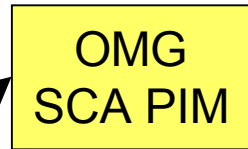
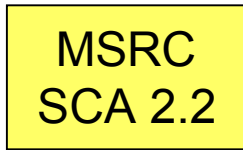


Software Communications Architecture *A Possible Roadmap*

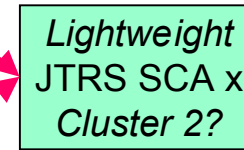
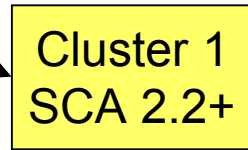
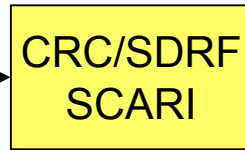
PIM



PSM



CORBA



Java or CORBA ?

PSM



Java



Java or .NET ?



OBJECT MANAGEMENT GROUP

OMG standards and Software Radio

Andrew Watson
VP & Technical Director, OMG



OBJECT MANAGEMENT GROUP

OMG's mission

- Develop a single architecture, using object technology, for distributed application integration, guaranteeing:
 - ✓ reusability of components
 - ✓ interoperability & portability
 - ✓ basis in **commercially available software**
- **OMG is about end-to-end interoperability, using whatever technology solves the problem, whether “in-house” standards or leveraging the results of others**
 - **CORBA, UML, XML, SOAP, .NET, Java,...**
 - **Integrating the next best thing whatever it is**



OBJECT MANAGEMENT GROUP

Worldwide Membership



2AB	Credit Suisse	GCHQ	NEC	Rockwell
3M	Daimler-Benz	HP	Netscape	SAP
Adobe	Deere & Co.	Hitachi	NTT	SmithKline
Air France	DHL	IBM	NIST	Siemens AG
Alcatel	DMSO	Int'active Obj	Nokia	Sprint
BAE Systems	DNS Tech	IONA	Nortel	Sun
BEA Systems	EBI	J. P. Morgan	NSA	Telefonica
Boeing	Economica	Keele Univ	Oracle	Thales
Borland	Ericsson	Lucent	Philips	TU Berlin
Bristol-Myers	Eurocontrol	Metaphase	Prism Tech	Unisys
CA	Ford Motor	Micro Focus	Rational	U. Newcastle
Chevron	Fujitsu	Mitre	Raytheon	VISA
Compaq	Fuji Electric	Motorola	Ricoh	W3C



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Main platform specifications

- **Unified Modelling Language (UML™)**
 - **Most widely-used modelling language**
- **Common Object Request Broker Architecture (CORBA®)**
 - **The only platform- and language-neutral middleware**
- **Common Warehouse Metamodel (CWM™)**
 - **Now the sole data warehousing standard**
- **Meta-Object Facility (MOF™)**
 - **The meta-data repository standard**
- **XML Metadata Interchange (XMI™)**



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OMG's Domains

- **Task Forces adopt Domain technology:**
 - ✓ Enterprise Integration
 - ✓ C4I
 - ✓ Finance
 - ✓ Transportation
 - ✓ Utilities
 - ✓ Manufacturing
 - ✓ Telecoms
 - ✓ Healthcare
 - ✓ Lifesciences
 - ✓ Space
- **Special Interest Groups share information:**
 - ✓ Analytical Data Mgmt
 - ✓ Software Radio
 - ✓ Systems Engineering
 - ✓ Human Resources
 - ✓ Simulation
 - ✓ (& more)



OBJECT MANAGEMENT GROUP

Availability

- **OMG adopts and publishes interface specifications**
 - **Implementation available from at least one OMG member**
- **Interfaces freely available to all (members or not)**
 - **Visit <http://www.omg.org>**
- **Interface selection via competitive process**
- **Decisions taken by members**
 - **Strategic direction controlled by Board**
 - **Technical direction determined by Technology Committees**



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OMG in action: Unified Modelling Language

- The successor to multiplicity of OO A&D notations of early 90s
- Result of OMG RFP begun in 1994, completed in 1997
 - Complemented by XML Metadata Interchange (XMI) and repository (MOF) specs
- Standard released flood of support
 - 90+ books
 - A dozen tools
 - Training widely available
- UML 2.0 process now underway



CORBA

- **Widely deployed for integration in enterprise systems, embedded systems, realtime systems**
 - **EJB/J2EE built on CORBA standards for interoperability, security, transactions, persistence**
 - **C/C++ CORBA used in high-throughput systems like SABRE, Wells-Fargo Bank**
 - **CORBA Components brings component development to non-Java systems**



CORBA



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(Some) CORBA implementations

2AB ORB2

AT&T Labs OmniORB 3

IBM Websphere

Borland Visibroker

BEA Weblogic Enterprise

Arno Puder MICO

Gerald Brose JacORB

Iona Orbix

Red Hat ORBit

Hitachi TPBroker

Harvard Arachne

OIS ORBExpress

Oracle 8i

Netscape Navigator 4.0

Lotus Notes 5.0

Novell Netware

Sun Java/IDL (in JDK 2)

Washington U. TAO

Paragon Software Oak

Lockheed-Martin HardPack

Fujitsu ObjectDirector

NEC ObjectSpinner

Gemstone GemORB

DNS SmalltalkBroker



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CORBA future

- See <http://www.omg.org/schedule> for RFPs adding new CORBA features:
 - **Pluggable protocols**
 - **Realtime Notification**
 - **CORBA/XML/Web services interworking**
 - **Smart transducers**
 - **Stream Control Transmission Protocol (SCTP) mapping**
 - **CORBA over Infiniband, etc**



CORBA



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CORBA Components

- **EJB-compatible components specification**
 - Usable with multiple programming languages (e.g. C++)
 - Extended compliance point adds extra features (e.g. events, multiple interfaces per component)
- **Multiple interoperable implementations demonstrated this year**
- **Being worked on mainly by telecoms companies**
 - Alcatel, Sprint, Siemens, Humboldt U, LIFL, ONE, Intalio
 - For use in telecom management software
 - Also referenced in Software Radio RFP



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Open Systems Avionics Technology II

- **Naval Air Warfare Center/Boeing demonstrator flies in AV-8B**
 - **Funded by US DoD Open Systems Joint Task Force**
- **CORBA integrates flight software across multiple COTS CPUs**
 - **Frees programmers from distribution complexities**
 - **Used C++, Ada95 components from OSAT-I, OSCAR**
 - **Copes with simulated in-flight CPU failure during bombing run in less than 50 mS**





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Model Driven Architecture

- **New OMG initiative to help design multi-platform, multi-technology applications**
 - **Based on modelling with UML**
- **Maintain common design base in a neutral, widely-used format**
 - **Unified Modelling Language (UML)**
- **Derive platform-specific UML models for platforms in use**
- **Use tools to transform platform-specific models into interface descriptions for all cooperating platforms**
 - **Links code to design, tools reduce coding and coding errors**



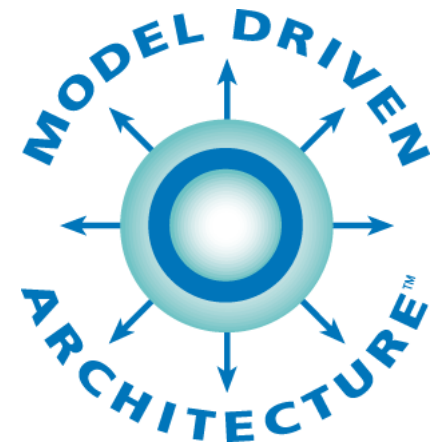
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Building an MDA application (1)

Platform-independent model

A detailed model, including pre- and post-conditions specified in OCL and semantics in Action Language

Start with a Platform-independent model (PIM) representing business functionality and behaviour, undistorted by technology details

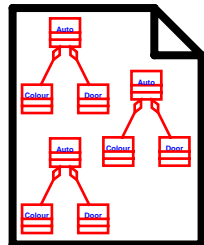


Building an MDA application (2)

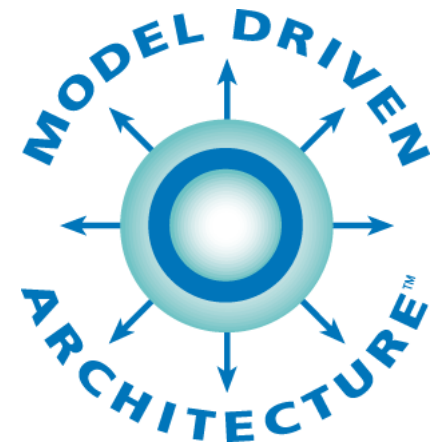
Platform-independent model

Map PIM to a specific
middleware technology via
OMG standard mapping

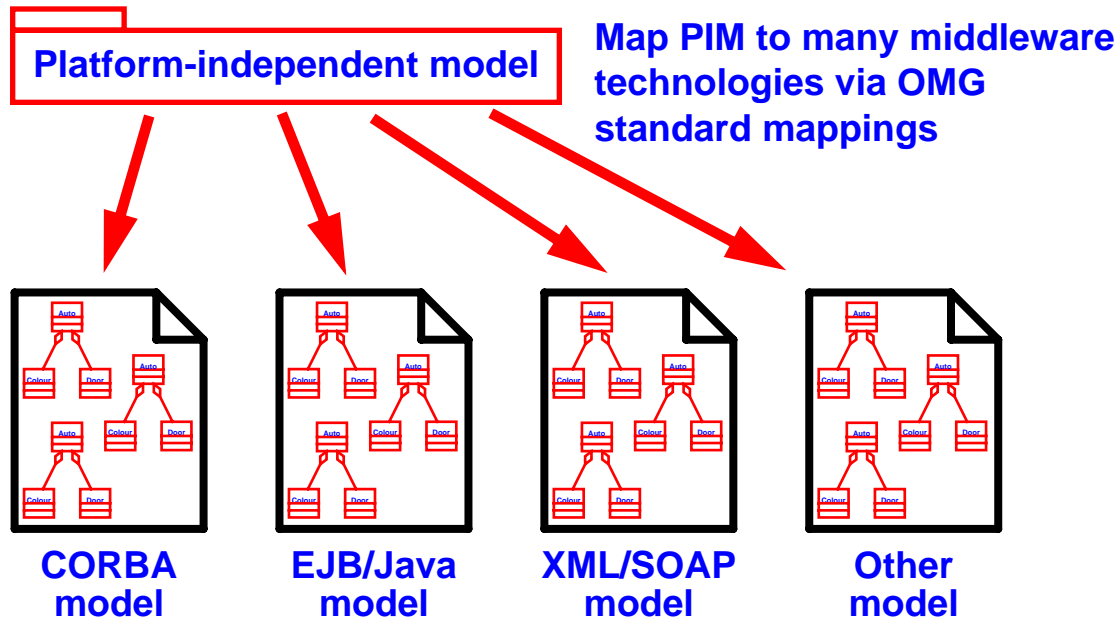
MDA tool helps apply
a standard mapping to
generate a Platform-
Specific Model (PSM)
from the PIM.



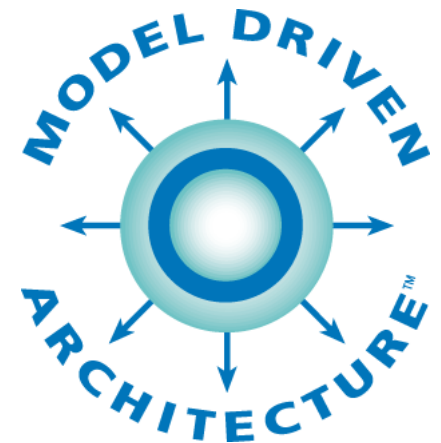
CORBA
model



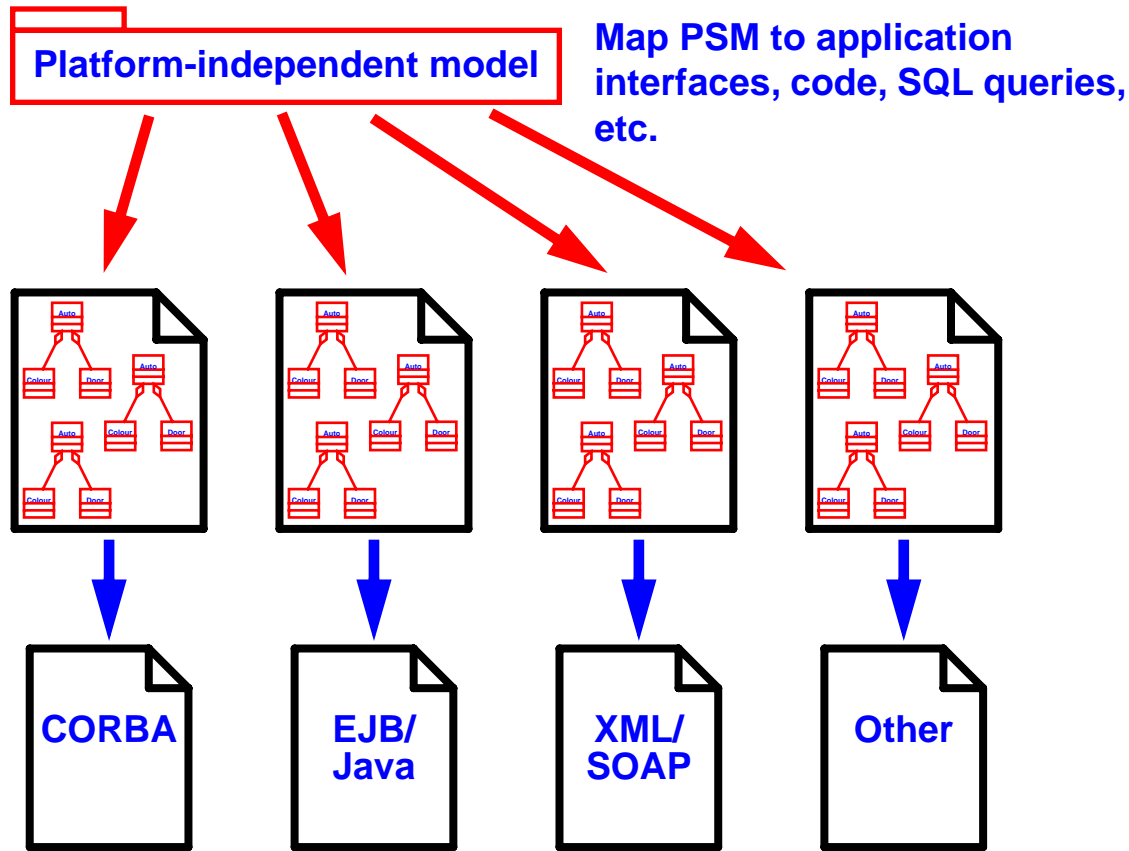
Building an MDA application (3)



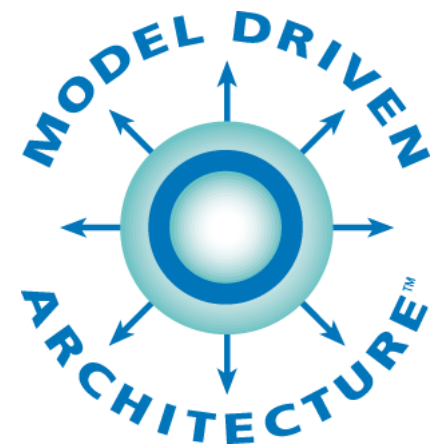
MDA tool helps apply a standard mapping to generate a Platform-Specific Model (PSM) from the PIM.



Building an MDA application (4)



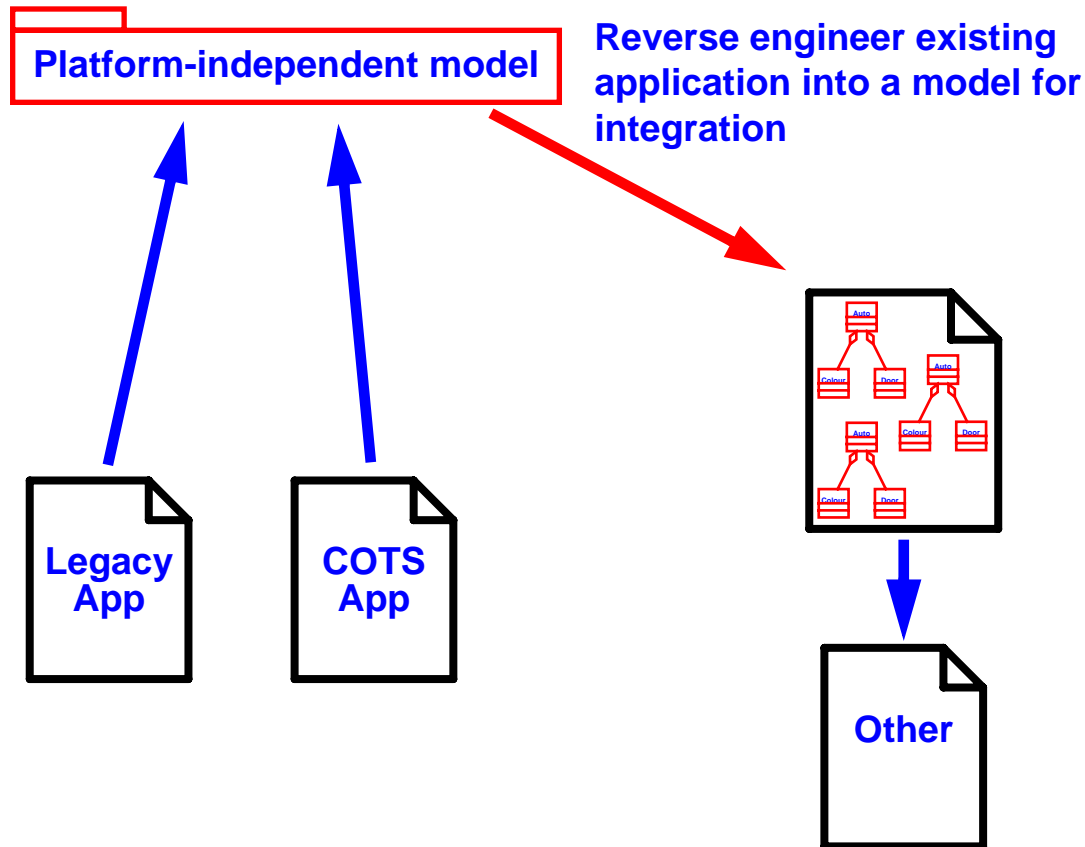
MDA tool generates all or most of the implementation code for deployment technologies.



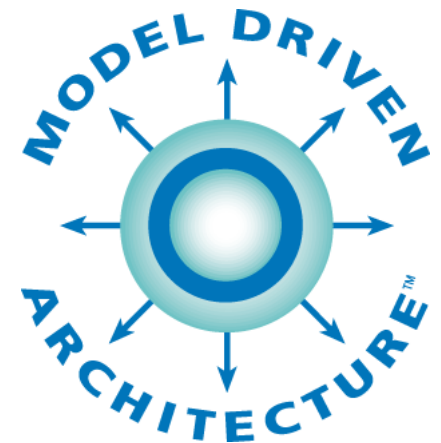


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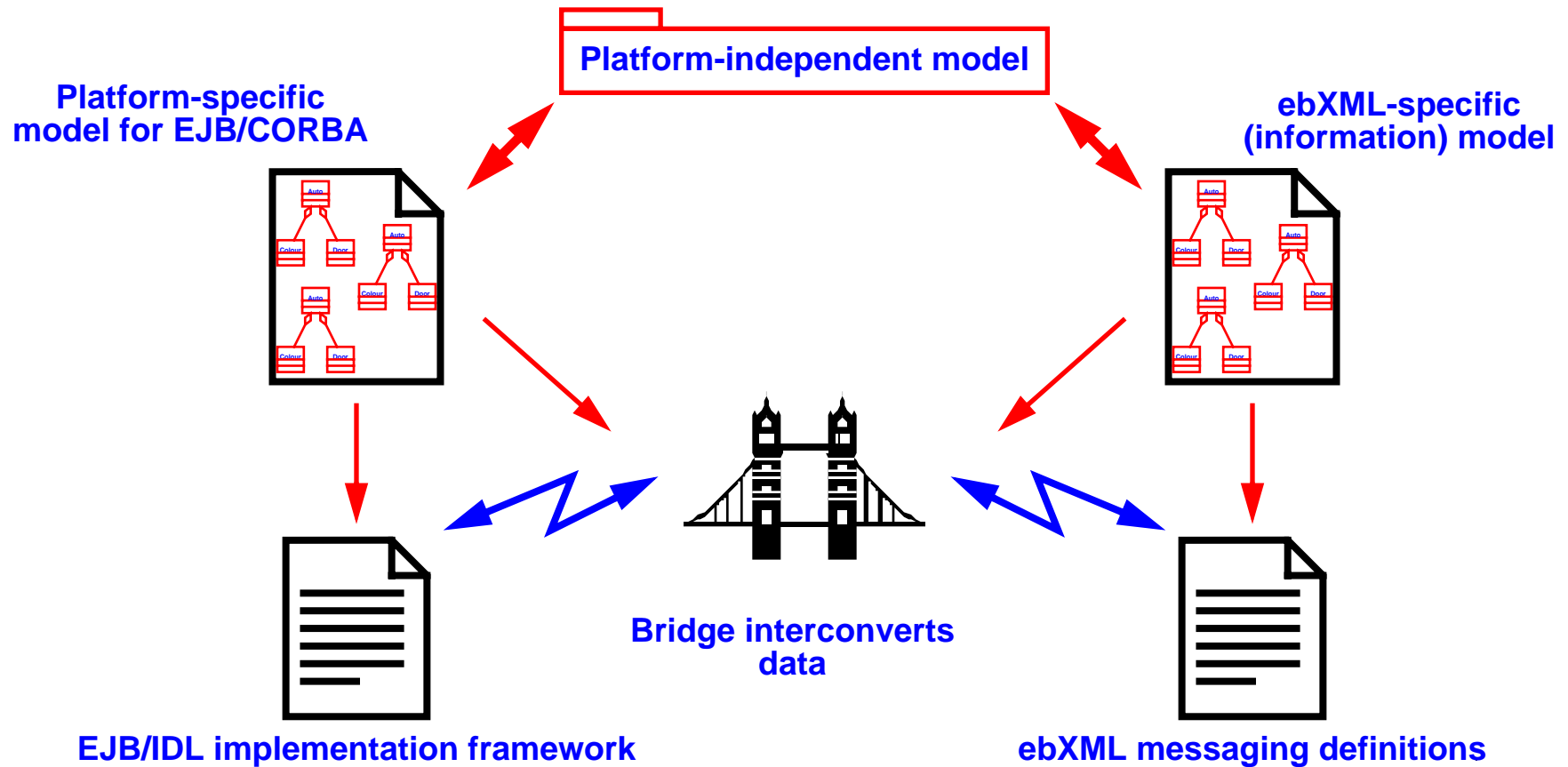
Building an MDA application (5)



MDA tools for reverse engineering automate discovery of models for re-integration on new platforms.



Automating bridges





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MDA in action: F-16 MMC

- **F-16 originally designed as a lightweight air-to-air day fighter**
 - **Jointly built by Belgium, Denmark, Netherlands, Norway, US**
- **First F-16A flew Dec 76, first operational Jan 1979**
 - **More than 4,000 F-16s manufactured to date**
- **Modular Mission Computer (MMC) in post-July 1996 aircraft**
 - **Also to be retrofitted to 1,000 earlier aircraft**
 - **Replaces computers for Fire Control, Head-up display, Stores management**
 - **Multiple MIPS R3000 64-bit CPUs, 60 MB memory, 155 MIPS**
 - **30x throughput & memory at 60% weight, volume & power**

F-16 MMC (2)

- **UML with Action Semantics specifies application behaviour**
 - **Platform Independent Model (PIM) not tied to APIs, OS or CPU**
 - **Complete representation of application in UML models (not a top-level or preliminary design)**
 - **Action Specification Language (ASL) yields executable model & early validation**
- **Tool used: Kennedy Carter iUML**





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F-16 MMC (3)

- **Design tagging specifies PIM to PSM mapping**
 - **Applied to, not embedded in, platform-independent model**
 - **Target-platform-dependent (in this case Ada-95)**
- **Mapping rules also specified in UML with ASL**
 - **Kennedy Carter supplied generic Code Generator**
 - **Lockheed Martin customised to optimise for MMC**
 - **Developed concurrently with application by 1-2 architects**
 - **Nearly all implementation-specific design tasks are performed by code generator, not software developers**



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F-16 MMC MDA benefits

- **Early design validation through simulation reduces rework**
 - **Increase in executable UML modeling span time is more than offset by decrease in Integration & Test span time**
- **Defect reduction**
 - **On a typical programme, after Requirements Definition approximately 2/3 of the defects are injected during coding**
- **40-60% of total 800,000 lines of Ada-95 generated by tool**
- **Application Software development schedule reduced by > 20%**



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OMG Software Radio SIG

- **Group working on Software Radio within OMG**
 - **Based on JTRS Software Communications Architecture**
- **Within OMG, gain access to (and influence direction of) real-time & embedded secure CORBA platform**
- **Using MDA approach to specify SCA in technology-neutral, tool-driven UML (PIMs and PSMs for Software Radio)**
- **See <http://swradio.omg.org/>**



OBJECT MANAGEMENT GROUP

OMG ISO Liaison

- **Close co-operation with ISO ODP work for many years**
 - **Object Management Architecture aligned with RM-ODP**
 - **OMG trader specification based on ODP work**
 - **OMG IDL became ISO standard (14750) through SC21 WG7**
- **OMG now has ISO Publicly Available Specification (PAS) status**
 - **Allows OMG specifications to be advanced to ISO standard in 1-2 years**
 - **IOP/GIOP has become ISO 19500-2, UML will be ISO 19501**
 - **Expect to see more OMG platform and domain specifications become ISO standards**



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Other Liaisons

ITU-T/SG4	TMN and CORBA
ITU-T/SG17	UML, SDL & security issues
3GPP	Universal Mobile Telecom Systems (UMTS) arch.
TMF	Next Generation Operating Support System
Parlay	Telecom APIs
ASC T1M1	US network management standards

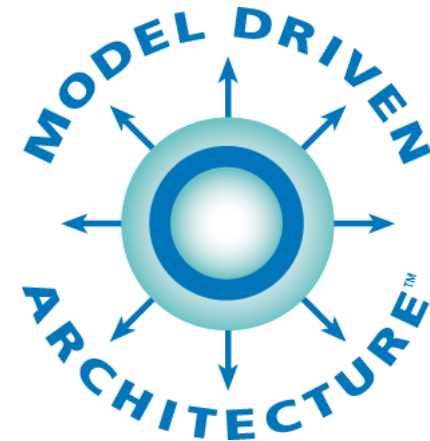
More listed at <http://www.omg.org/news/about/liaison.htm>



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For further Information

- **General:** <http://www.omg.org>
- **UML:** <http://www.omg.org/uml/>
- **MDA:** <http://www.omg.org/mda>
- **SW Radio:** <http://swradio.omg.org/>
- **Email:** andrew@omg.org



Thank You



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Reserve slides



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Recent CORBA versions (1)

- **CORBA 2.3** **June 1999**
 - **Objects by value (mainly for Java integration)**
 - **COM/CORBA interworking**
 - **Language mappings moved to separate books**

- **CORBA 2.4** **October 2000**
 - **Asynchronous messaging**
 - **Firewall**
 - **Minimum CORBA (for embedded systems)**
 - **Real-time CORBA (static scheduling only)**



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Recent CORBA versions (2)

- **CORBA 2.5** **September 2001**
 - **Fault tolerance**
 - **Portable Interceptors**
 - **Real-time 1.2**
- **CORBA 2.6** **January 2002**
 - **Secure Interoperability**
- **CORBA 3.0 (by year end) to include formal publication of CCM (CORBA Component Model)**
 - **Not formally published until implementations available**