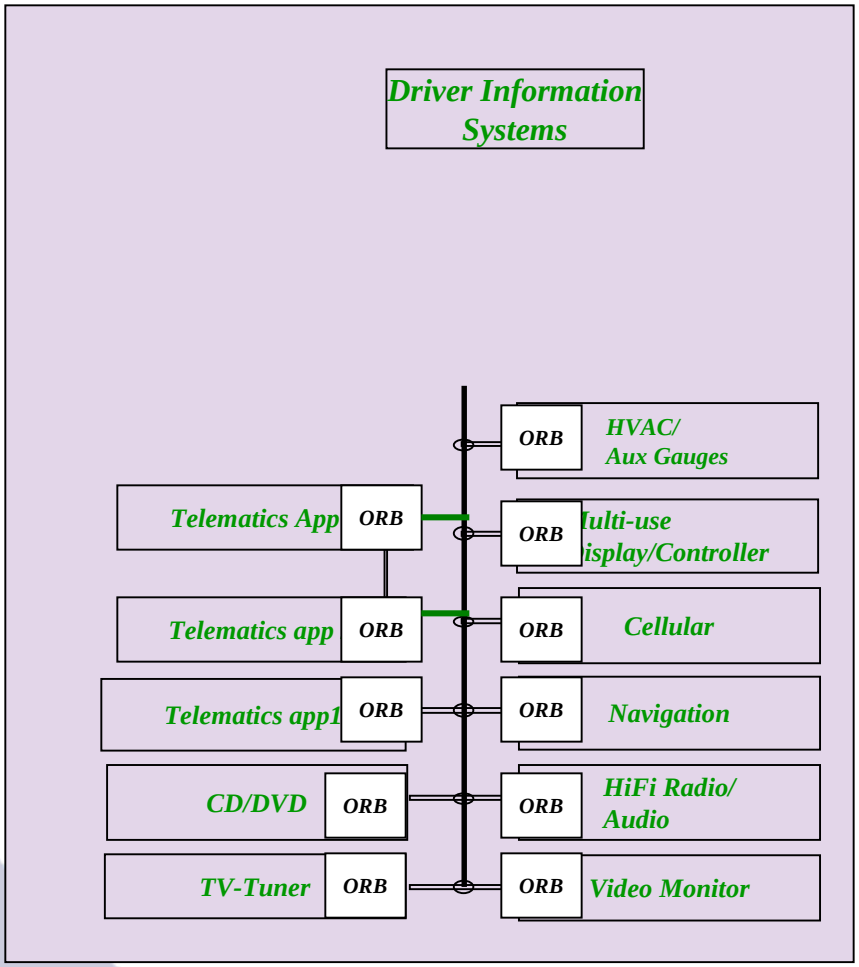
Automobile industry

- Cars and trucks more than simple modes of transportation
- AutoPC: PC class hardware to provide services support platform for the future internet-based services (C++, Java)
- Control functions (real-time, C++) and infotainment (C++, Java) functions
- High-end car has more than 80 microprocessors for control systems and infotainment systems

Car's Information Highway –



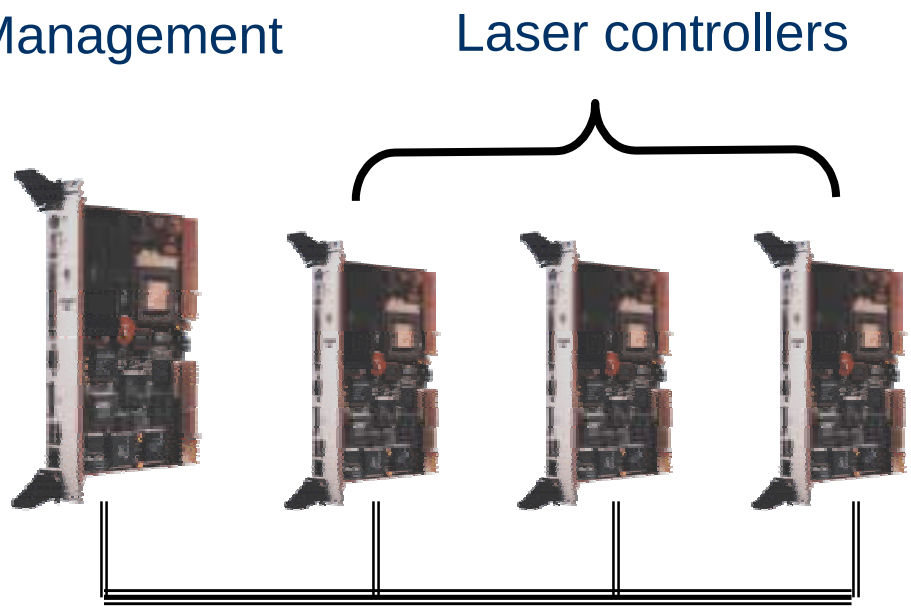
VDO - CORBA Network



- Simple IDL interfaces remove dependency on a single supplier
- New services with minimal impact in the existing system
- Interoperability between existing and new applications
- Platform independent services so changes in hardware will have minimal impact on the system

Control of laser positioning and irradiation

Used in Laser lithography at the <16 Angstroms Internal Command and Control – very precise control



OS: Winsows NT, Green Hills Integrity

CPU: PPC750

Bus: cPCI

A detailed case Study:

Boeing Phantom Works team

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Analysis of where we are today -

- A lot of myths have been dispelled in the last 2 years
- CORBA has grown in cases through very high quality implementations to meet the challenges of hard real-time control capability to facilitate use in mission critical control paths – even RT CORBA – kudos to all ORB implementers
- There is a specialist OMG movement in the real-time SIG to look at creating specifications for RT fault-tolerance (for dependability) and better still a control systems movement -
- Talk to Prof. Ricardo Sanz and Prof. Herman Kopetz
- TTP protocols have come into the CORBA fold.
- Read John Rushby's analysis of TTP vs FlexRay and CAN and other controller protocols.
- Get involved in the RT SIGs CORBA in control systems activity.

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Conclusions

- CORBA continues to grow and meet the challenges of new types of systems being developed.
- CORBA allure for large scale, open flexible interoperable system design continues and now stretches to closed loop feedback control system implementation.
- Real-time CORBA, with dependability aspects rolled in and some specialized specifications for standard control system ‘components’ specified is a very attractive option for control system designers
- CORBAs permeation into DSPs for transducer banks, Microcontrollers and general purpose processors now makes it possible to have CORBA on all parts of a modern sophisticated control system.
- CORBA continues to spread its gospel of open heterogenous, and extensible system implementation in the control system community today.

Thank You