A Mobile Agent Workbench

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FollowMe:
A European ESPRIT project

- Our brief: “Understand Agents”
  - Mobility
  - Location
  - Autonomy
  - Negotiation
  - Scalability
  - Security

- This paper presents the Mobile Object Workbench which underpins the project

MOW Motivations

- Supports real-life pilot projects
  - one of which is currently non-mobile, wishing to become mobile
- Usable by network applications programmers
  - not researchers into distributed systems!
  - familiar with Java, RMI, CORBA
- Open, extensible architecture
  - avoid built-in policy choices
- So - approach from RM-ODP starting point
  - fit RM-ODP concepts to Java

ODP Distribution Transparencies

- Access
- Location

Access objects regardless of object or client location

- Migration
- Relocation

Allow the object and client to move

- Persistence
- Failure

Long lived, failure tolerant objects

- Transaction

Consistent, concurrent access

- Replication

For scale, performance, availability

- Security

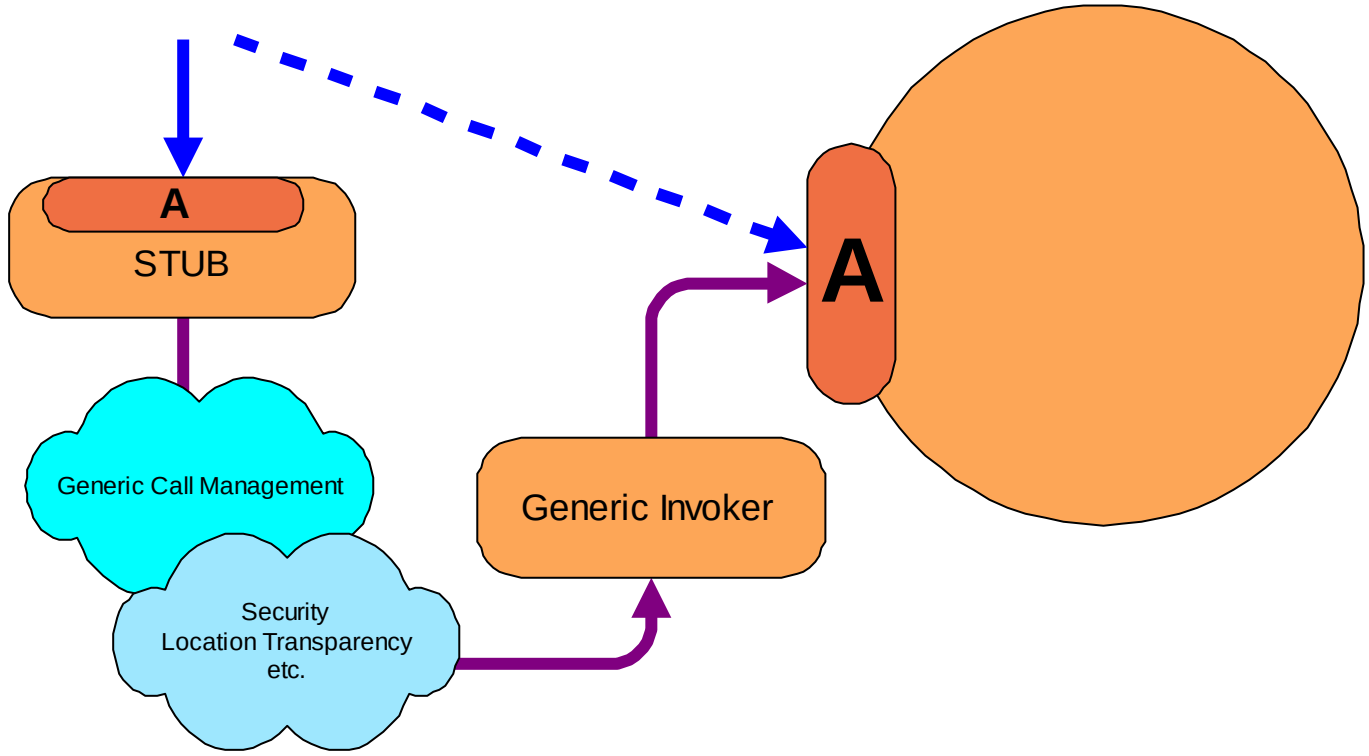
Control and audit access

Java and ODP

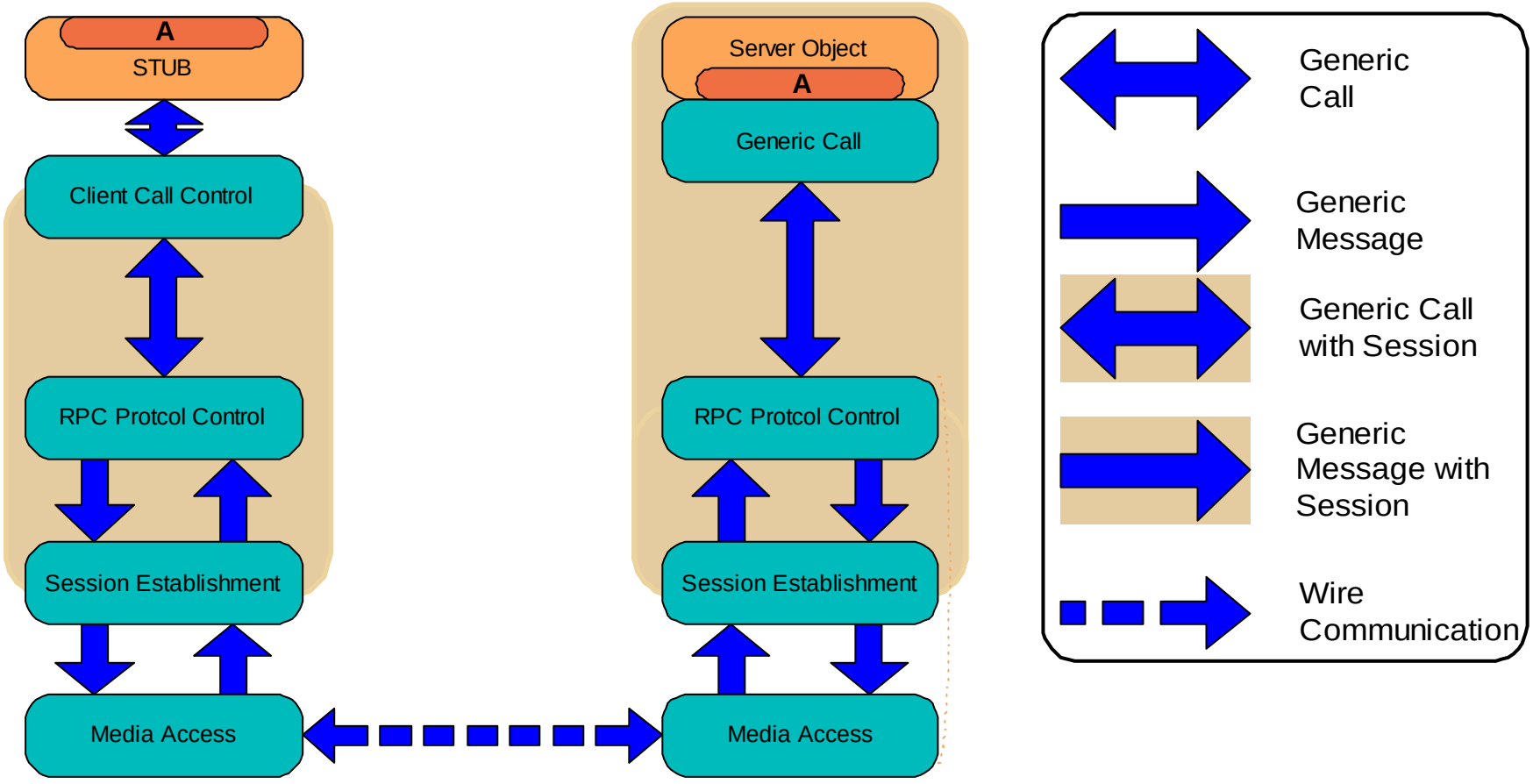
- Java RMI
  - imposes policies on serialisation, class loading, protocols, pre-compilers
- Java ORB
  - imposes CORBA model on Java - overly complex
- Keep language features and abstractions
  - architect interfaces, not messages
  - strong typing for safety
  - reflection and introspection for dynamic binding

Use JAVA with
"sea of objects" abstraction

JAVA reflection and introspection allows us *Generic* Communication



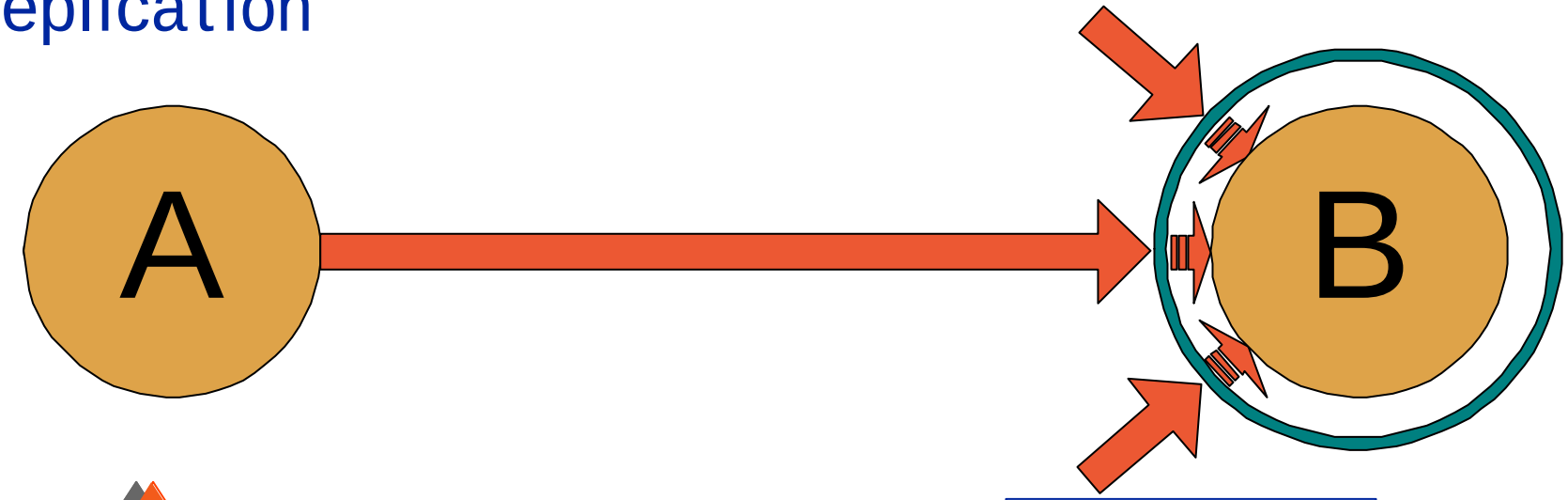
FlexiNet and the Generic Communications Stack



ODP Distribution Transparencies

- Migration
- Relocation
- Persistence
- Transaction
- Replication

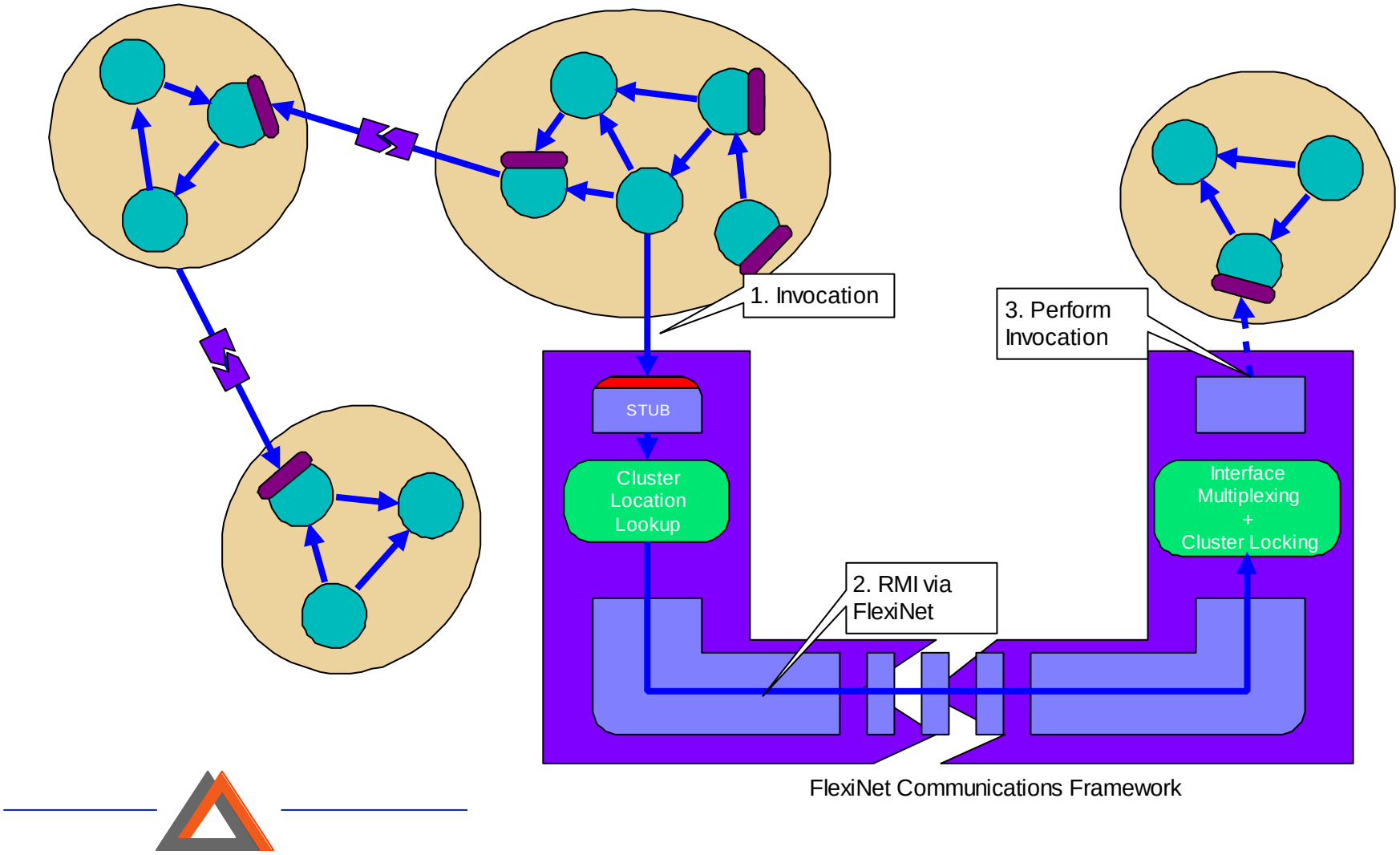
Concept of Cluster as the engineering unit of distribution



Strong Encapsulation

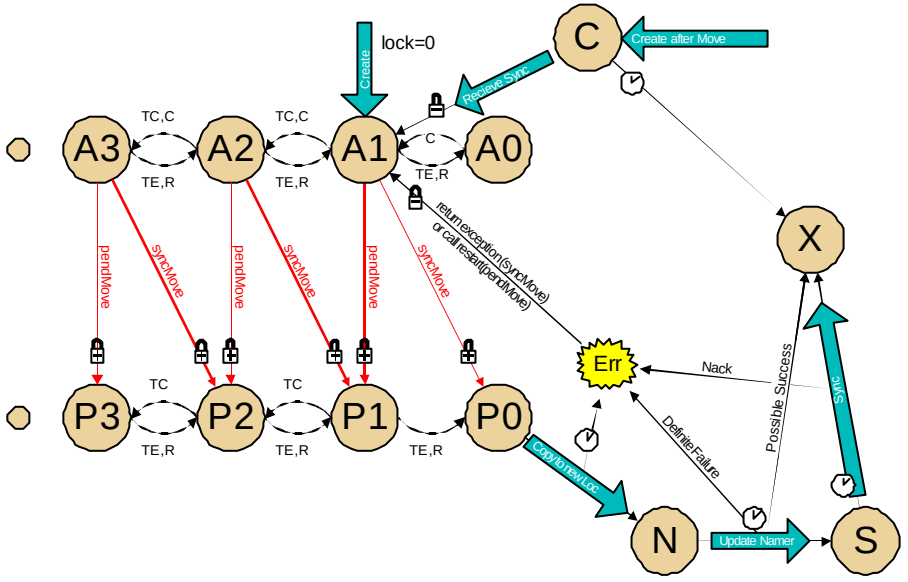
- We use strong encapsulation to keep clusters separate
  - Objects are always passed by copying
  - Interface references are passed by value
  - No objects are shared between clusters
- Strong encapsulation supports “virtual processes”
  - De-couple Threads to manage control flow in clusters
  - Separate class name spaces
  - Separate security managers and security policies

Communication between Clusters



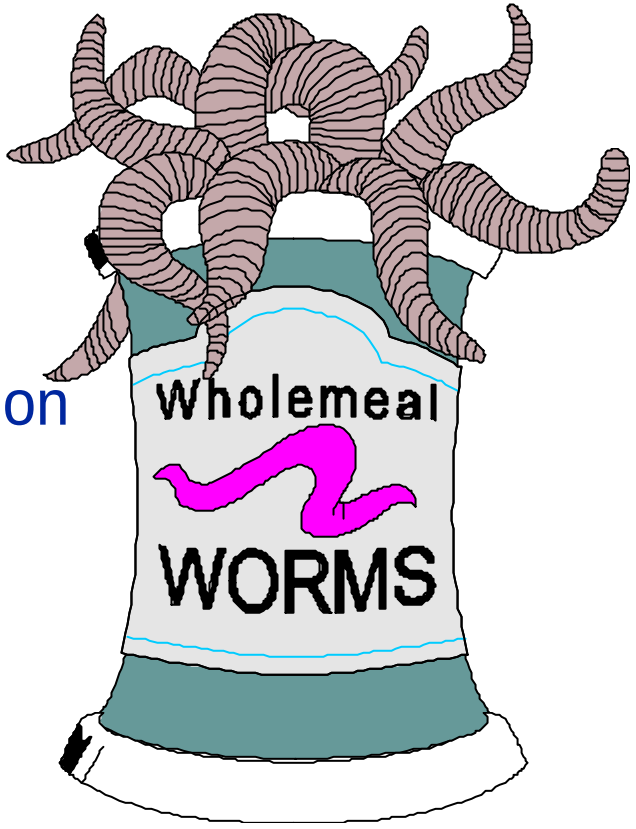
Ensuring Consistent & Atomic Moves

- Track threads within the cluster
  - Block threads wishing to enter
  - Wait until there are no active threads
- Two phase commit
  - ensures agreement about object location
- -> mobile objects!



Other Issues

- Mobile Agents
  - Just mobile objects?
- No
  - number of separate applications, not just parts of a single application
    - different code bases
    - complex trust relationships
    - no global coordination



Other issues for agents

- We don't claim to solve all that is required to create mobile agents
- We provide, instead, ways of doing things with standard language and distributed computing techniques
- Specifics:
  - Autonomy of movement
  - Replication and storage
  - Security
- MASIF?

Autonomy of Movement

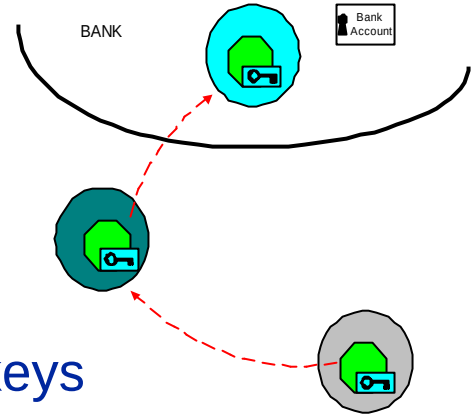
- Part of the mobile object story

Replication and Storage

- Clusters with server side storage / replication managers in place of migration manager
- FlexiNet class loading to install client side manager
- Scaleable low-level object naming and location service

Security

- Host integrity
  - Public Key Infrastructure to identify places
- Cluster integrity
  - check signatures on receipt
  - audit trail to avoid false copies
- Cluster confidentiality
  - seal state variables with host (group) keys
- Cluster authority
  - link signatures to trust policies
- Access control
  - link signatures to trust policies



Current status

- MOW Framework and Components implemented
  - Core
  - Migration
  - Persistence
  - Security
- Comms protocols supported
  - TCP/IP, SSL, IIOP, UDP
- Location transparent naming service
  - refining to enhance scalability
- Network of class repositories and caches
  - transparency managers don't need to be pre-loaded
  - federated namespace to resolve naming clashes