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ANSA Phase III

Interception (TC presentation 11/94)

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Abstract

Interception technology is one of the corner stones of large scale federated systems for two main reasons: Interception technology can be used as enabling technology to overcome technical differences between systems. It can also be used to create administrative boundaries between systems or parts of systems where such boundaries are necessary from a business or organizational point of view.

A model of interception is presented and used to develop different interception strategies. The changes necessary in distributed application development platforms to accommodate these strategies are then outlined.

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Interception

- **Model of Interception**
- **Immediate and Deferred Resolution Strategies**
- **Deferred Resolution and Reloation**
- **Enhancements to Invocation References and Binders**

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Overview

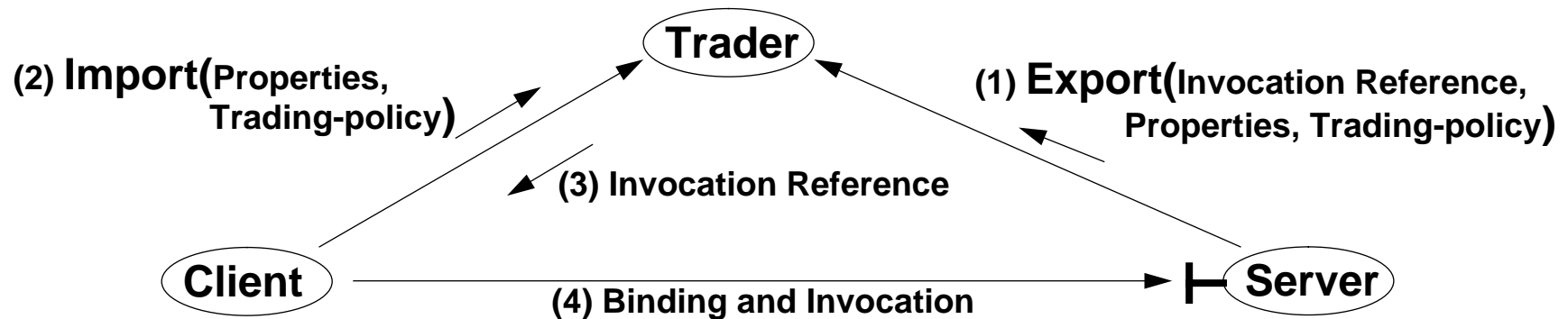
- **Federation: trading and interception in context**
- **The problem - crossing domain boundaries**
- **Phases of the interception process**
- **Immediate and deferred resolution strategies**
- **Deferred resolution and relocation**
- **Invocation References (IR) and Binders**
- **Future work and implementation plan**



Federation

- **Large systems are made up of autonomous islands interconnected incrementally**
 - no central authority
 - legacy of old technology
 - conflicting choices of new technology
- **Resulting in many differences between systems:**
 - exploit homogeneity where possible (trading)
 - overcome heterogeneity where encountered (interception)

Trading - Looking for compatibility!



- **Discovering an interface that provides a service:**
 - exporter makes service offer
 - importer makes service request
 - trading marries import to export
 - if successful, trader provides importer with invocation reference (IR)
 - importer can now use IR to bind to server and subsequently invoke it
- **Emphasis in trading is on finding compatible objects**



Interception - Dealing with differences!

- **What kind of differences:**
 - **technical:**
 - ▲ **communication protocols**
 - ▲ **RPC (DCE, ANSAware, CORBA, others)**

==> Language of interaction and ability to interact

 - **administrative:**
 - ▲ **authority (responsibility, liability)**
 - ▲ **security**
 - ▲ **remuneration**

==> Nature of the dialogue



Interception - overcoming differences and creating boundaries

- **Technical boundaries** (can we interact): **gateways necessary to deal with difference:**
 - prevent failure
 - overcome technical differences

- **Administrative boundaries** (do we want to & how do we want to interact): **gateways necessary to create difference:**
 - enable
 - disable
 - intervene:
 - ▲ add information
 - ▲ remove information
 - ▲ translate information
 - ▲ monitor information

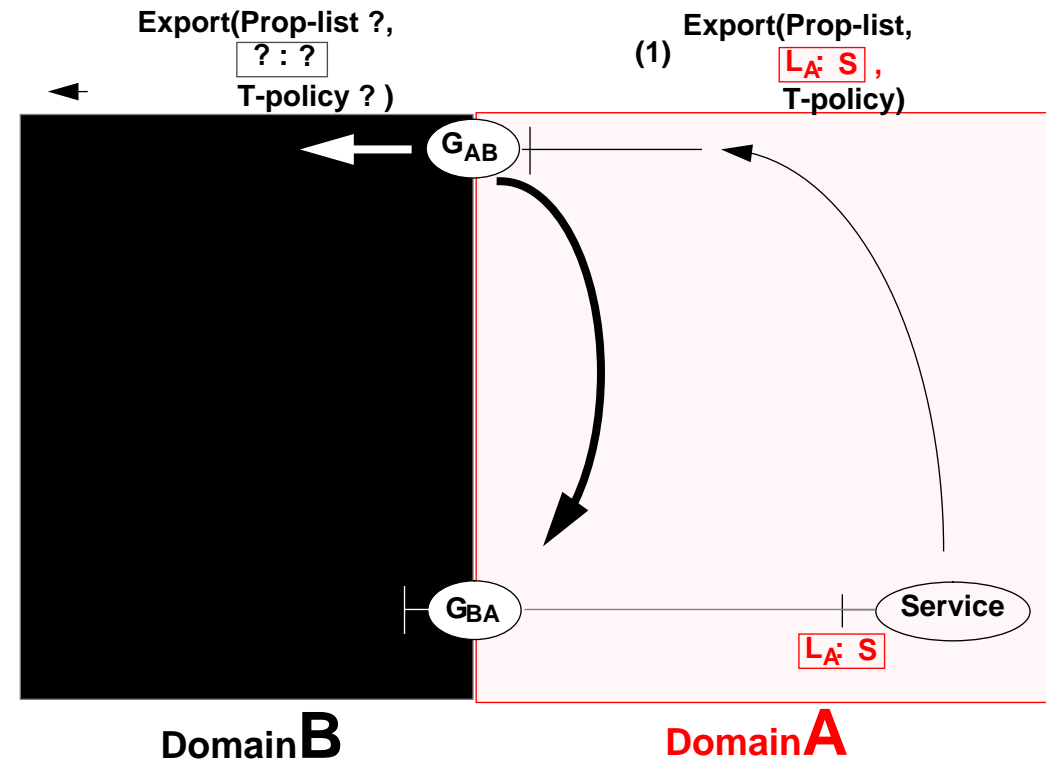


Dynamic nature of Distributed Systems

- **Problem of gateway design and construction:**
 - per client-server pair, multiple clients, per service type, generic
 - development of private communication protocol or RPC
- **The creation of bindings at run-time requires dynamic management of gateway:**
 - creation
 - insertion
 - maintenance
 - destruction
- **This talk concentrates on how to deal with the dynamic setting up of links between objects residing in different domains**
- **Starting point to investigation is trading**

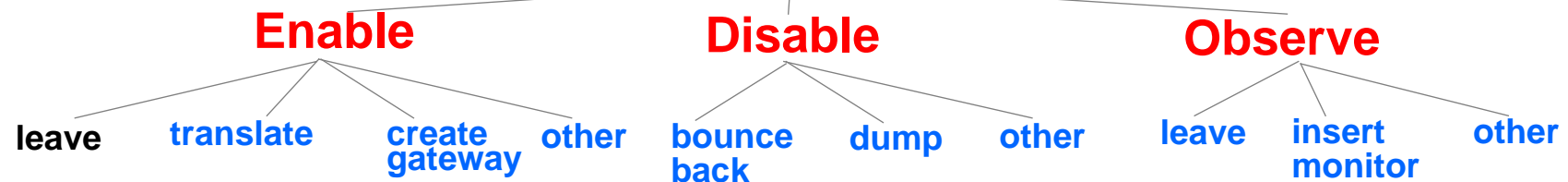
Problem overview - Crossing Domain Boundaries

- Export() across a boundary:
- What do we have to do to enable crossing ?
 - leave untouched
 - translate
 - build gateways
- How to do it ?
- What mechanisms are necessary ?
- Where can mechanisms be put ?
- What information is necessary ?
- Where should the information reside ?
- What changes are required to each domain to enable solutions ?
- What are the minimal changes required ?



Interception Technology

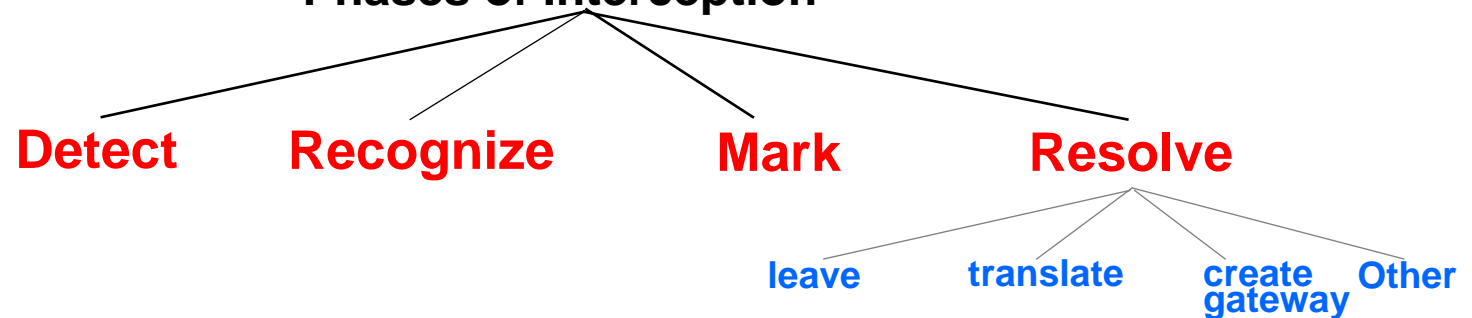
Interception



- **Interception is necessary in order to deal with the federation of domains which are sufficiently different from each other to require intervention in order to:**
 - **enable the crossing of boundaries: perform the necessary transformations to overcome the differences**
 - **disable the crossing of boundaries: prevention where the differences cannot be overcome or where for enterprise reasons it is not desirable**
 - **observe the crossing of boundaries: where monitoring events crossing the boundaries are important (issues of liability, security or remuneration are involved, for example)**

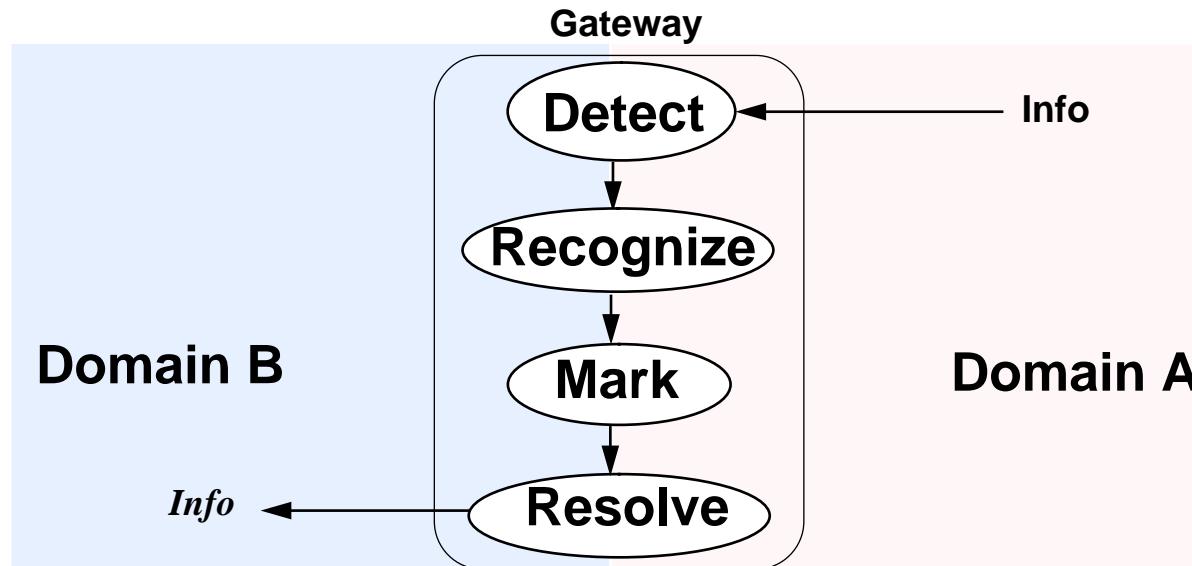
Phases of the Interception Process (I)

Phases of Interception



- **DETECT:** the crossing of the domain boundary
- **RECOGNIZE:** the information which should effect or be affected by the crossing
- **MARK:** the recognized information
- **RESOLVE:** act according to or on the marked information

Phases of the Interception Process (II)



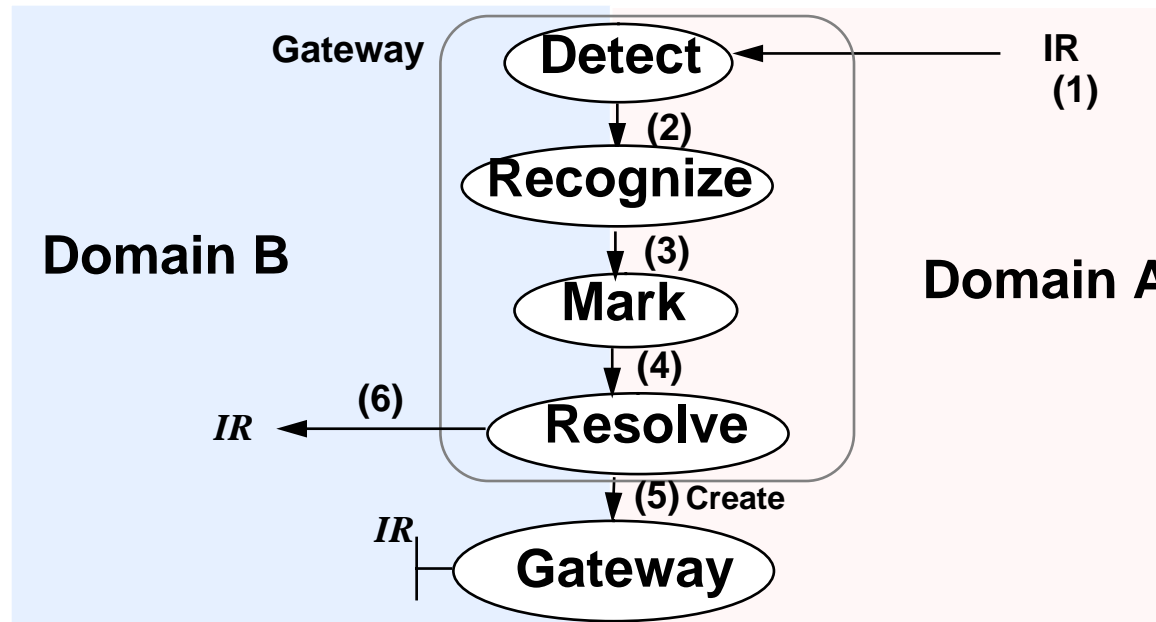
- **Marking and Resolution - distribution in time and space:**
 - how much to resolve immediately or how much to leave for later
 - how much information to keep in gateway or how much to forward
 - resource utilization and performance issues



Resolution Strategies

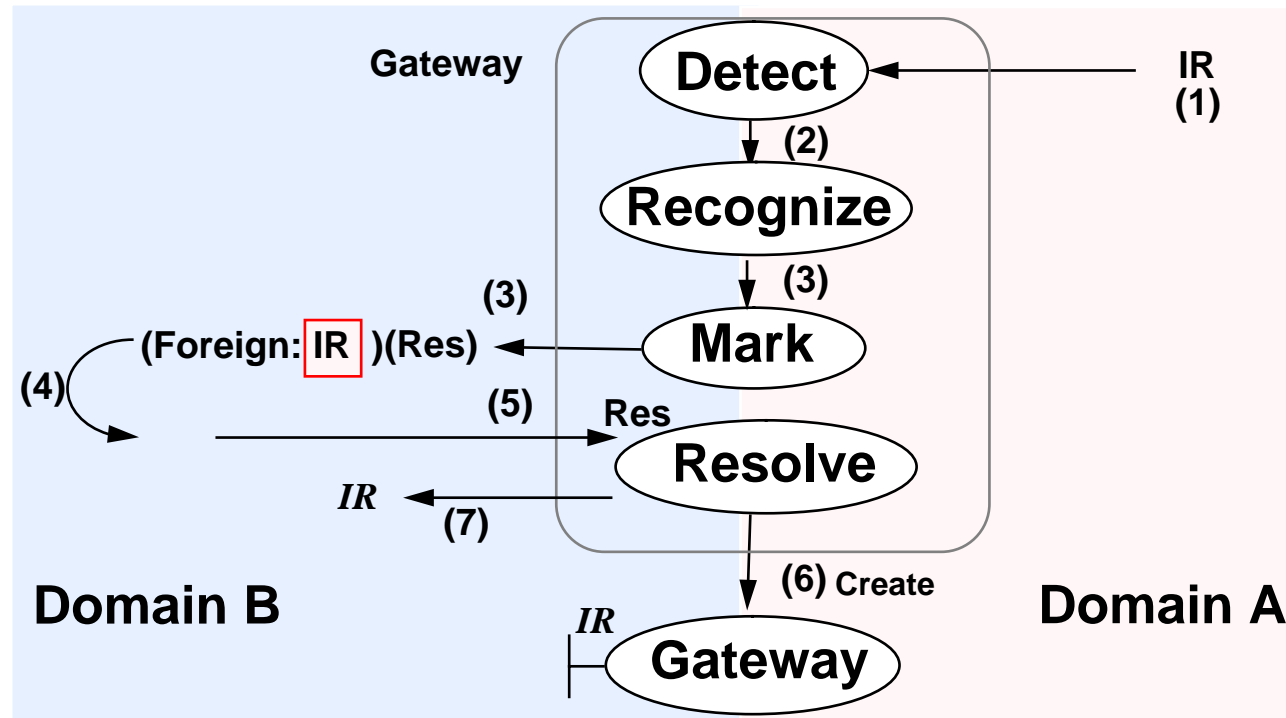
- **Two major strategies of resolution emerge from the description of the phases of the interception process:**
 - **Immediate resolution: resolve differences immediately upon the information passing the gateway**
 - **Deferred resolution: mark the necessary parts of the passing information to indicate what has to be resolved and where, pass the marked information into the other domain, deferring the resolution process on a “need to use” basis**
- **There are intermediate flavours**
- **Invocation References (IRs) can be:**
 - **ANSAware Interface References (Ifref's)**
 - **DCE Binding Handles**
 - **CORBA Object Pointers**

Immediate Resolution Strategy



- Recipient in Domain_B always gets immediately usable information
- All action takes place in Gateway -> no need to change anything in Domain_A or Domain_B

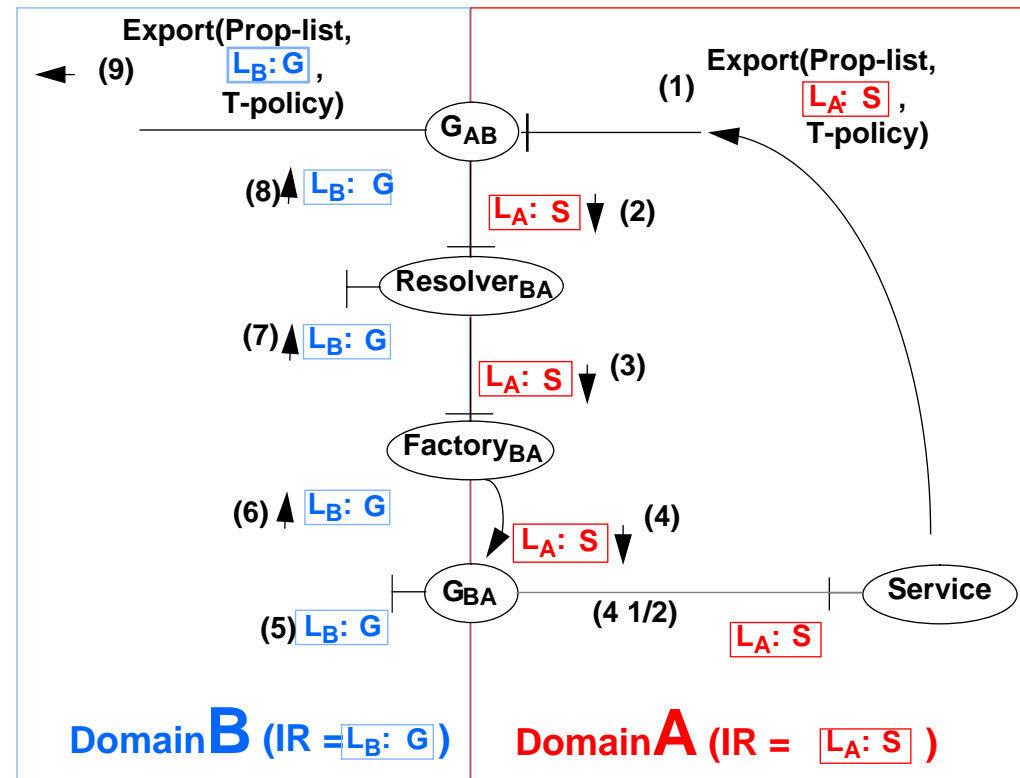
Deferred Resolution Strategy



- Requires Domain_B to be able to deal with marked information

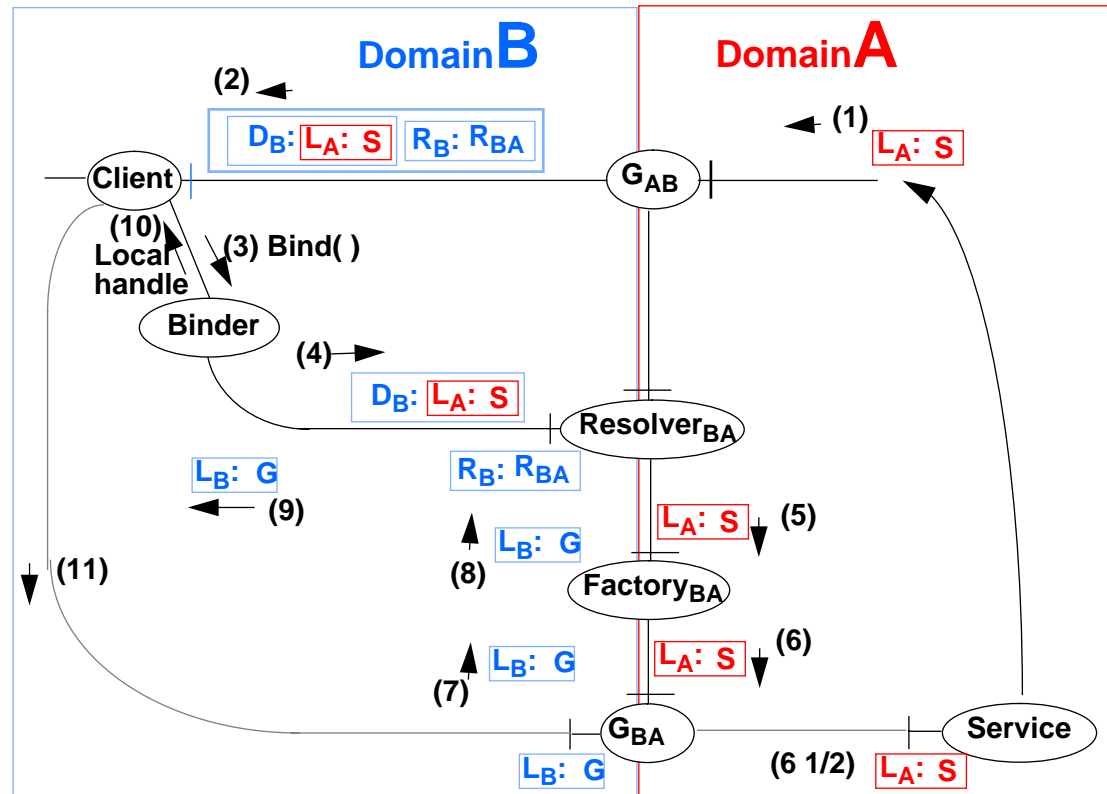
IR Boundary Crossing (Immediate Method)

- **Export()** across an IR boundary:
 - different format (but mappable)
 - different information (but mappable)
 - different protocols (but mappable)
- **Trader in Domain B does not have to deal with foreign IR's**
- **It may be required to add another property to Prop-list indicating IR boundary has been crossed**
- **Same sequence when passing IR's as parameters in operations other than Export()**

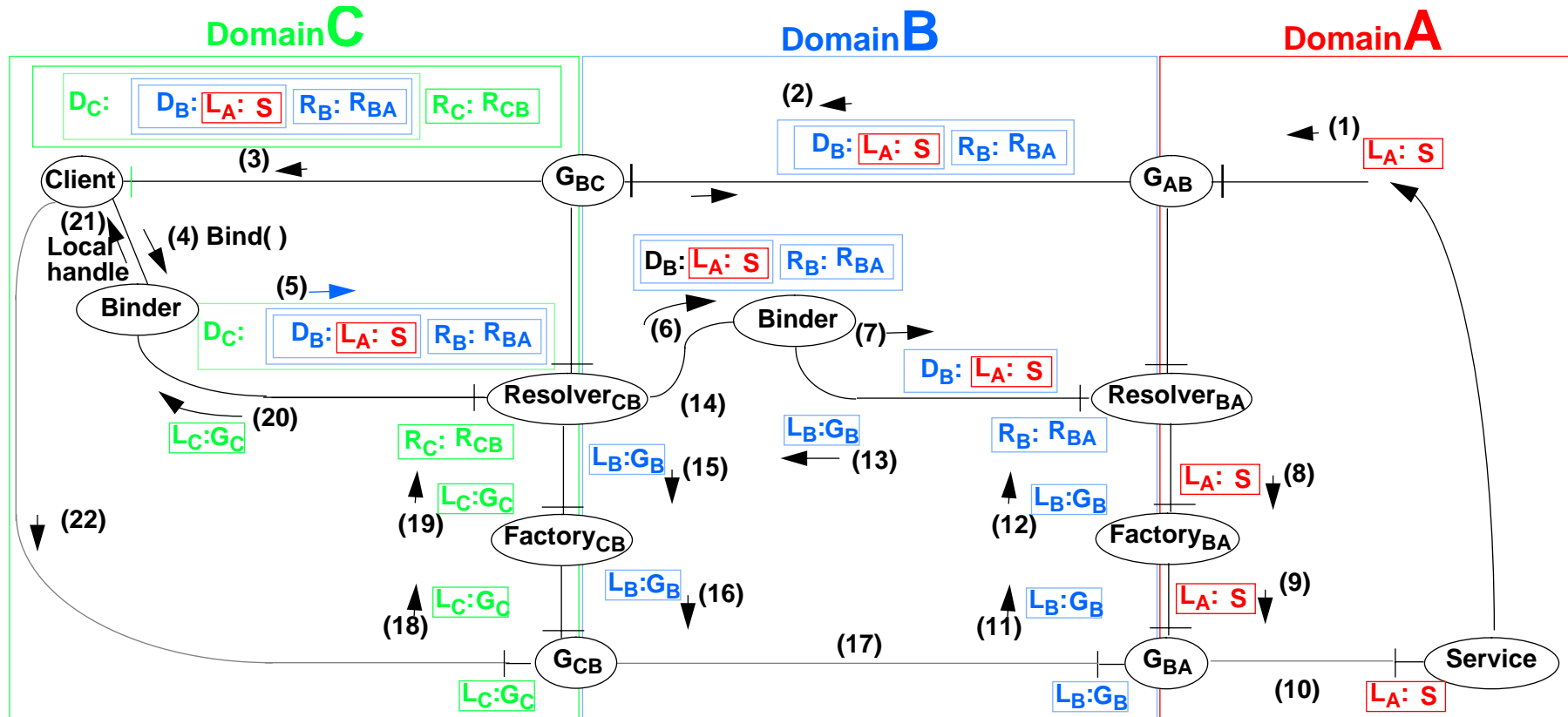


Resolution of Deferred Method

- IR has to have information for Binder:
 - the deferred information marked
 - where to resolve it
- Binder has to be able to deal with it

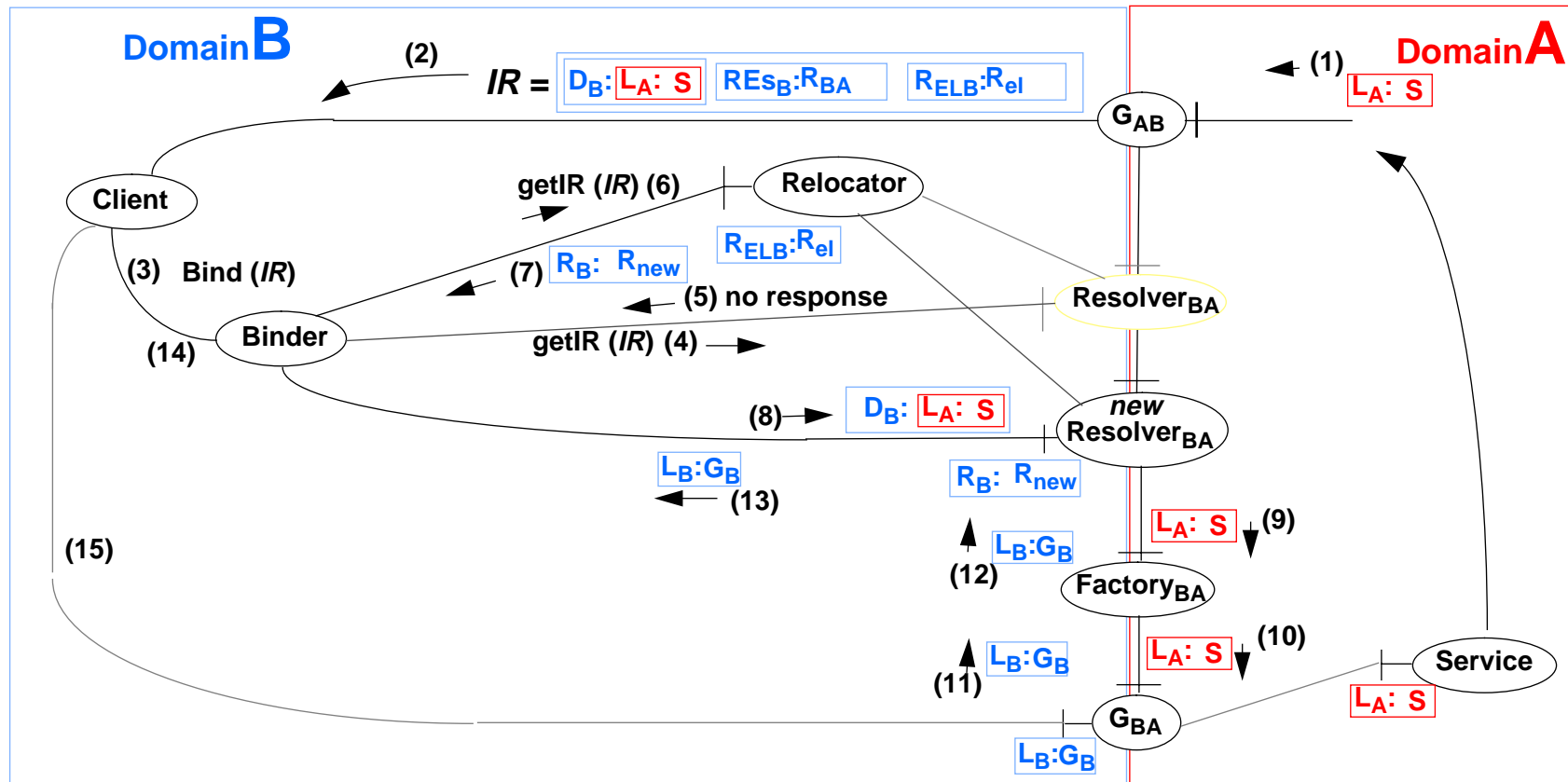


Multiple Resolution of Deferred Method

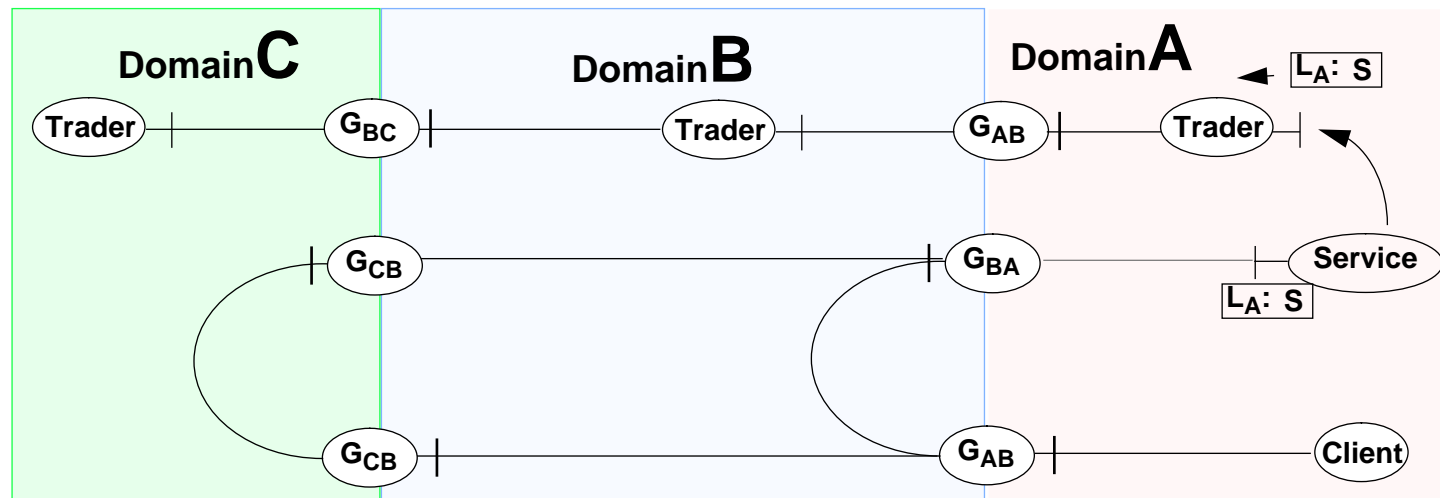


Note: instead of steps 6-7 it is possible to provide G_{CB} with the information to be used when it is invoked (Implicit vs explicit binding)

Deferred method and relocation



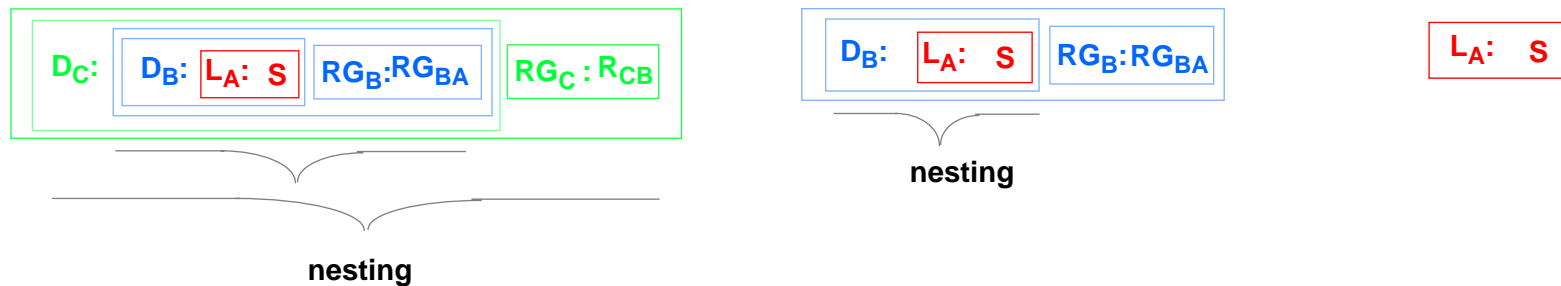
Circularity of Reference



- **Prevention:**
 - use trading policy to search locally before searching in remotely
- **Detection:**
 - distinguish between technical and administrative boundaries



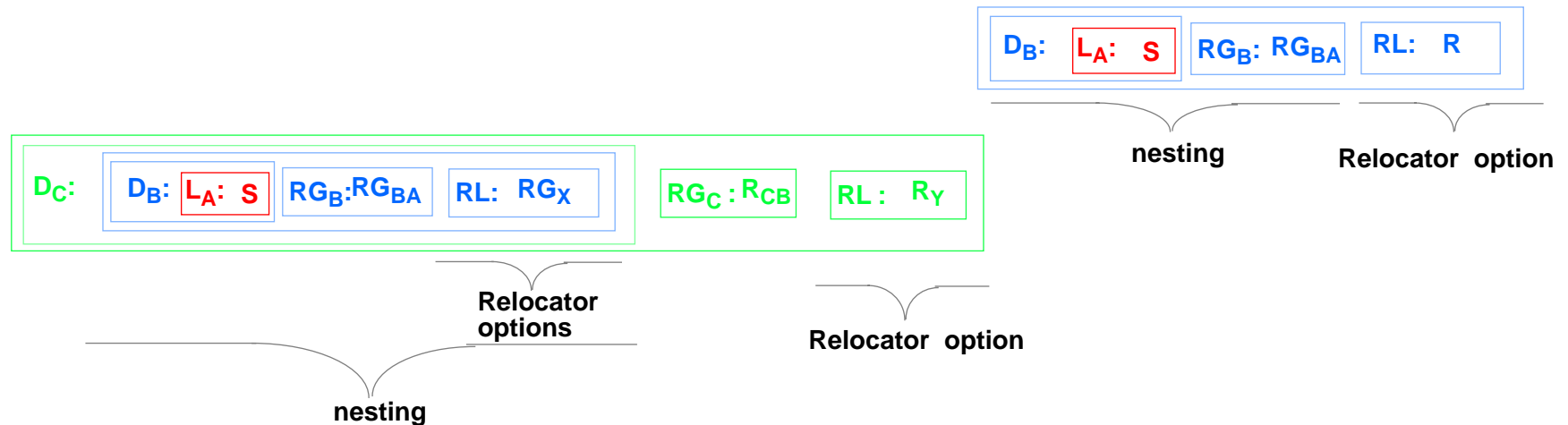
Invocation Reference nested structure => Gateways



- Gateways: encapsulated/nested IR records -> cascade of gateways
- Nested records are NOT options - Binder must not jump a gateway if it cannot resolve
- Requires domain reserved words: Local, Deferred, Resolve, Relocate



Invocation Reference sequenced structure => Relocation



- Relocators: sequence of IR records -> options of increasing scope
- Binder will only use the next one if the previous one did not work



Requirements from infrastructure

- **Extension to IR's to allow:**
 - **structure of IR to include:**
 - ▲ **sequences of IR records**
 - ▲ **nested IR records**
 - ▲ **be able to incorporate foreign IR's**
 - **language of IR to mark local, deferred and other cases of IR records**
- **Extensions to Binder to deal with:**
 - **relocation**
 - **gateways**
 - **other cases should fit the scheme:**
 - ▲ **passivation/activation**
 - ▲ **migration**
- **Use: ANSAware relocation scheme, UNO proposal IOR structure**
(UNO = Universal Networked Objects, IOR = Inter-operable Object References)



Current status

- **Hand crafted implementation of a simple gateway for:**
 - ANSAware client and Orbix server
 - Orbix client and ANSAware server
- **Monitoring facilities integrated to allow visualization (with the DEMON tool)**



Summary

- **The model of interception (detect, recognize, mark & resolve) can be used to show how the process can be carried out at different times and places by different agents**
- **Decision of which approach to use is a tradeoff between issues such as:**
 - **performance**
 - **resource utilization**
 - **security**
- **Trading and Interception processes are the corner stone of federated systems**



Future directions and implementation work

- **Passing IR's between platforms:**
 - type inference problems: when IR's are of a type whose operations pass IR's
- **Implement Immediate resolution method between Orbix and ANSAware:**
 - federate traders in both platforms: Orbix Match-maker and ANSAware Trader
 - generate gateways when IR's cross
- **Implement Deferred resolution method between Orbix and ANSAware:**
 - change of Binder in ANSAware
 - change of IR format in ANSAware