

You Can't Do That With Smalltalk! - Can You?
*Lessons From The Past - Challenges For
The Future*

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About The Talk

- Brief History Of Commercial Smalltalk
- Yes You Can! - The OTI Smalltalk Experience
- Opportunities For Smalltalk
- In Search of Sapphire - ScriptingSmalltalk
- Summary

Commercial Smalltalk The Early Years 1984 - 1994

- PPS Smalltalk Dynamic Translation - Peter Deutsch
- Tektronix AI Workstation
- Digitalk Methods and Smalltalk/V
- Apple Lisa Smalltalk
- Berkeley Smalltalk - Generation Scavenging
- Gemstone
- ST/VMac Digitalk and OTI
- OTI Envy/Developer
- Tektronix Oscilloscopes and OTI Embedded Smalltalk/V, CRC, RDD

Commercial Smalltalk The Early years 1984 - 1995

- Instantiations TeamV, KSC mentoring, Object People - Toplink, Objectshare WindowBuilder
- Digitalk VisualSmalltalk, PPS Visualworks, Envy Smalltalk, Smalltalk/X
- ANSI ST, IBM VisualAge/Smalltalk and Mainframe Smalltalk
- QKS Smalltalk Agents, Dolphin Smalltalk, MTS Smalltalk
- Optimizations - Polymorphic Inline Cache
- Namespaces and Packages

Commercial Smalltalk Research and Development Post 1995

- StrongTalk, OTI Uvm, Smalltalk/X Java Extensions, PPS Jigsaw (last major commercial R&D)
- Circa 95/96 - Dolphin, Smalltalk MT, Squeak

Once Upon A Time A Long Long Time Ago

- A small new CS department with 3 Professors wanted to use to understand OOP
- We had 1 Sun 2 workstation and 3 Apple LISA and many PCs and Macs
- We introduced Smalltalk into first year, and we performed world class research with few resources
- We just set out to find the best tools for our work and focused on interesting industrial applications
- We sought a long-term research agenda called Object Utopia
- We liked the technology so much we started a company
- We seeded OTI, Object People, Object Time as well as several other companies and participated in enabling an industry

The Wall Street Journal - June 17,
2000

"Today Utopia Inc.. announced the long awaited OU/200000, the world's first fully object-oriented computer system. The development language for OU/200000 system software/ firmware as well as the end user 5GL programming language are dialects of Lavata. The machine uses custom VLIV technology to directly implement the object management 5GL architecture."

Passive

Reflective

Trusted

Object Utopia

Persistent

Distrib.

Active

How Can Virtual Machines Be Efficient for Real Applications?

- Migrate Application "case tests" into message dispatch
- Uniform Representation of Descriptions and Programs
- Highly Optimized Application Oriented Instructions
- Exploit On-Chip Resources - Memory or Registers
- Exploit Software Locality - Cache
- Efficient Memory Management - SGC

OTI Virtual Machine Technology

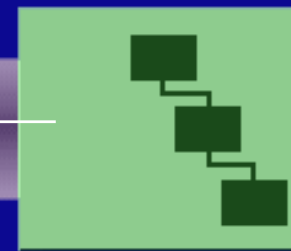
- Widest range of supported platforms:
 - iX86, 370, PowerPC, PA-RISC, SPARC, MIPS, Alpha, 68K...
 - Windows, NT, MVS, OS/2, AIX, HP/UX, Solaris, Mac, OS/400..
 - RTOS such as VxWorks, OSOpen, OS/9, QNX...
- VMs built with advanced Meta-VM generator technology
- Designed for embedded - in low memory applications the RTOS is not required and can be eliminated ("bare metal")
- Designed to be Re-entrant (thread able for SMP, MPP) and Rumble
- Extensive interfaces to other languages
 - Call-outs, Call-ins & Call-backs
- Dynamically loadable "applets"

Virtual Machine Development Process

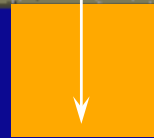
Generic VM
Framework



Processor
Description



Meta
VM
Builder



Processor Specific VM

Scaling Up? "But Can You Run It Under CICS?"

- Support for transaction based applications
- Mainframe
- Multi-processor SMP and MPP
- Distributed
- Security

Scaling Up To Today's Legacy Systems

Urgent HTTP message from Jurassic Park

...locating host connect ... waiting ...

“The Dinosaurs are back check the stock price!!!”

- MVS CICS/DB2, IMS, Batch
- AS/400 RISC
- Mixed COBOL/PLI/RPG/C + VM
- Terminals and Thin Clients



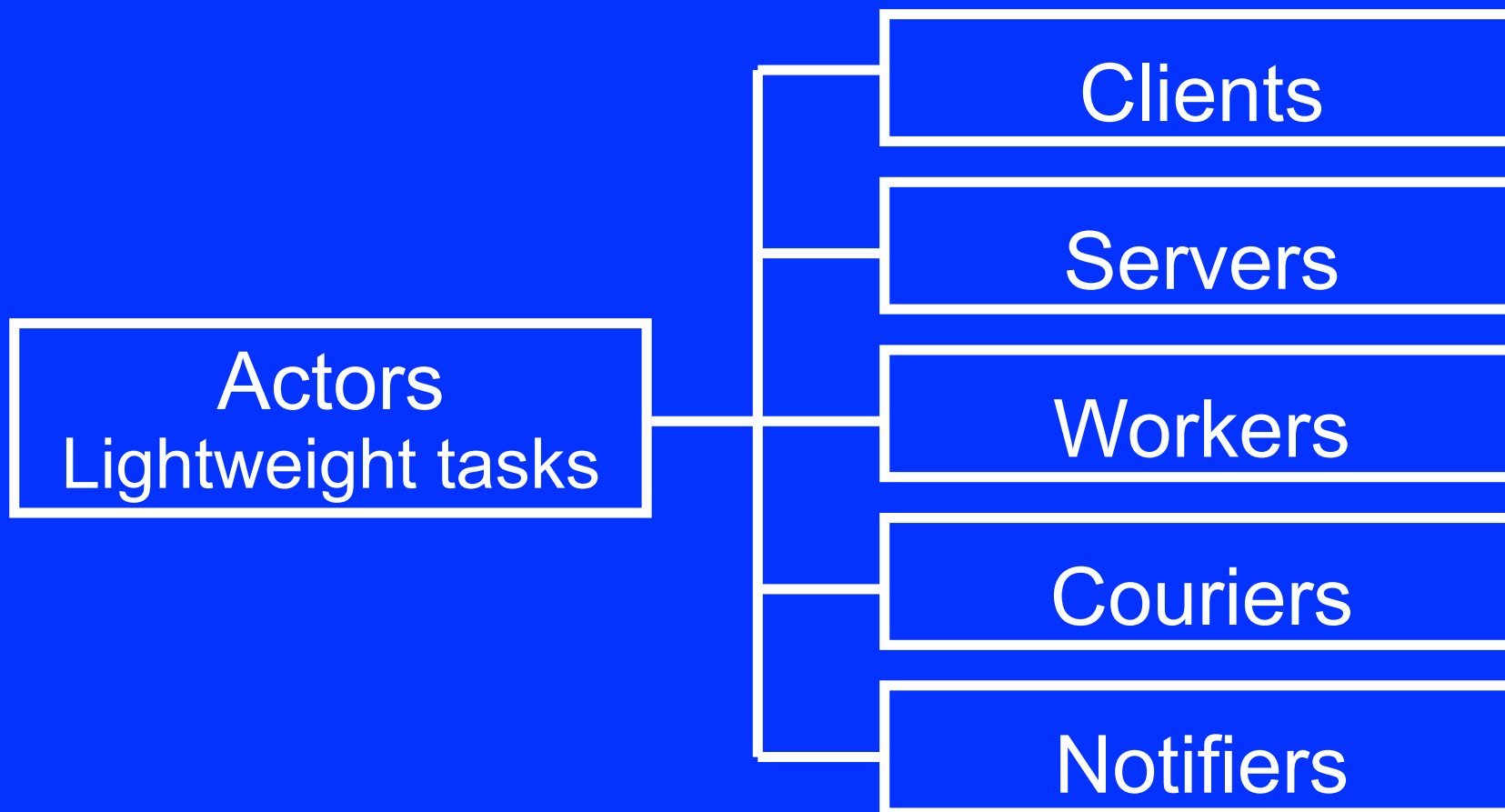
JCL For Building CICS TP Image App

```
BROWSE -- ESIMA3.MSA3.MUSST.JCL(BLDIMS) - 01.19   LINE 00000000 COL 001 080
COMMAND ==>                                     SCROLL ==> PAGE
*****
//PLKED      EXEC PGM=EDCPRLK, PARM= 'MAP, MEMORY, NOER, NOCAL',
//          REGION=3072K
//STEPLIB    DD  DSN=CEE.U1R3M0, SCEERUN, DISP=SHR
//SYSMSGSGS  DD  DSN=CEE.U1R3M0.SCEEMSGP(EDCPMSGG), DISP=SHR
//SYSLIB     DD  DSN=&STDEUL..MUST.OBJ, DISP=SHR
//          DD  DSN=&STDEUL..&STGRP..OBJLIB, DISP=SHR
//SYSMOD     DD  DSNAME=&&PLKSET, UNIT=UIO, DISP=(MOD, PASS),
//          SPACE=(CYL,(1,11)),
//          CB=(RECFM=FB, LRECL=80, BLKSIZE=3200)
//SYSOUT     DD  SYSOUT=*
//SYSPRINT   DD  SYSOUT=*
//LIBRARY    DD  DSNAME=&STDEUL..&STGRP..OBJLIB, DISP=SHR
//SYSIN      DD  DSN=&STDEUL..&STGRP..OBJ(MAIN), DISP=SHR
//          DD  DSN=&STDELU..&STGRP..OBJ(EBCDIC), DISP=SHR
//          DD  DSN=&STDELU..&STGRP..OBJ(CFLTPR), DISP=SHR
//          DD  DSN=&STDELU..&STGRP..OBJ(CINTPR), DISP=SHR
//          DD  DSN=&STDELU..&STGRP..OBJ(COMPFIX), DISP=SHR
//          DD  DSN=&STDELU..&STGRP..OBJ(CONTEXT), DISP=SHR
//          DD  DSN=&STDELU..&STGRP..OBJ(DEBUGDLL), DISP=SHR
F1=HELP      F2=SPLIT      F3=END      F4=RETURN      F5=RFIND      F6=RCHANGE
F7=UP        F8=DOWN       F9=SNAP     F10=LEFT      F11=RIGHT     F12=RETRIEUE
Print operation complete to the default printer device file.
```

Scaling Up To Servers

- Support for heterogeneous transaction based applications
- Distributed and SMP
- Huge Memory and Massively Parallel

Conventional SMPs (4-64 Processors)

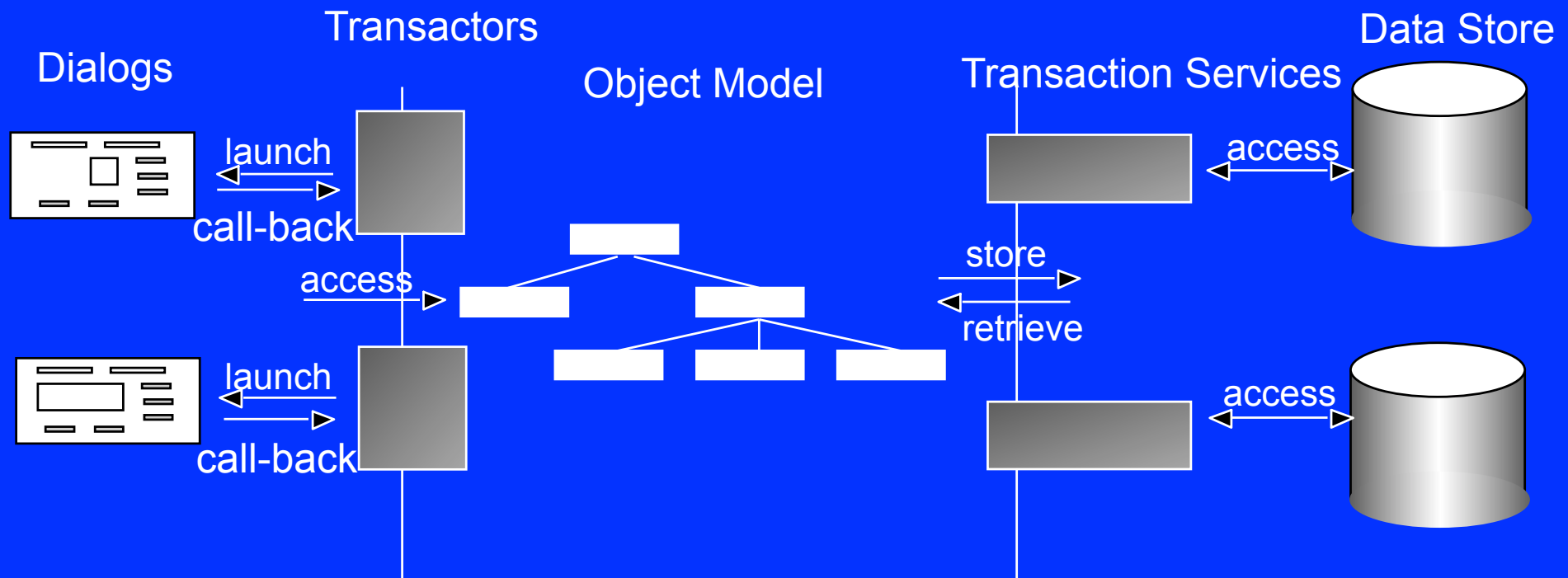


Persistent Transaction Framework (PTF)

Application Programmer (Use Cases)

ODMG

Data Access Programmer (IDL/SQL)



Actors - Active Objects

- Anthropomorphic Programming - Clients, Servers, Agents, Managers, Secretaries, Couriers, Workers, Notifiers ...
- First Class Active Components which encapsulates a set of state and behaviour together with a thread of control
- Transactors = Active Transactions with atomic behaviour
- Business Processes = Workflow + Rules + Control (e.g.. Taylor engines)
- Agents = Actor where methods are rules
- Avatar = Actor where method is script and displayOn: uses VRML

Server VMs

- Communications Middleware
- Object Marshalling and Transmission
- Async Call-in Callout
- Integration with TP Monitors
- Multi-tasking (threading) and Multi-processing (e.g.. SMP) shared memory, VM & GC
- Concurrent Debug and Performance Tools
- Concurrent Programming Model(s)
 - e.g.. Actra, Concurrent Smalltalk, Linda, Simula ...
- Thread Safe Libraries
- Large Memorys and Object/Relational Persistence

Distributed VMs

- Server plus ...
- Distributed VM and GC support
- Distributed Debug and Performance Tools
- Distributed Programming Model(s)
 - communicating images (SCI, RMI or ORB)
 - proxies and transparent forwarders
 - distributed virtual memory with logical processes

Working in the MUD - Jupiter/ Worlds

Places and Spaces - Supporting Virtual Organizations

Working in the MUD

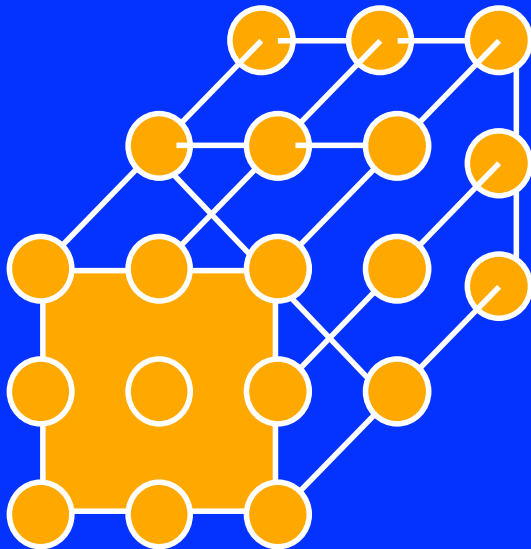
- Large Memory Server (10GB -1000GB)
- Variable Bandwidth Connections (3270 to VRML)
- Complete Simulation of Business Processes
- Simulation Model = Image
- Multi-user Shared Image
- Image is up to date and database is backup
- Thread Safe and Persistent Libraries
- Federated Business Objects
- Business to Business Communication = Interacting MUDs

Security - Trusted VM

- Capability protection within the virtual machine
- Garbage collector is security aware
- Virtual machine (VM) is verified
- Security policies are behaviors

Fine Grained (4K-64K Processors)

- visibleStars do: [:star |
star twinkle]



Applications

- + Behaviour investigation (N-Body)
- + Execution domain changes (ENVY/*Expert*)
- + System design and construction (Vibes)
- + Executable Business Models

CodA - ENVY/Expert Implementation

- Implemented in Smalltalk on 512 processor Fujitsu MPP
- Integrated with full environment
- Reuse entire Smalltalk class library
- 18 methods annotated
- 16 methods added
- Only 34 of 1000 methods affected
- Lazy and transparent

Applications Oriented "Thinking Machine"

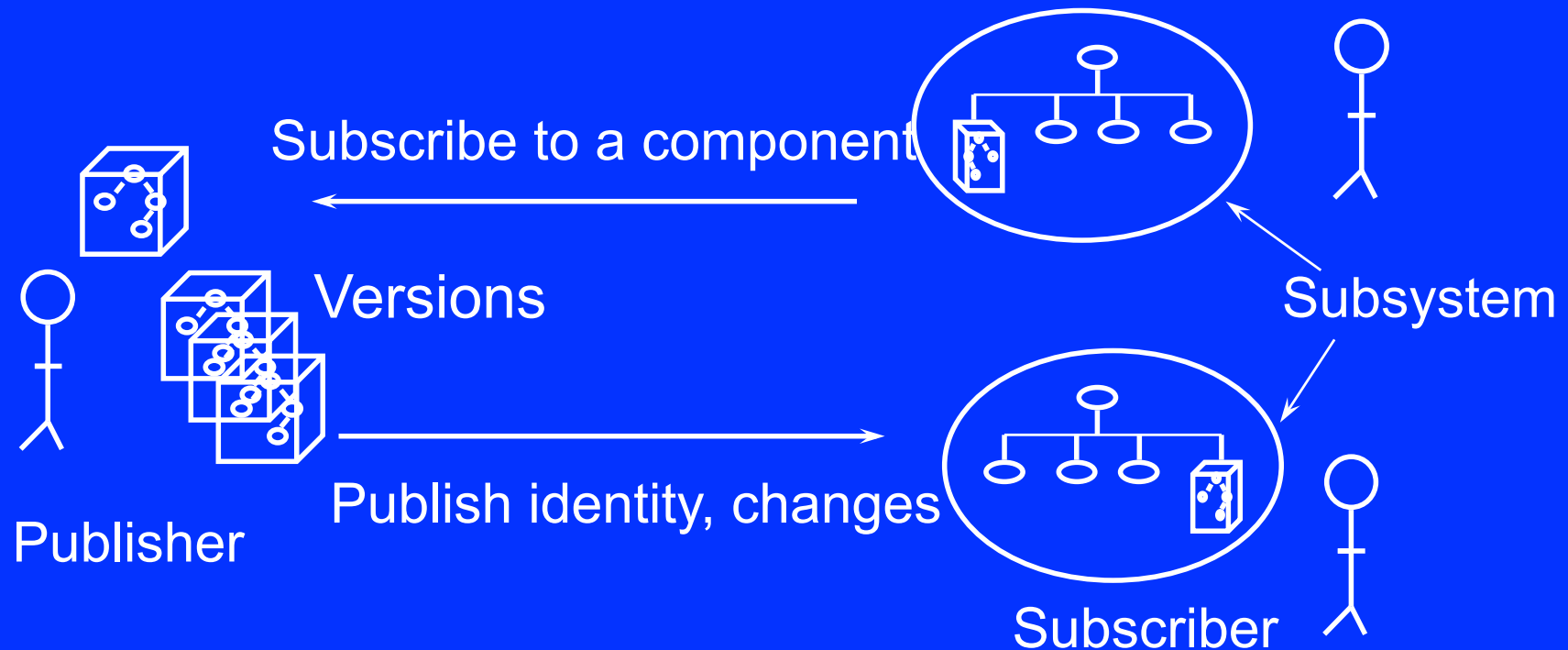
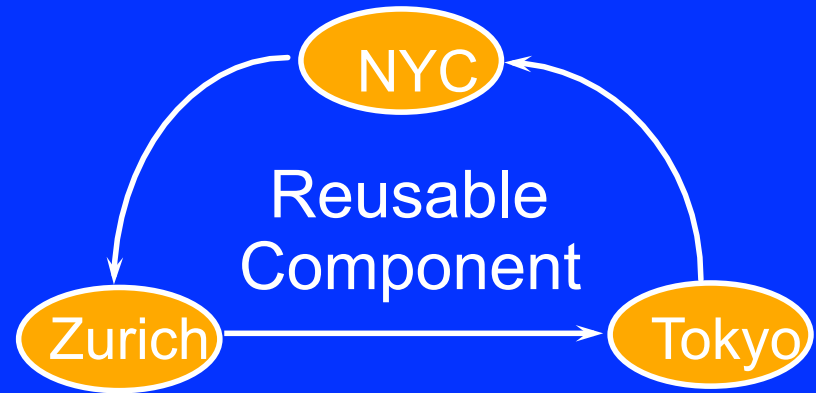
- high performance reliable fibre and serial buses
- simple processors with private reliable flash or CMOS memory
- distributed shared memory for some applications
- fault tolerant distributed middleware
- message and object oriented programming
- one or more objects multiplexed to a processor/VM giving a processor per business object
- computer system models system it simulates

MPP Applications

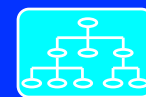
Every Object has a Processor

- Every airplane has a processor and keeps track of it's flights
- Every customer has a processor which keeps track of their bank accounts
- Every business process has a processor
- Every airplane component has a processor and keeps track of it's self
- Every industrial process has a processor which monitors it's progress
- Every room has a processor which keeps track of the room

Components Everywhere!



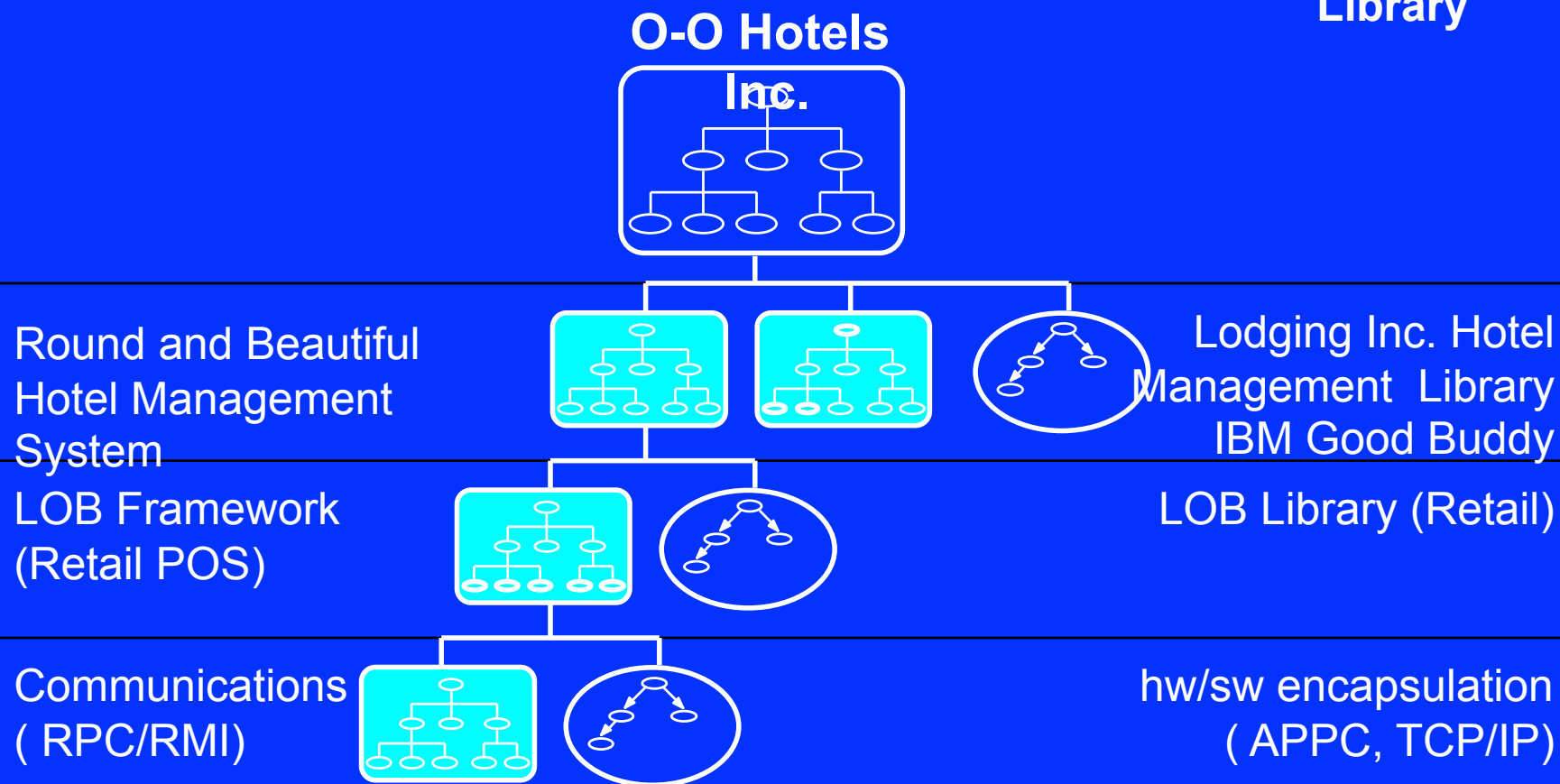
Example Software Bill of Materials



= Subsystem



= Component Library



Component Publishing

Experience with ENVY/Packager, Swapper and App

- component publisher must be able to select
 - granularity method, class, component, library
 - package format (.exe; shared library; rom; ocx, app, ssl)
 - visibility of source, object, interfaces, partial
 - binding time from shrink wrap to load on demand
 - package for multiple platform
 - package for multiple countries
 - package for specific customers
 - include/exclude associated materials such as initialized data, help, icons

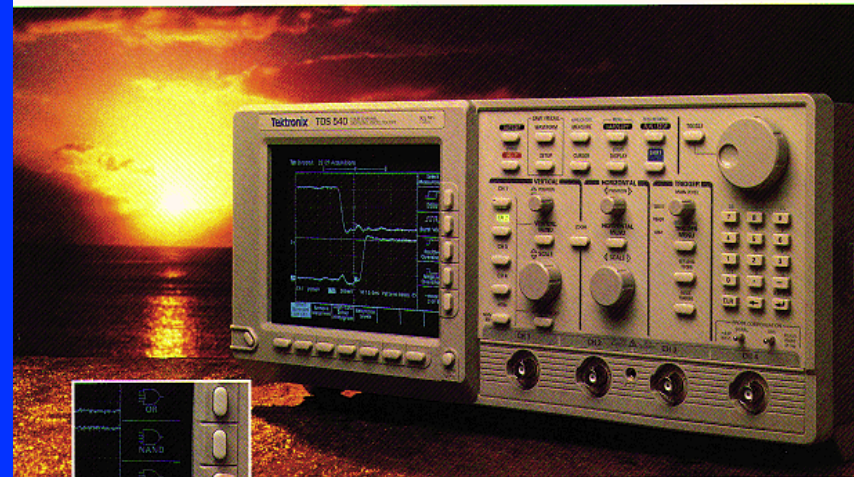
Scaling Down to Embedded Systems - NCC, PDA and Internet Appliance

- Compact virtual machine
- Interrupts
- Minimal image
- ROM, Flash, PCMCIA based applications
- Separate development and target environments

Tektronix TDS 500 Series Oscilloscope

- 500MHz bandwidth
- friendly UI - waveforms + icons + soft keys
- Multiprocessor MC68020 and DSP
- Smalltalk + C/DSP assembler (DSP)
- approximately 250 classes
- nearly all in ROM
- uses less than 64K DRAM

You have to build a million oscilloscopes to build just one like this.



More than a million Tektronix oscilloscopes have all been leading up to this: the most powerful, versatile, and intuitive instruments ever developed for the mainstream of test and measurement.

It's all made possible by new levels of integration. By a unique multiprocessor architecture that includes Tek's TriStar™ Digital Signal Processor (DSP). And by real advances in making high performance look easy.

The TDS Series arms you with up to four full-featured channels. With 500 MHz bandwidth. Up to 1 GS/s sampling and 4 ns peak detect. Up to 50K record lengths. Plus time interval, 2 ns glitch, runt,

pattern and state triggers. Its real-time DSP lets you perform single-shot averaging and extend resolution to 12 bits.

Simplified front panel, VGA-quality display resolution, on-line help, and innovative graphic menus with display icons — all add up to an intuitive user interface you must see to appreciate.

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One company measures up.

Tektronix
COMMITTED TO EXCELLENCE

Texas Instruments Integrated Wafer Fabrication Facility

- Goal - reduce fabrication costs and cycle times by 10
- High level factory management tasks - planning, scheduling, production tracking
- Low level tasks - process control and diagnostics, performance monitoring, intra-machine scheduling, quality control
- Smalltalk initially used to construct a simulation of the system architecture and the user interface

Application Example

Embedded PBX

- 8 line PBX/Voice Mail System w/- T1 interface
- Based on Motorola 68360 micro controller
- 500 classes
- < 2 Megabytes of ROM and 1 Megabyte of RAM
- To field testing in 9 months
- Ready to ship in 12 months

Application Example Gas Analyzer

- Based on Intel i386 processor
- Embedded DOS with 32 bit extender
- 1 megabyte of ROM 1 megabyte of RAM
- < 6 man months

PDA Framework



DTO



VisualAge Embedded Tools

- Development Workstations - WinTel; AIX, OS/2, HP-UX, Solaris, QNX
- Target Processors - PowerPC, 68K, x86, MIPS, Alpha, ARM
- RTOS - QNX, OS/9, OSOpen, VxWorks, JavaOS
- Bare-metal - In many space demanding applications where the RTOS can be eliminated.
- PowerPC 403GA - Uses the OS Open RTOS. Provides a basis for customer evaluation and early application development

The Smalltalk Opportunity Today

- Tools for research
- Tools for reverse engineering
- Grid and MPP Computing
- Meta-modeling and Meta-Programming environments
- Simulation Environments For eLearning
- Searching For Sapphire?

In Search of Sapphire - ScriptingSmalltalk

- Perl, Javascript, PHP, Python, Ruby ... needs competition - bad design, too complex, too slow
- TTY Smalltalk with friendly Publication Language and ASCII Syntax
- Java like class and package structure
- Proper Modules, Namespaces and Components
- Multiple IDE Support - Smalltalk-80, Eclipse, Visual Studio.Net
- Proper lexical closures and continuations
- Don't Ignore Functional and Vector Languages

In Search of Sapphire - ScriptingSmalltalk

- Bindings to Windows and Linux platforms C APIs (internet programming)
- Better support for strings, XML, threads (persistent CGI)
- SapphireWeblog - Smalltalk's own vision of Zope which combines, Wiki, Web server
- Improved Libraries - Simplified (VB) and better Algorithms
- Image disappears and reappears as a cache
- Smallscript.net and F-Script are exemplars, we need more

Summary

Respect The Best - Embrace The Future

- The path to widespread use or commercial success is never clear - follow the customer
- Customers keep you honest and should force you to simplify
- Smalltalk is a much better language for modeling the world
- Smalltalk is a much better language for modeling than UML
- Smalltalk is a much better language for scripting than Python, Ruby, PHP etc. but needs to meet them on their own terms

