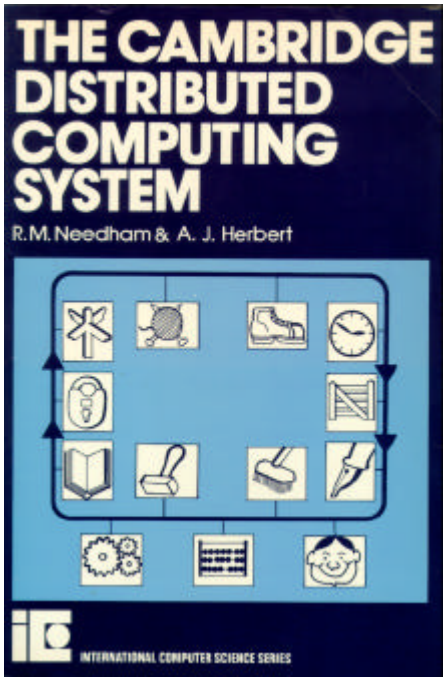
An ANSA Retrospect

Andrew Herbert

1982



1985-98

1998

CITRIX

Citrix Systems, Inc. is the leading provider of thin-client/server system software for delivering high-performance, cost-effective deployment of business-critical applications throughout the extended enterprise.

ANSA Objective

- Harvest academic research in distributed computing and produce
  - an industry standards architecture for distributed systems
  - prototype technology for vendors
  - demonstrator applications for users
- On behalf of ANSA Consortium members
  - computer vendors, systems integrators, telecoms vendors, telecoms operators, end-users

Time line

- 1983-84 Project conception
- 1985-88 Alvey ANSA Project
  - 50% UK Government funded, 12 UK & US companies
- 1988 APM founded
- 1988-92 ESPRIT ISA Project
  - 50% ESPRIT funded, 24 European & US companies
- 1993-98 ANSA Phase III
  - 100% industry funded 12->6 companies
- 1996 APM creates Digitivity Inc
- 1988 APM & Digitivity acquired by CITRIX

Computing in 1985

- DEC VAX and IBM mainframes
- Sun just starting to sell in Europe
- 10M Ethernet, 9.6Kbs modems
- Unix 4.2BSD
- OSI vs TCP/IP
- Xerox Star Document System
- WordStar on PC's
- Microsoft - just one of several PC OS vendors

Starting Points

- State of the art review of research
  - RPC systems (Sun, NCS)
  - TP systems (Argus)
  - Process groups (ISIS)
  - Directory systems (DNS, Grapevine)
  - Symmetric encryption, KDS-based Authentication
- Correlation with industry requirements
  - telecoms sponsors demand dependability & scalability
  - computer sponsors demand inter-operability and developer productivity

What is “architecture”?

- Separation of concerns in design process reflected in system structure
  - scenarios & perspectives
  - dimensions for “unified” system model
    - domain separation (“aspects”) e.g., management, communications
    - abstraction separation (“projections”)
- Components (interfaces vs implementations)
- Rules -- compulsory patterns
- Guidelines -- useful patterns

Alvey ANSA Results

- ANSA Reference Manual
  - Introduced distributed computing to sponsors
  - Concept of “service” - separation of interface from implementation
  - Local autonomy versus global consistent schema
- ANSA Testbench
  - Gave sponsors hands on experience of developing applications
  - Widely used in academia
  - Used in products (ICL DAIS) and real applications (NASA ADS)

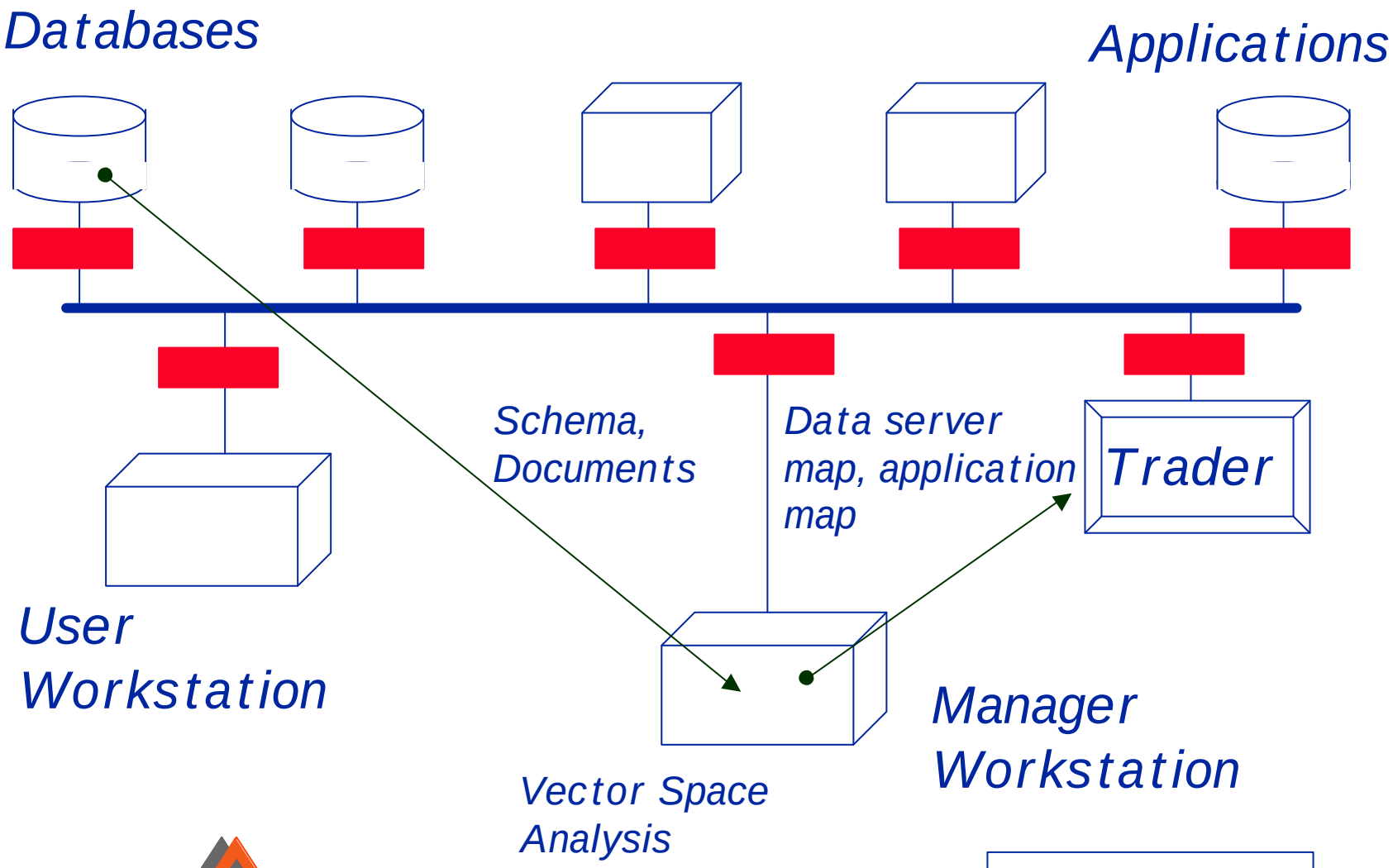
Reversed Assumptions

- Local->remote
- Direct->indirect binding
- Sequential->concurrent execution
- Synchronous->asynchronous interaction
- Homogeneous->heterogeneous
- Single instance->group
- Fixed location->migration
- Single name space->federated name space
- Shared memory->disjoint memory

ANSA Testbench

- Complete RPC environment
  - Interfaces: IDL and STUBG
  - Abstraction: PREPC
    - added “interfaces”, “remote operations”, “threads” and “exceptions” to C
    - c.f. DCE APIs
    - hide engineering detail from application developer
  - Trader
    - federation rather than hierarchy
  - Basic host management system
- Delivered as source code

NASA ADS



ESPRIT ISA - 1988-92

- Standards
  - RM-ODP: Viewpoints, Selective transparency
  - CORBA 1.1->2.0
- Prototypes
  - ANSAware: Interface references, Persistence, migration, replication
  - Arjuna: transactional C++ objects
  - DPL: network objects
  - IMAC: multi-media services

ODP Viewpoints

- Need to separate concerns (without free variables)
  - Enterprise = Policies, Boundaries
    - actors, resources, goals, constraints
  - Information = System Modelling
    - representation of objects, description of processes
  - Computation = Programming
    - location of functionality, interfaces
  - Engineering = Abstract Machine tool kit
  - Technology = Standards
- Not layers, not a design process…

Did the viewpoints work?

- Information
  - OMG is using UML to model functionality
  - Introspection in CORBA and Java
- Computation
  - Java comes very close
- Engineering
  - A computational reflection of the abstract machine
  - ANSA FlexiNet
- Abstract and Automate tools vision unfulfilled
  - component oriented middleware; Java EJB

Transparency

- Access
- Location
- Relocation
- Migration
- Failure
- Replication
- Persistence
- Transaction

Features which distinguished different distributed computing infrastructures

Holy grail is compositional transparency mechanisms

Selective Transparency

- Full transparency is expensive - defaults can exploit application knowledge
- Want same API across all transparency choices for application portability
- Provide a control interface to allow the application to interact with the transparency mechanism

OMG and Transparency

- Explicit CORBA Object Services
  - "transparent mode" relies on implicit context parameter
- Revision of CORBA APIs and IIOP as each new service transparency added
- Java RMI making the same mistake
- Filters and transformers in Orbix don't share session context
- Starting to address the issue with the POA

ANSA Phase III 1993-6

- Real-time multi-media
  - ANSAware/RT
  - DIMMA
- WWW & CORBA -- web-based applications
  - ANSAweb
  - Quartz
  - Reflective Java
- End-to-End Security for the Internet Project

Real-Time Multi-Media

- Driven by telecoms oriented sponsors
  - Telephone / data networking convergence - TINA
  - Managed quality, multi-service network
- Stream Objects and Explicit Binding
  - Nice abstraction for flow and event-based communications (TCP, RTP, …)
- Resource Controls
  - Application scheduling of buffers, threads and objects
  - Forced clean internal structure
  - Allowed high performance paths
- Commercial demand not strong enough

RETINA vs DCAN

- RETINA: TINA distributed processing environment built to ODP & CORBA rules
  - heavyweight switches export “connection manager” to CORBA DPE
  - complex QoS negotiation and connection control interfaces
  - CORBA-based telecoms management
- DCAN: Distributed Control of ATM Networks
  - CORBA-based connection managers create service-oriented networks across lightweight switches
  - demanding performance and reliability criteria on ORB
  - CORBA-based telecoms services

CORBA and WWW

- ANSAWeb showed
  - CORBA client could drive a web application
  - A Web Server could drive CORBA applications
  - IDL <-> HTML form mapping (c.f. servlets)
  - IIOP outperforms HTML (connection caching)
- Quartz demonstrated combination of
  - Push (via email)
  - Pull (via HTML/HTTP)
  - CORBA integration
  - Convinced sponsors Web applications were practical

ANSA Phase III 1997-8

- FlexiNet
  - Component-oriented ORB for Java
  - Exploit reflection and introspection
  - Generate stubs on deployment
  - Federated class loading
  - Nearly full set of transparency mechanisms
  - Turned out to implement RM-ODP structures!
- FollowMe
  - Mobile object / Persistent information space infrastructure for a mobile agent project

ANSA & APM

- APM Ltd founded in '88 to run ANSA Laboratory
  - employ staff
  - enter contracts
- Started commercial activities to ensure "life after ESPRIT"
  - sold ANSAware, training, consulting
- Compatible with consortium during early phases
  - created tensions when distributed computing became commercially important

The End Game

- ANSA completed in December 1998
  - FlexiNet very close to full implementation of computational and engineering viewpoints
- APM Ltd consulting thrived
  - web apps are a system integrator's paradise because there is no guiding architecture
  - ANSA/RM-ODP helped us succeed
  - Java EJB based tools and infrastructure and MSFT IIS/MTS/COM are emergent architectures
- Security has become a real issue

APM to Citrix

- APM Management looking for life after ANSA
  - consolidate consulting
    - needed more domain expertise
    - organic growth is hard slog
  - exploit security opportunity
    - higher risk, but faster growth opportunity
    - brain-stormed CAGE product and business plan
    - sought $5m investment to create product division
      - Digitivity, US persona
- Acquired by Citrix in 1988 for $40M
  - for Java, security, “vision” and architecture expertise

Summary

- Met our goals
- Consistently predicted 2-3 years ahead
- Good value for sponsors -- 140my effort for 15my expense each
- Helped get CORBA established
- Help Telecoms industry get to grips with distributed computing though RM-ODP, TINA, etc
- Provided open source extensible platform for application oriented projects
- RM-ODP gave us a good consulting business helping newcomers to the field
- Trained an excellent engineering team for Citrix