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Interoperability for Space Mission System Monitor and Control: Applying Technologies from Manufacturing Automation and Process Control Industries

Satellite Networks Workshop
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Outline

- Space Project Mission Operations Control Architecture (SuperMOCA) Goals and Methods for Achieving Them
- Some Specifics on the Architecure
  - Open Standards and Layering
  - Enhancing Interoperability
  - Promoting Commercialization
- An Advertisement
- Status of the Task
  - Government / Industry Cooperation
  - Architecture and Technology Demonstrations
- Key Features of Messaging Services and Virtual Devices

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Space Project Mission Operations Control Architecture (SuperMOCA): Goals and Methods

- **Significantly reduce the monitor and control cost for integration, test, operations and maintenance of ground-based and spaceborne systems used in space missions**
- **Facilitate space industry and government agencies cooperation in the execution of space missions**
- **Partner with industry in a consortium environment to develop**
  - an architecture and operations concept that is commonly understood by customers and suppliers
  - open standards based on technologies and open standards and from manufacturing automation and industrial process control industries
  - a lucrative commercial market for space mission monitor and control products

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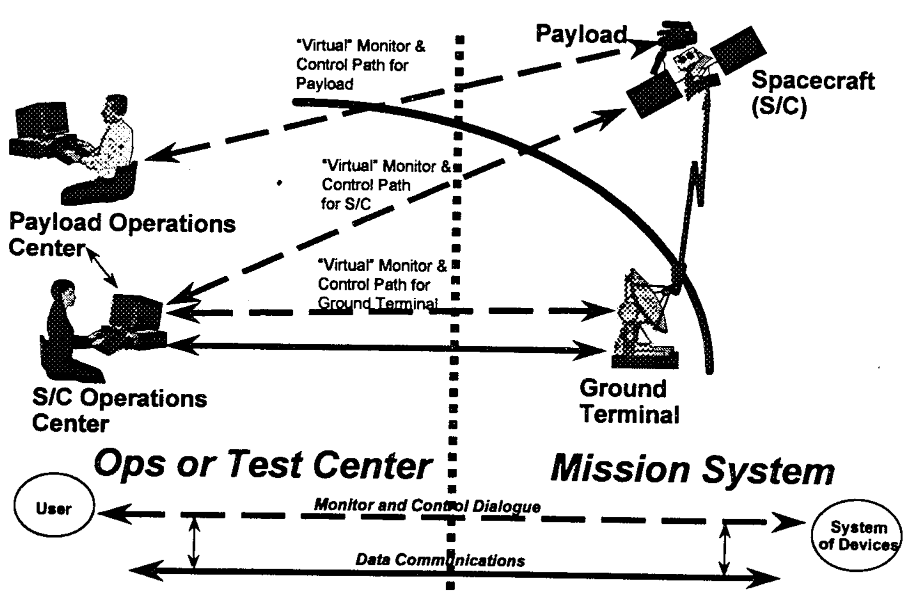
Space Mission System Monitor & Control



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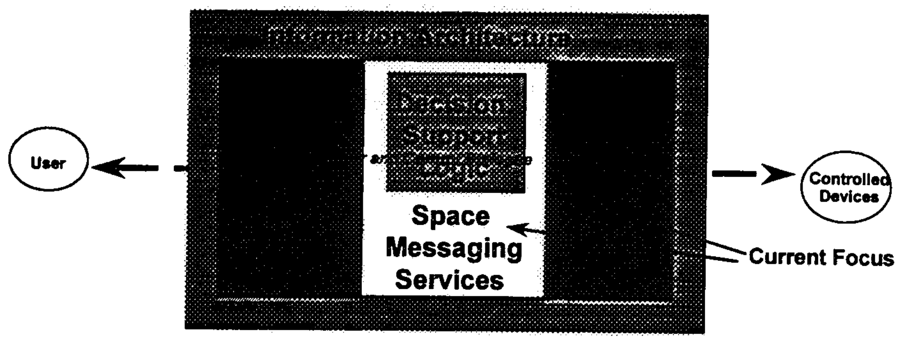
An Architecture and Standards for Space Mission System Monitor & Control



- An architecture for the monitor and control during integration, test, and operations of:
  - spacecraft and launch vehicles
  - launch complexes and ground tracking stations
- A set of open standards that are consistent with the above architecture and apply to the devices used in space missions and the products used to monitor and control those devices.

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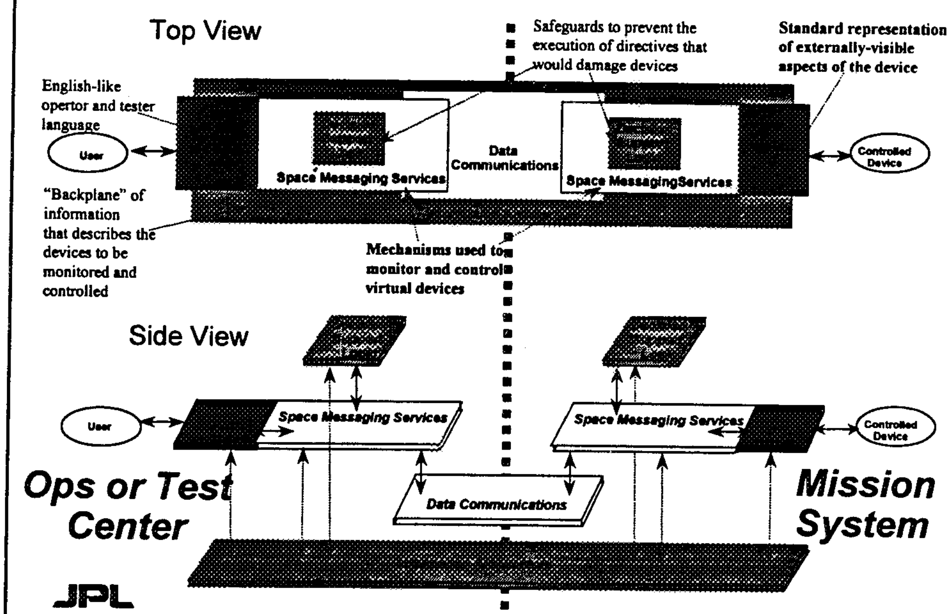
Open Standards and Layering



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Enhancing Interoperability

- **A definition** - Monitor and Control (applications-level) Interoperability: Once connectivity has been established based on communications interoperability, components built by different organizations can operate together to execute an activity by exchanging monitor and control information (i.e., plug and run)
- Advantages for space mission monitor and control
  - simplifies multiple agency cooperative missions
  - shortens system integration and test and training time
  - preserves customer options on component suppliers
- Advantages for commercial products
  - lower customer support costs
  - products are compatible with more systems
- How the architecture enhances interoperability
  - makes mission-specific descriptive information available to monitor and control applications in a standard structure (Information Architecture)
  - decouples device design from monitor and control application design (messaging service and virtual device concepts)

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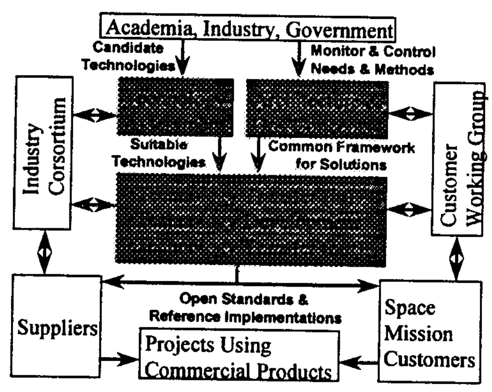
Promoting Commercialization

If we (the customers) want to benefit soon from a commercial market, then we need to participate in creating it. The SuperMOCA task and architecture are intended to promote a commercial market. Specifically they will:

- Provide an understanding of the common cost drivers among government and commercial space missions
- Reduce costs for both government and commercial operators throughout the project life cycle
- Provide business opportunities to a large set of companies
- Promote commerical competition



Path to a Commercial Market

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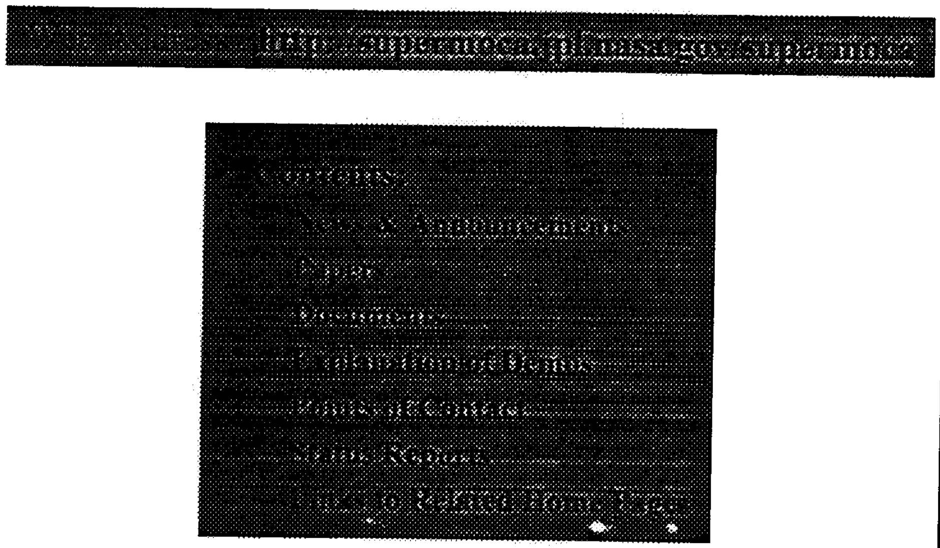
SuperMOCA Homepage



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Status of Government / Industry Cooperation

- FY 98 and FY 99 funding from NASA's Space Operations Management Organization (SOMO) standards program
- FY 98 work is being done at JPL and through contracts with SRI and Fieldbus, Inc.
- Will get support from Department of Defense (DOD) in FY 99 to incorporate any DOD-specific needs into the architectural design work
- Negotiated a preliminary Memorandum of Agreement with Fieldbus Foundation (FF) and NASA on for a cooperative program to:
  - demonstrate FF process control technology being developed to operate in ethernet networked environments
  - develop a space monitor and control industry consortium based on the FF experience as a process control industry consortium
- Working with Fisher-Rosemount (an FF member company) in developing a design for remote access to monitor and control systems via satellite links

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What is the Fieldbus Foundation?

Over 100 Companies
Major International Automation Companies
Multi-national End Users

Fieldbus Foundation is:

Activities:

- Provide conformance testing and certification
- Device Descriptions

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Fieldbus Foundation Members

- ABB Industrial Systems Inc.
- Alfa Laval Automation AB
- Allen-Bradley Co., Inc.
- Allen-Bradley Japan Co., Ltd.
- Alpret (Pty) Ltd.
- Apparatebau Hundsbach GmbH
- Bailey Controls Company
- Bailey Japan Co., Ltd.
- Beamex Oy, AB
- Belden Wire & Cable
- Borst Automation
- Bray International, Inc.
- Bronkhorst High-Tech B.V.
- Brooks Instruments
- Caltex Services Corporation
- Chevron Research & Technology
- Danfoss A/S
- digi table thielen GmbH
- DKK Corporation
- Druck Ltd.
- du Pont Engineering Co.
- EMCO
- Endress + Hauser GmbH
- Enraf
- Exxon Research & Engineering Co.
- Fieldbus International A/S (FINT)
- Fisher Controls International, Inc.
- Fisher-Rosemount Systems Inc.
- Fraunhofer Institute IITB
- The Foxboro Company
- Fuji Electric Co., Ltd.
- Furon Company, Dekoron Div.
- Glaxo Inc.
- GSC Precision Controls
- Hartmann & Braun AG
- Hitachi, Ltd.
- Honeywell Inc.
- ifak
- Instituto de Investigaciones Eléctricas
- Johnson Yokogawa Corp.
- K-Patents Oy
- K.K. Codix
- Keystone International, Inc.
- Kimray, Inc.
- Knick Elektronische Meßgeräte GmbH &Co.
- Koso Service Co., Ltd.
- KROHNE Messtechnik GmbH & Co.
- Leeds+Northrup
- Magnetrol International
- Masoneilan - Dresser Industries, Inc.

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Fieldbus Foundation Members

- Measurement Technology Ltd.
- Mettler-Toledo, Inc.
- Micro Motion, Inc.
- MILLTRONICS Ltd.
- Mitsubishi Electric Corporation
- Monsanto Company
- Motoyama Eng. Works, Ltd.
- Nagano Keiki Seisakusho Ltd.
- National Instruments Corp.
- NEC Corporation
- Neles-Jamesbury Oy
- NEMA
- Niigata Masoneilan Co., Ltd.
- Norsk Hydro a.s.
- Ohkura Electric Co., Inc.
- Oval Engineering Co., Ltd.
- Pacific Avionics Corporation
- Pepperl+Fuchs
- POHTO
- Politecnico di Torino -Dai
- Presys Instrumentos e Sistemas Ltda.
- R. Stahl Schaltgerãte GmbH
- Ramsey Technology, Inc.
- Ronan Engineering
- Rosemount Analytical, Inc.
- Rosemount Inc.
- Saab Tank Control
- Schneider North America
- Servomex Company Inc.
- Shell Oil Company
- Shimadzu Corporation
- SHIP STAR Associates Inc.
- Siebe ECD
- Sieger TPA Ltd.
- Siemens Industrial Automation, Inc.
- Simrad Albatross AS
- SMAR Equipamentos Industriais Ltda.
- Softing GmbH
- StoneL Corporation
- TMG i-tec GmbH
- Tokyo Keiso Co., Ltd.
- Toshiba Corporation
- Valmet Automation Inc.
- VALTEK International
- VEGA Grieshaber KG
- Vinson Supply Company
- WorldFIP Europe
- Yamatake-Honeywell Co., Ltd.
- Yokogawa Electric Corporation
- Yokogawa Electronics Co., Ltd.

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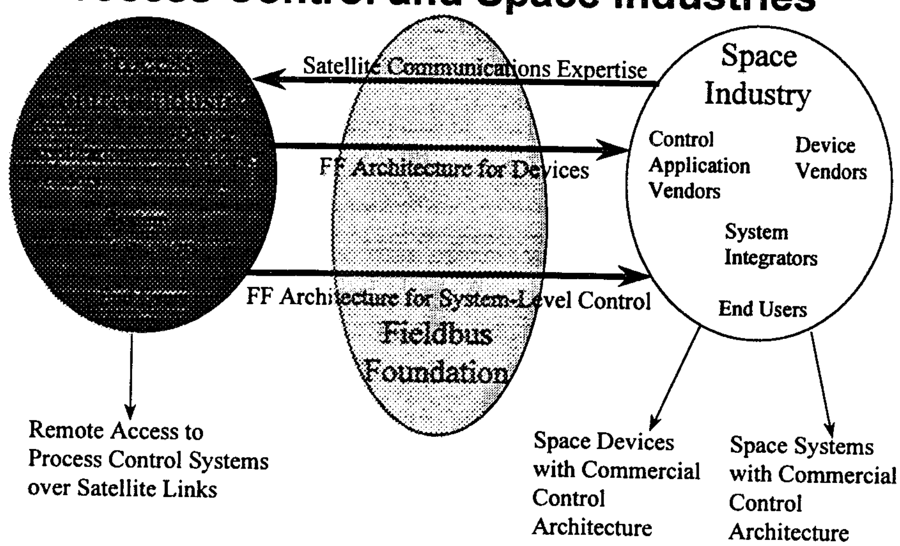
Two-way Tech Transfer Benefits Both Process Control and Space Industries



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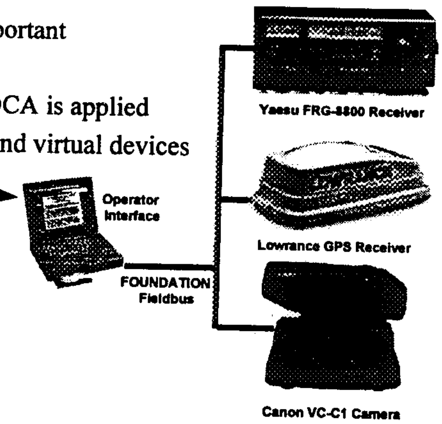
Status of Architecture and Technology Demonstrations

- Overview Documents Available
  - Summary - Why SuperMOCA is important
  - Architecture - What SuperMOCA is
  - Operations Concept - How SuperMOCA is applied
- Current Focus is on messaging services and virtual devices
- Road Show Demo
  - Commercial messaging system
  - ISA Show in Anaheim in Oct. 97
- JPL Demo
  - Commercial messaging system
  - Simulated S/C



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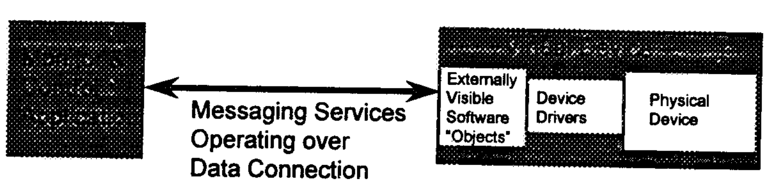
Messaging Services and Virtual Devices

- Virtual devices consist of software-implemented "objects" that represent the externally-visible aspects of the device
- Messaging services provide the capabilities to monitor and control the device through manipulation of the "objects"
- Fieldbus Messaging Service (FMS) is an example of an integrated architecture with which to build a monitor and control system
  - set of messaging services
  - set of virtual device "function blocks"



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