Poseidon House
Castle Park
Cambridge CB3 0RD
United Kingdom

TELEPHONE: **Cambridge (01223) 515010**
INTERNATIONAL: **+44 1223 515010**
FAX: **+44 1223 359779**
E-MAIL: **apm@ansa.co.uk**

Training

ANSAwise - CORBA Event Management and Message Queuing

Chris Mayers

Abstract

Existing computer systems may already use an approach to distribution.

This module of the ANSAwise programme describes the Remote Data Access, Remote Procedure Call, and Robust Queued Messaging approaches. It examines Robust Queued Messaging, and concludes that although the technique may be valid, it is not inherently any more robust than the others. However, it does provide a more asynchronous form of communications.

Remote Data Access and Remote Procedure Call are not examined in detail

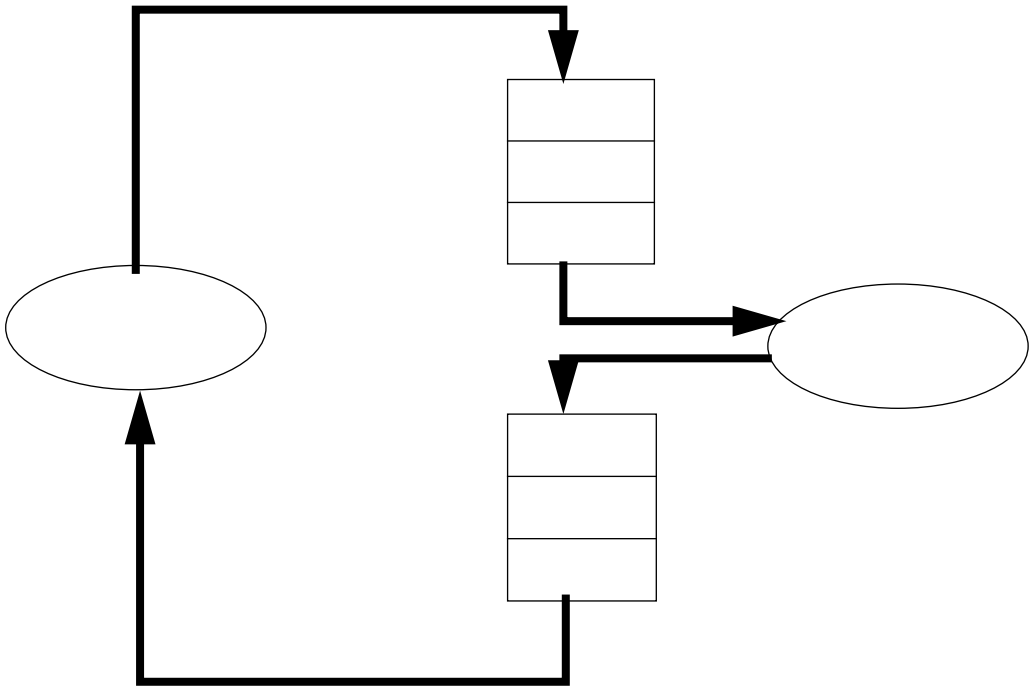
This module then describes the CORBA Event Management service, and shows how it supports queued messaging.

APM.1747.01 **Approved** 4th April 1996

Briefing Note

Distribution:
Supersedes:
Superseded by:

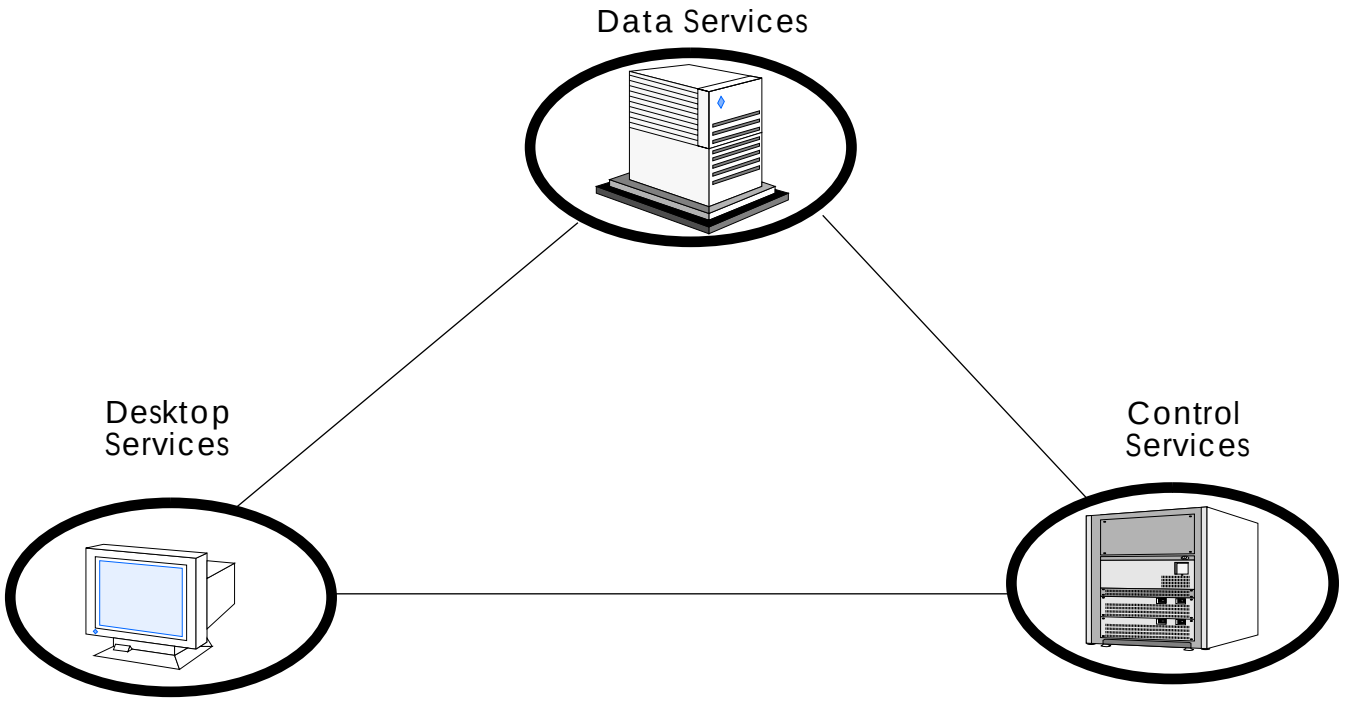
CORBA Event Management and Queued Messaging



In this session

- **Review three basic techniques for communications in distributed systems**
- **Explore one of these techniques in detail**
- **Look at standards for this technique**

Communications techniques for all kinds of services

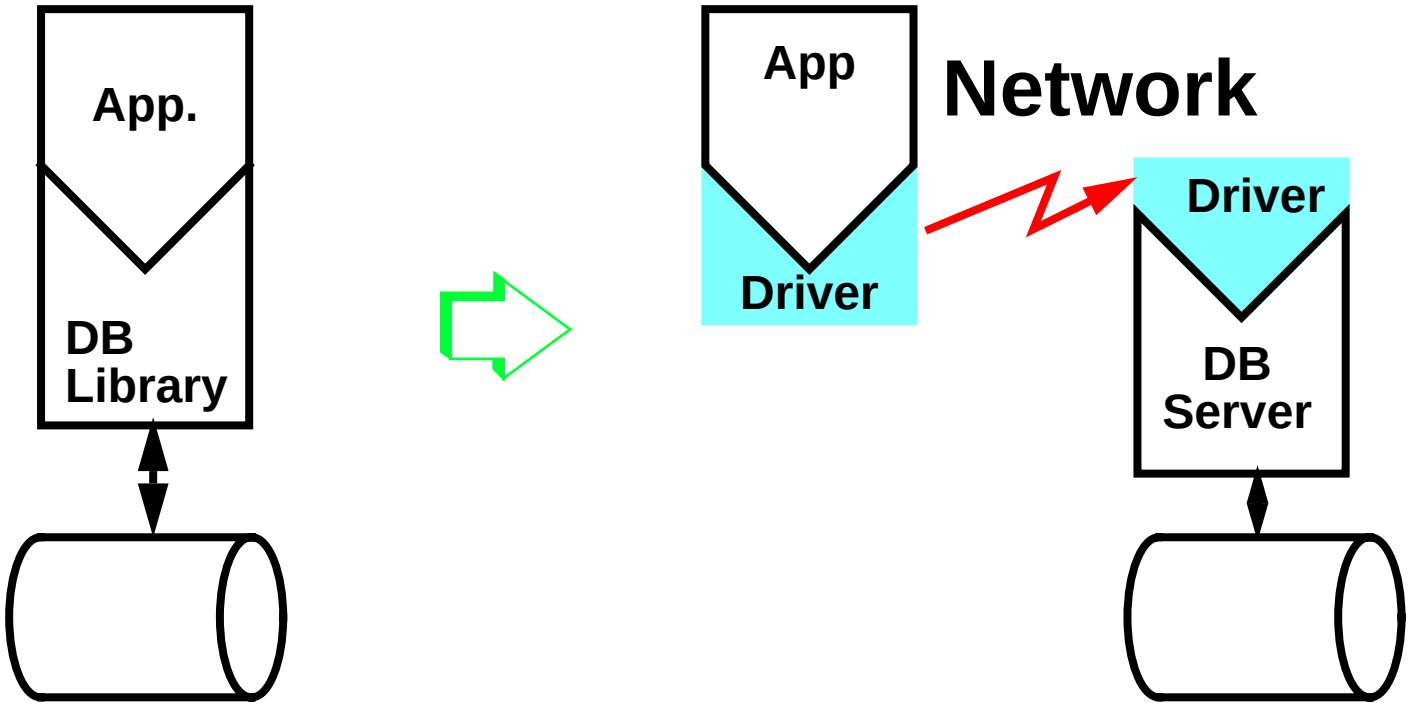


The three techniques of communication

- **Remote Data Access (RDA)**
  - **also known as remote database access**
- **Remote Procedure Call (RPC)**
- **Robust Queued Messaging (RQM)**
  - **also known as reliable messaging (RM) or message-oriented middleware (MOM)**

Remote Data Access (RDA)

- **Local database access can be transformed into remote database access**

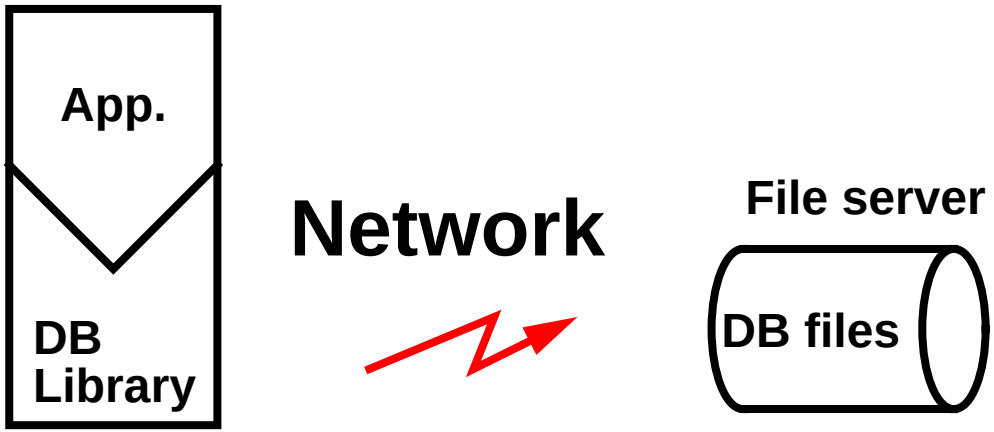


Applications for RDA

- **Desktop front-ends to remote databases**
  - **from spreadsheets**
  - **from report writers**
  - **from 4GLs**

Remote Data Access Is Not File Sharing

- Do not confuse RDA with database file sharing...
  - ... where a database is placed on a file server

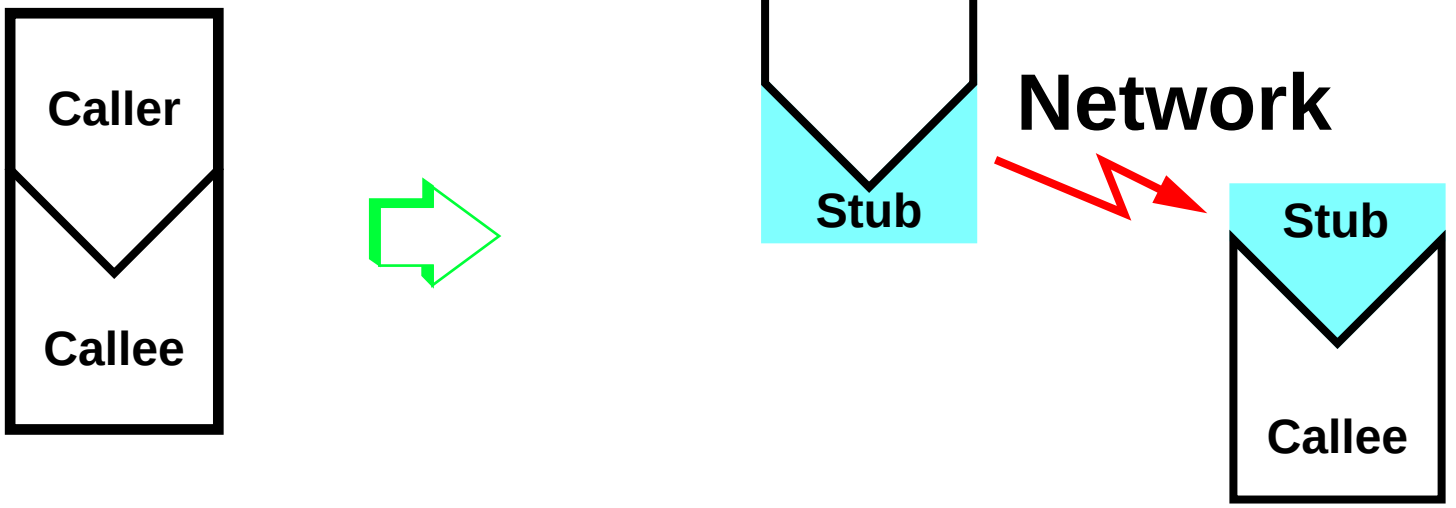


RDA and database file sharing

- **Database file sharing merely transmits file reads, writes, and locks over the network**
  - **there is no database server, only a file server**
- **Remote data access transmits database queries and updates over the network**

Remote Procedure Call (RPC)

- Local procedure call can be transformed into a remote procedure call



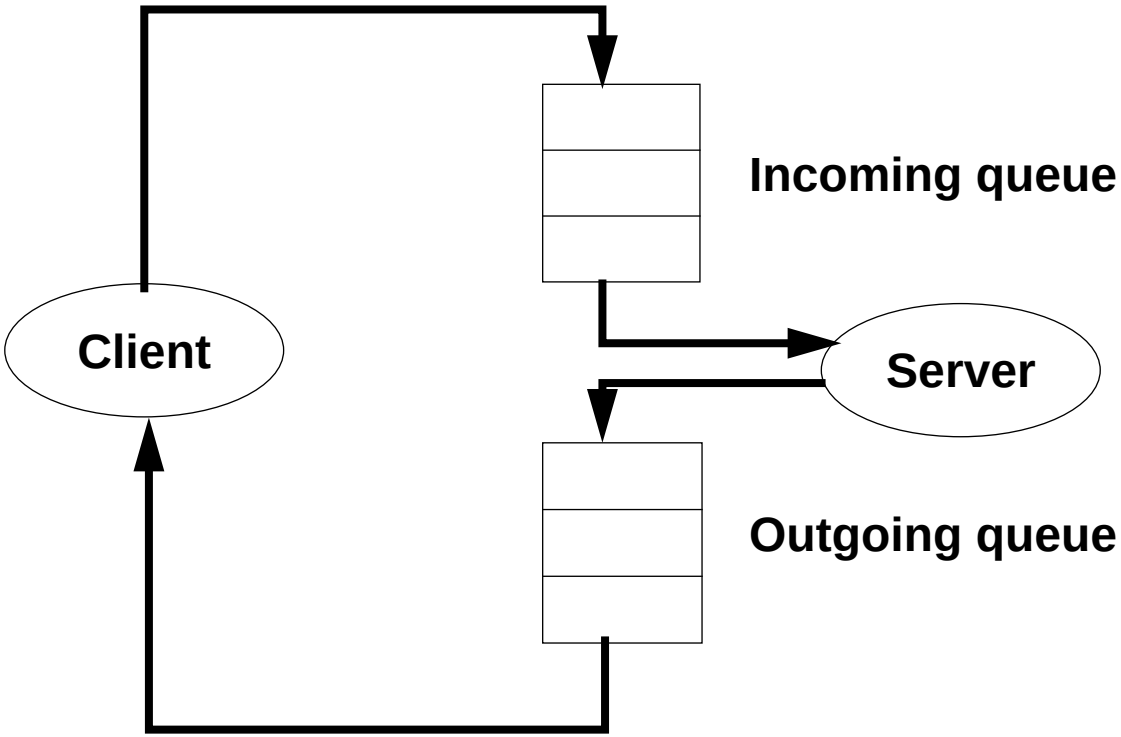
- The caller is the client, the callee is the server

Applications for RPC

- **Most distributed computing applications**
  - **typically, applications integration**
- **Particularly suited for building or integrating distributed object-oriented applications**

Robust Queued Messaging (RQM)

- **Requests and responses are queued**



Applications for RQM

- real-time systems
- command and control
- transaction processing
- financial trading

When is robustness important?

- **High cost of failure**

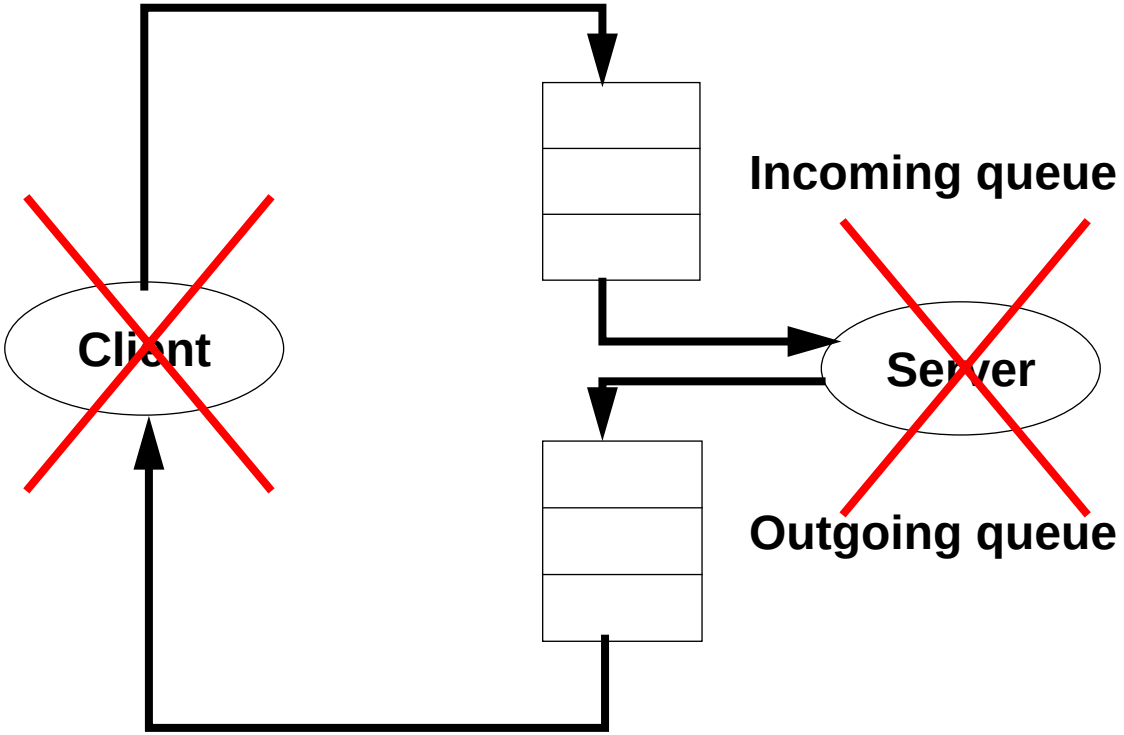
- **Rapid recovery from failure**

Information flow in Robust Queued Messaging

- **Client and server do not communicate directly, but via intermediate queues**
  - **client places request on queue**
  - **server retrieves request from queue**
  - **server places response on queue**
  - **client retrieves response from queue**

Failure in Robust Queued Messaging

- **Client and server can fail independently; queued messages not lost**



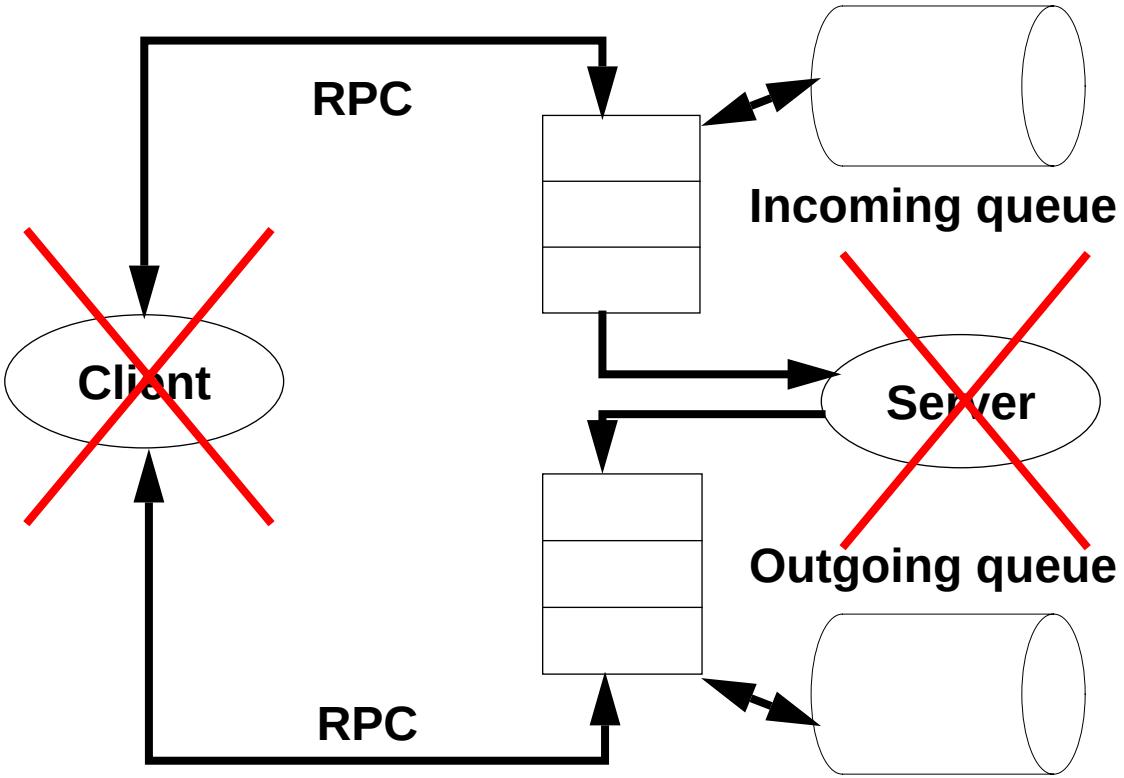
Client Failure and Recovery

- If a client fails and is restarted, it can receive pending messages from the outgoing queue
  - responses to a request from an earlier ‘incarnation’ of the client
- This is an unfamiliar challenge for most application designers
  - how to handle these particular responses?

Failure and Recovery in Robust Queued Messaging

- **Client and server can recover messages from incoming and outgoing queues**
- **What other potential points of failure are there?**
  -
  -
- **What can be done about them?**
  -
  -

RQM using RPC



Handling queue overload

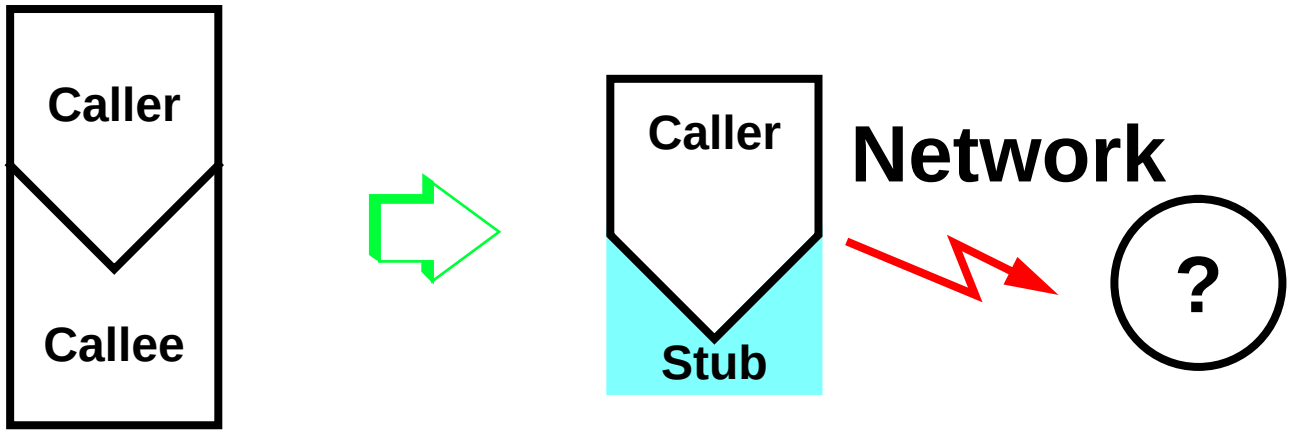
- Some commercial products simply discard messages on overload
  - this is inconsistent with the aim of robustness
- Queue overload control requires either flow control or rate control
  - this is more complex than in RPC, where flow control/rate control can be part of the RPC protocol itself
- Do not confuse queuing with buffering
  - large messages may be fragmented and require buffering for defragmentation...
  - ... but this is a communications issue, not a distributed systems issue

Dependability - beyond robustness

- For many applications, robustness is not enough...
- ...they need dependability, including
  - Atomicity (transactions)
  - Fault tolerance
  - Security

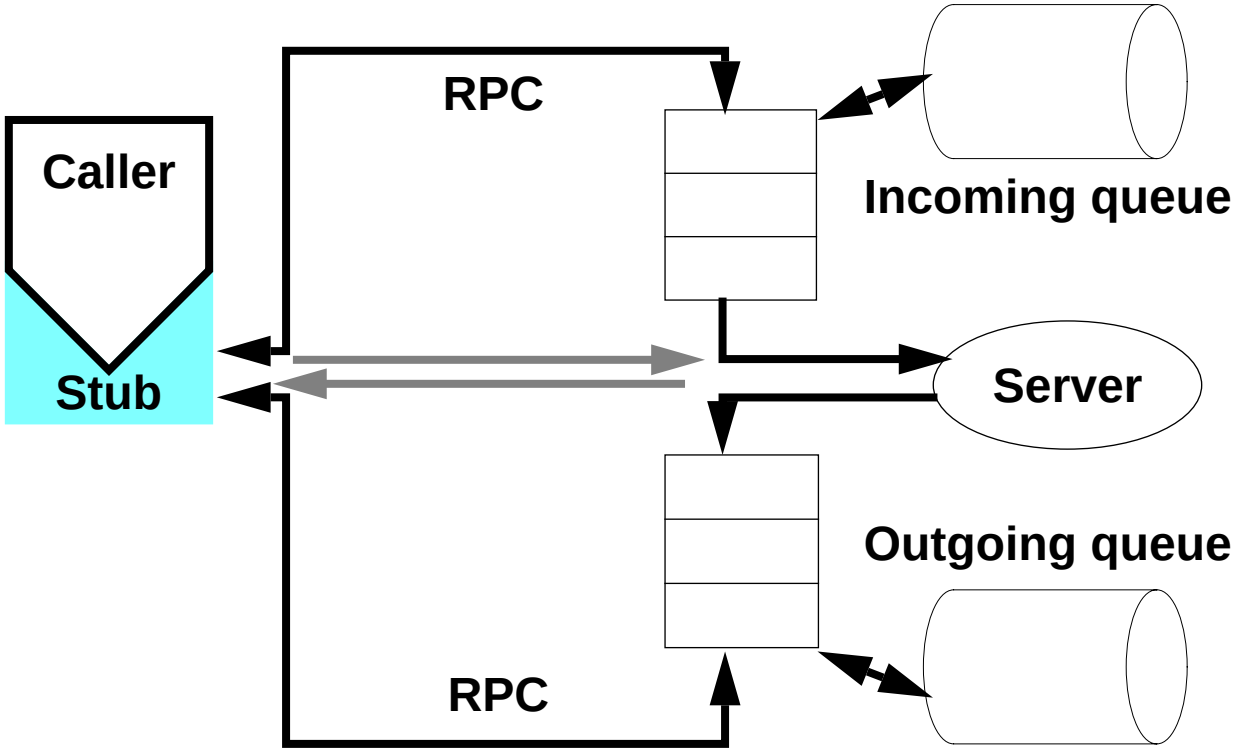
Queue transparency

- **Should the client even be aware of the queue?**



RPC interface to RQM

- **Caller just sees a simple RPC interface**



RPC interfacing to RQM

- The programming interface to RQM can be complex...
  - most programming languages don't support message queuing
  - some programming languages are described as 'message-passing'...
  - ... but this is a different meaning of the word 'message'
  - ... they don't support message queuing any better than ordinary programming languages
- ...using a standard RPC simplifies RQM for the application designer
  - whichever programming language you use

RQM management

- **Queues naturally support testing and debugging...**
  - **message logging, filtering, and tracing**
  - **message insertion and deletion**
  - **load monitoring and balancing, flow control**
  - **management**
- **... these can be separate interfaces to the queue itself**

Other RQM possibilities

- RQM can be a good interface to legacy systems
  - the two sides of the queue can use different protocols
- RQM allows complex message patterns (the response can come from a third process, multiple responses, one-way messages,...)
  - such designs do not scale well and can be difficult to maintain
- RQM can support off-line (e-mail style) messaging
  - messages can remain in queues for long periods...
  - ... servers can poll queues, or only run periodically

How effective is RQM?

- **Efficiency**
  - **mainframe transaction processing (TP) monitors gain efficiency from queuing**
- **Managability**
  - **queuing does offer an effective point of control**
- **Robustness - arguable!**
  - **... in practice RQM tends to be robust, but this is probably due to the care and attention given to typical design and implementation**
  - **... plain RPC should be at least as robust under the same conditions; there is less to go wrong**

RQM in practice

- The queue manager can be made very simple
- The queue manager can be integrated with the system...
  - giving high throughput
- ... or integrated into applications libraries
  - leaving a more lightweight micro-kernel, and giving the application control of queuing policies and mechanisms
- The latter is more likely in the future

Selecting an RQM system

- **If you believe RQM is appropriate technology, you need to be clear about your specific needs**
  - **Different systems offer different kinds of robustness (for example, in overload)**
  - **RQM systems may or may not offer transactional (atomic action) capabilities**
  - **Different RQM systems do not interoperate**
  - **RQM systems may or may not offer real-time quality-of-service**
  - **RQM systems support online reconfiguration differently**

Other issues for RQM

- **Technical expertise can be hard to acquire**
  - **it is spread across specialist markets**
- **Off-the-shelf products are available but can be expensive**
  - **IBM MQSeries, DECrtr, Tandem Pathway, ISIS**

Why more than one technique is needed

- For interoperability with existing products and standards
  - each has different availability implications
  - each has different performance trade-offs
- Systems can use different techniques in different places
  - interfacing between techniques is possible

Will one technique predominate?

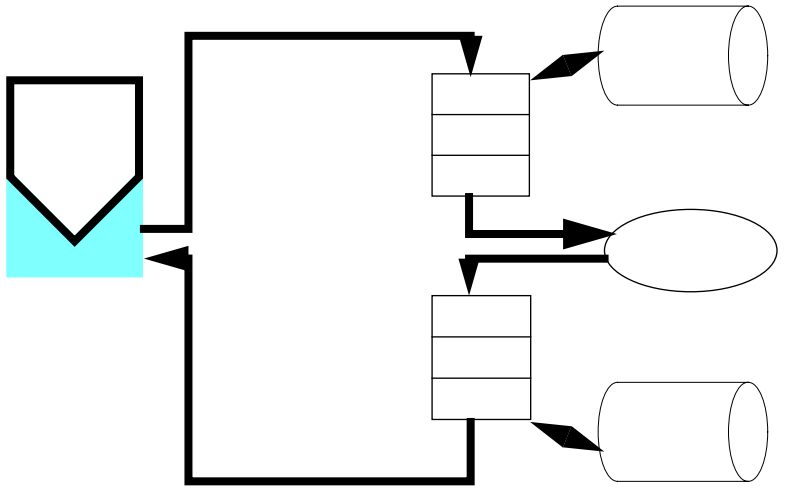
- **Probably not...**
  - **the need to interface with legacy systems will persist**
  - **new products continue to refine each technique**
- **...it is therefore important to understand the strengths and weaknesses of each**

Standards for RQM

- **Currently there are no generic standards for RQM**
  - **the Message Oriented Middleware Association (MOMA) is attempting to resolve this...**
  - **... by providing interoperability, at least**

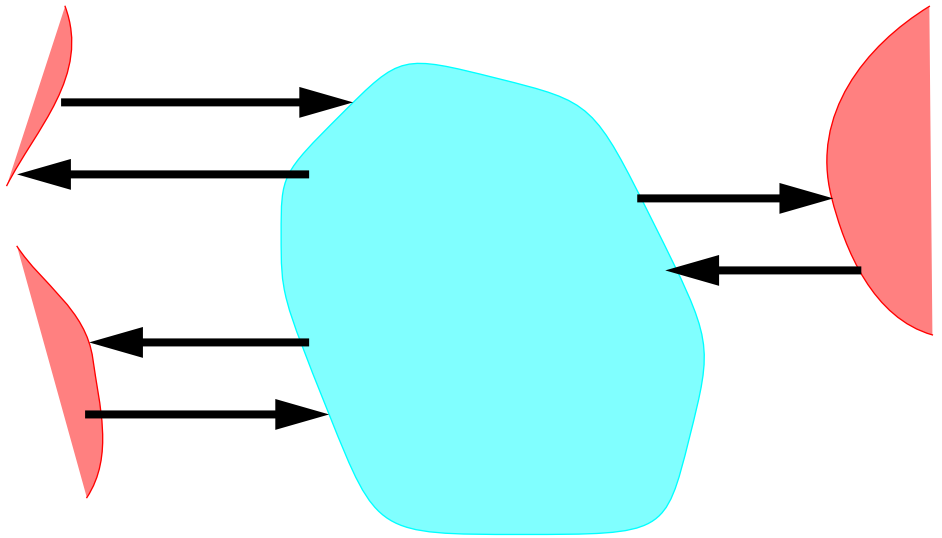
Hybrid techniques - using RPC with RQM

- RPC can be implemented over RQM, (transparently or not)...



- ...RQM can be implemented over RPC
  - as in Channels in the CORBA Event Service

The Event service



- **Events are concerned with asynchronous communication between objects**

Events

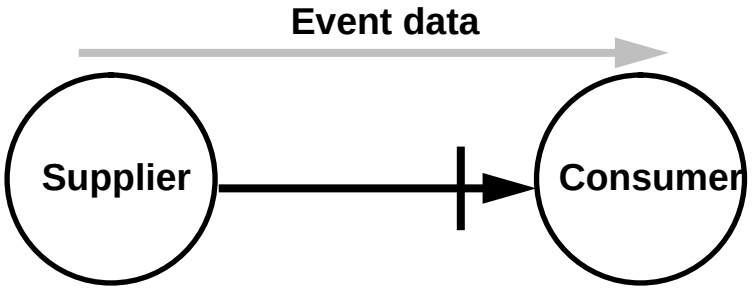
- Events support asynchronous notification
  - ...‘alerts’, ‘change notification’
  - for example, when disk space is getting low
- Suppliers and consumers of events are decoupled
  - via an event channel
- There can be multiple suppliers and multiple consumers
- Events could be used to build an RQM (Robust Queued Messaging) interface
  - or to interface to an existing one

Conspiracies - a ‘new’ object concept

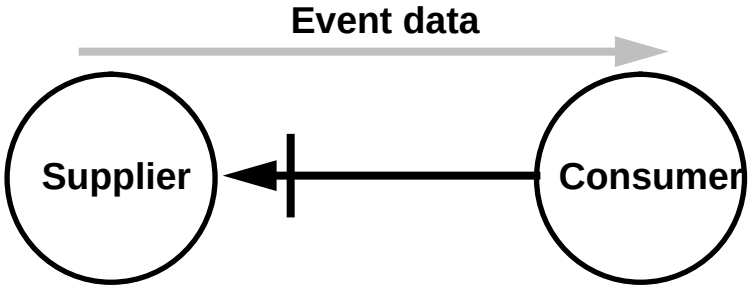
- Channels have (at least) two interfaces
  - one consumer, one supplier
- Currently in CORBA an object can only have one interface
- But a service can have multiple interfaces
  - provided by a set of ‘conspiring’ objects

Push and pull models for communicating event data

- **Push model: suppliers push data to consumers**

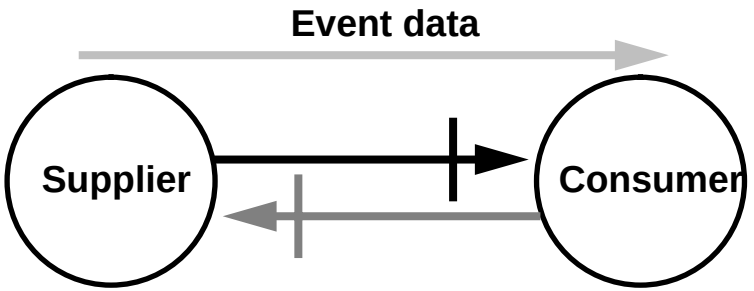


- **Pull model: consumers pull data from suppliers**



Connecting and disconnecting channels

- **Channel connections are made by separate channel administration interfaces**
- **Channel connections are broken by either the supplier or consumer**
  - **a reverse interface is optionally provided for this (as shown in the push model here)**

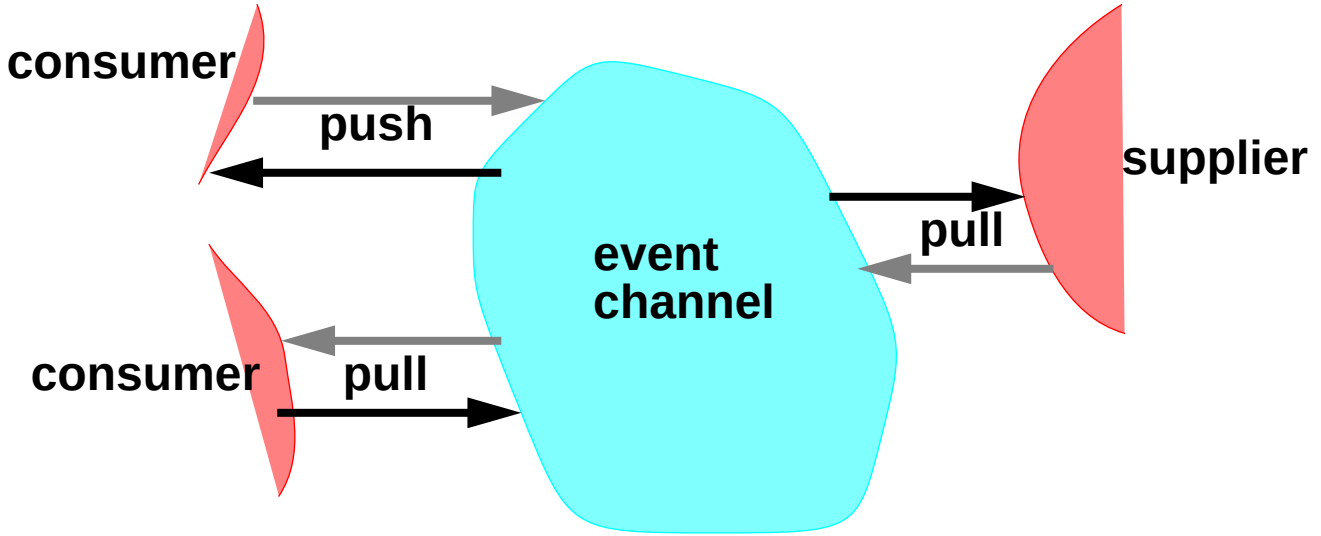


The CosEventComm Module

```
module CosEventComm { exception Disconnected{};
   interface PushConsumer {
        void push (in any data) raises (Disconnected);
        void disconnect_push_consumer();
   };
   interface PushSupplier {
        void disconnect_push_supplier();
   };
   interface PullSupplier {
      any pull() raises (Disconnected);
      any try_pull (out boolean has_event) raises (Disconnected);
      void disconnect_pull_supplier;
   };
   interface PullConsumer {
      void disconnect_pull_consumer();
   };
};
```

Push and pull with event channels

- **Suppliers and consumers can use the same or opposite models...**



- **... the models are decoupled by the event channel**

Generic and typed channels

- Generic event channels allow communication of arbitrary (untyped) data
- Typed event channels allow communicate via an IDL interface
  - any IDL interface by mutual agreement between consumer and supplier
  - ... operations in that interface are transformed into ‘pull’/’try_pull’ operations, with the same parameters
- Typed event channels also support generic events
- Push and pull models are supported for both generic and typed event channels

The Event specification

- Module `CosEventComm`
  - interfaces for the push and pull operations
- Module `CosEventChannelAdmin`
  - interfaces for making connections between suppliers and consumers
- Module `CosTypedEventComm`
  - as `CosEventComm`, but the push and pull operations are provided by objects agreed by the suppliers and consumers themselves
- Module `CosTypedEventChannelAdmin`
  - as `CosEventChannelAdmin`, but for typed event channels

Using the Events service

- Use the Events service if you need
  - queued messaging
  - notifications
- Use the Events service with the Timer Event service if you need periodic events
- Use a vendor-specific service if you need atomic delivery
  - the Events service does not give the ordering or delivery guarantees of a replication service

Summary

- **Robust Queued Messaging (RQM) is a misnomer; the queuing is the important aspect**
  - **queuing improves performance, not robustness; it belongs in application libraries, not in the system**
- **100% reliability is impossible**
  - **cost-effectiveness entails careful application design and system engineering**
- **RDA, RPC, and RQM each have their place**
  - **RPC is the most natural fit to most programming languages**
- **For more information on robust messaging**
  - **see *Transaction Processing Concepts and Techniques* by Jim Gray and Andreas Reuter (Morgan Kaufman)**