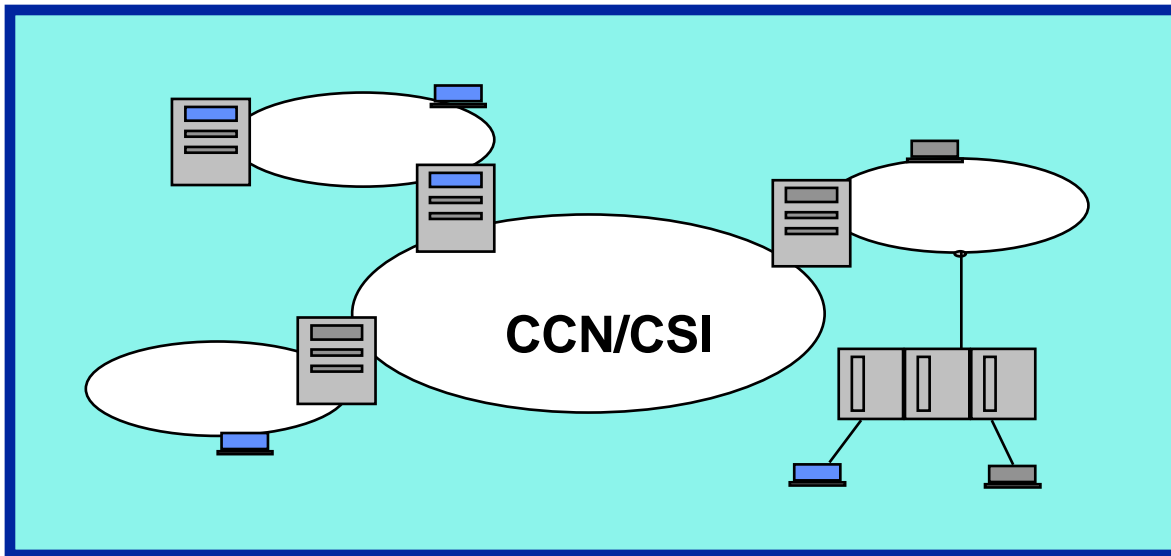# CCN/CSI Course Notes

➡ **CCN/CSI General Concepts**

CCN/CSI

Structure of the Course

- **This course is intended for:**
  - **the CSI application architects and developers**

- **Three modules are proposed:**
  - **CCN/CSI General Concepts (1/2 day)**
  - **CSI Applications Design (1/2 day)**
  - **CSI APIs Description (2 days with exercises)**

Objectives

- **The objectives of this course are to enable you :**
  - **to design, write and test programs using CCN/CSI**
  - **to understand the key elements of program design needed by the message queuing paradigm and the request/response paradigm**

CCN/CSI

- **Prerequisites:**
  - **Experience in application design and programming (C, COBOL or Java language) on an Application Platform supported by CCN/CSI**
  - **Message queuing and transaction management notions**

- **Reference Documents:**
  - **CCN/CSI System Overview**
  - **Application Programming Guide**
  - **Application Configuration Guide**
  - **Reference Manuals**

General Concepts

➡ **CCN/CSI definitions**

• **CCN/CSI overall architecture**

• **CCN/CSI benefits**

• **CCN/CSI functional model**

• **Services offered by the Common System Interface**

• **Synchronous and Asynchronous Data Exchange**

CCN/CSI Definitions

- **CCN   Common Communication Network**

- **CSI   Common System Interface**

- **NA   National Administration**

- **AP   Application Platform
        (Unix [AIX, Sun, HP-UX],
        Linux [RedHat, Suse],
        Windows,
        IBM MVS/CICS)**

- **GW   Gateway (Bull AIX 4.3)**

- **CCN/CSI definitions**
- **CCN/CSI overall architecture**
- **CCN/CSI benefits**
- **CCN/CSI functional model**
- **Services offered by the Common System Interface**
- **Synchronous and Asynchronous Data Exchange**

CCN/CSI Overall Architecture

National Networks

CSI

CCN

CCN backbone

AP

GW

NA

GW

AP

NA

NA : National Administration

AP : Application Platform

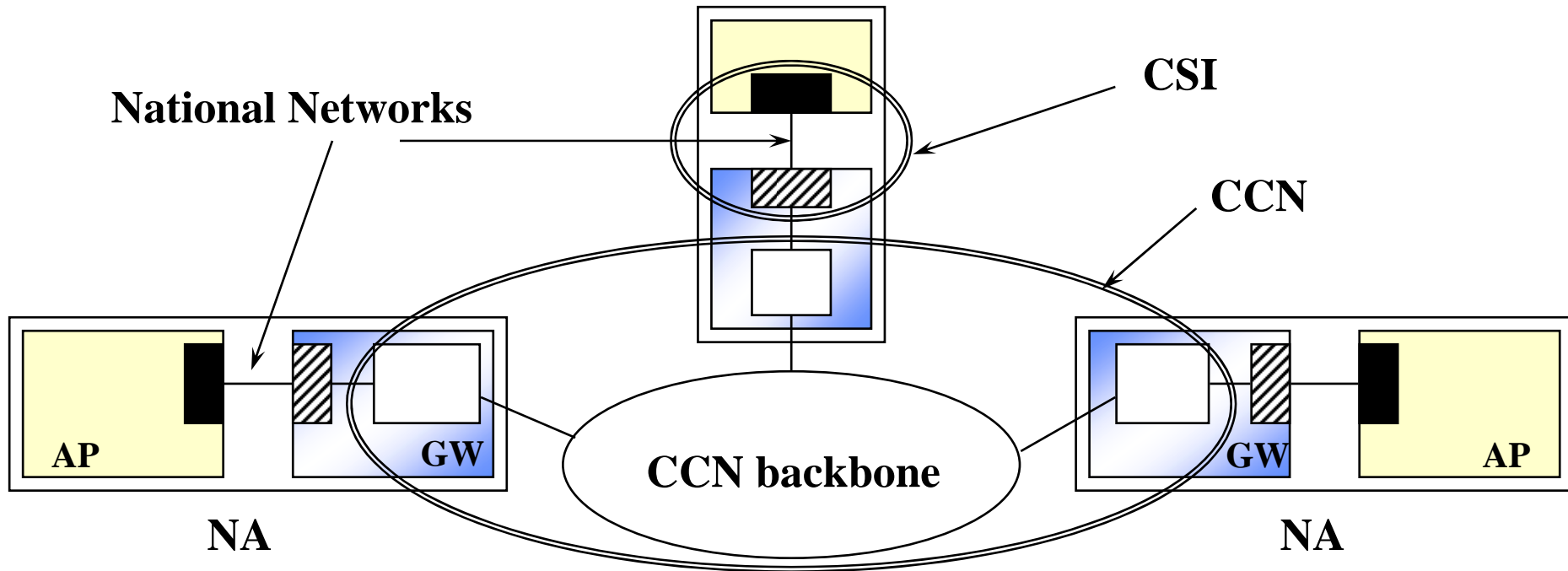GW : Gateway

: CSI stack

: Remote API Proxy

: CCN software

General Concepts

- **CCN/CSI definitions**
- **CCN/CSI overall architecture**
- **CCN/CSI benefits**
- **CCN/CSI functional model**
- **Services offered by the Common System Interface**
- **Synchronous and Asynchronous Data Exchange**

CCN/CSI Benefits

- **The CCN/CSI architecture simplifies the programming of distributed applications by introducing several types of transparency**

    – **Location transparency**

    – **Network transparency**

    – **Implementation transparency**

- **Location transparency**

  – Automatic name resolution (service and queue)

  – Binding to the CCN, not to a peer application

  – Application can be moved to a new Application Platform

  – CCN Directory Server on Gateways

  – Configuration file on Application Platform

- **Network transparency**

    – Support of the following communication protocols :
        TCP/IP (socket, WinSock)

    – Support of different byte ordering and character sets

    – CCN backbone relies on TCP/IP through a WAN provider

- **Implementation transparency**

  - Peer application programs agree on their interface, not on their internal structure

  - Maximum data size supported by CCN is limited only by platform characteristics

  - Applications can be written in C language, in COBOL or in Java

- **CCN/CSI definitions**
- **CCN/CSI overall architecture**
- **CCN/CSI benefits**
- ➡ **CCN/CSI functional model**
- **Services offered by the Common System Interface**
- **Synchronous and Asynchronous Data Exchange**

Application Domain

Application A

Application B

Application Protocol

CCN/CSI Infrastructure

Inter-Application Bus (IAB)

CCN/CSI Functional Model
F, T, C Model Breakdown

Application

VAS

GAS

High level F layer

Remote API Proxy

Local Intelligence

F

F

Low level F layer

Low level F layer

Low level F layer

F

GT layer

GT layer

GT layer

T

T

T

CT layer

CT layer

C

C layer
(National Communication Services)

Tuxedo / MQ-Series

C

Application Platform

Gateway

CCN/CSI Functional Model
CSI Stack and Remote API Proxy Description

Application

HL API

High level F layer

CSI, GSS,
PRES API

Low level F layer

T API

GT layer

CT API

CT layer

C layer
(National Communication Services)

Remote API Proxy

**Binding and
Authentication**

CSI, GSS, PRES API

**API calls
remote execution**

SPI Stack

CSI Stack

XATMI, MQI

Tuxedo / MQ-Series
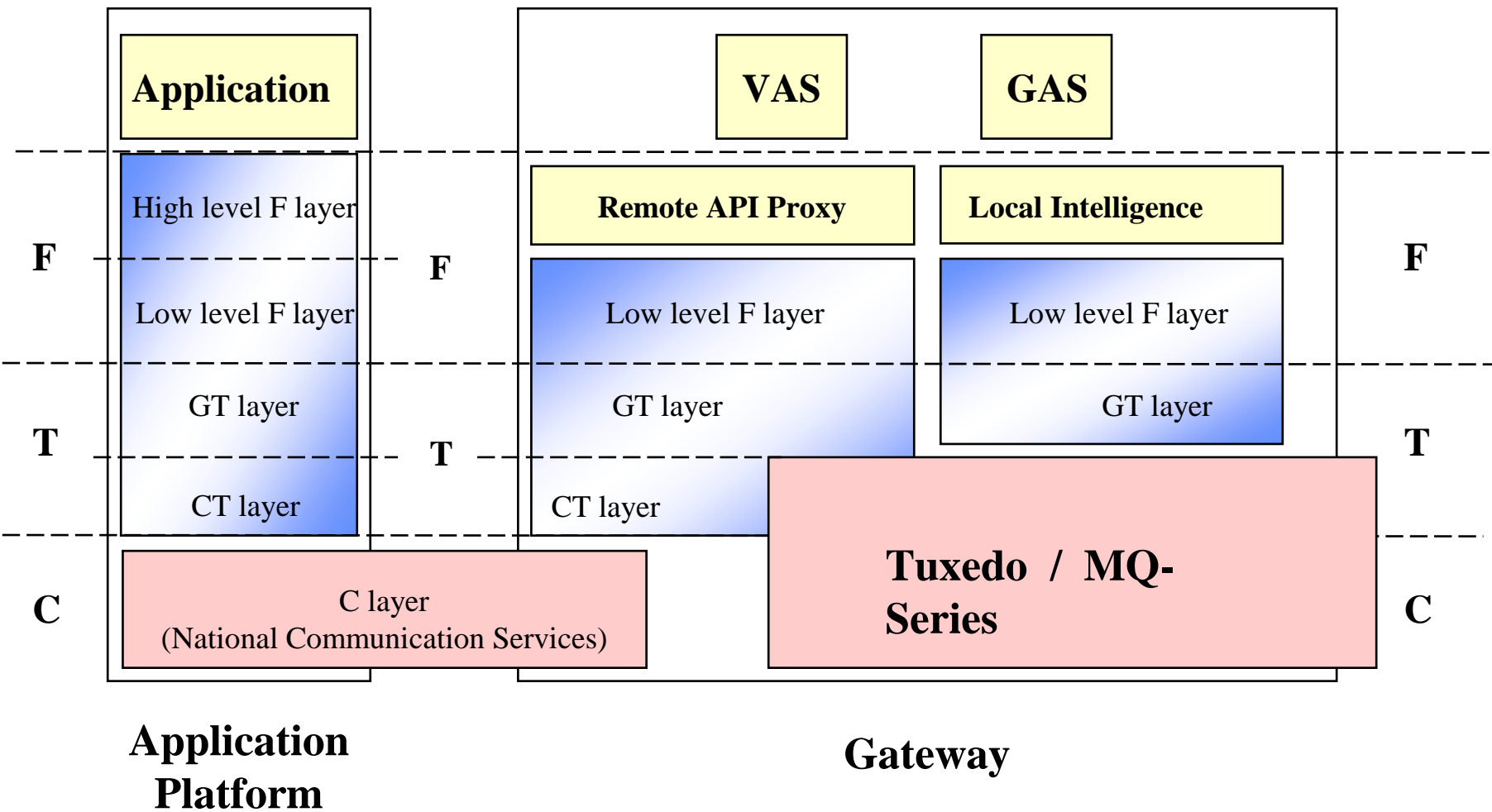
**Application
Platform**

Gateway

General Concepts

- **CCN/CSI definitions**
- **CCN/CSI overall architecture**
- **CCN/CSI benefits**
- **CCN/CSI functional model**
- **Services offered by the Common System Interface**
- **Synchronous and Asynchronous Data Exchange**

Services offered by the Common System Interface

- **The main services offered by the CSI are**
  - synchronous data exchange services
    - asynchronous data exchange services
    - security services
    - routing and addressing services
    - data presentation services
    - generic application services
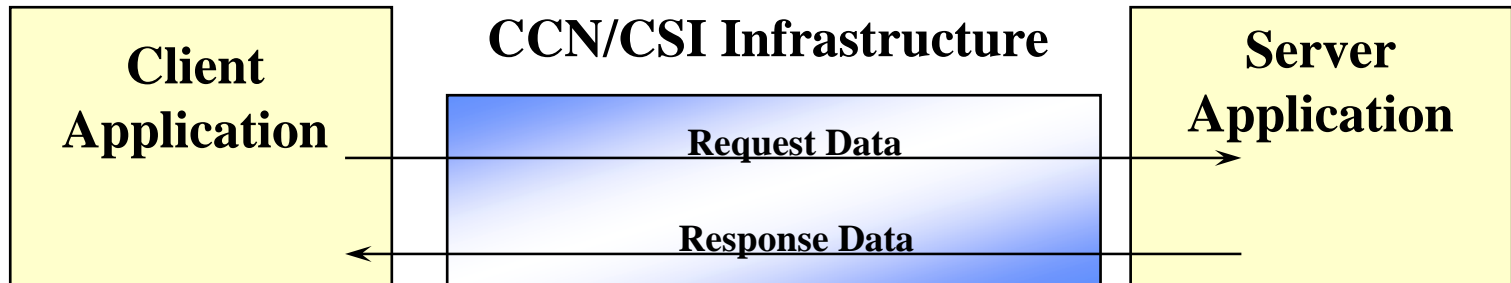   - quality of service handling

Synchronous Services

- **CSI provides APIs allowing applications to perform <u>synchronous</u> interactions**

  – in *blocking* request/response mode

  – in *non-blocking* request/response mode

- **Two kinds of applications must be distinguished**

  – client application, which generates requests and receives replies

  – server application, which accepts requests from clients and returns replies
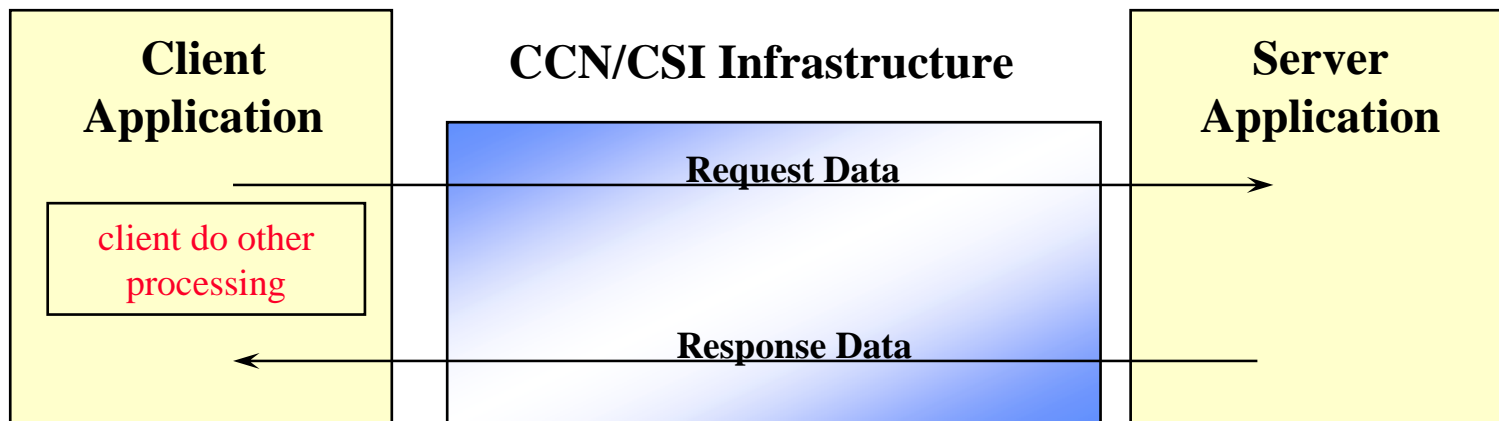
Blocking Request/Response Interactions

CCN/CSI

Client Application	CCN/CSI Infrastructure	Server Application
	→ Request Data →	
	← Response Data ←	

- **The elements of request/response interactions are:**
  - CCN/CSI provides a Request/Response API to the Applications
  - CCN/CSI takes charge of the data exchange between client and server
  - The server processes the request data and sends back the response data
  - CCN/CSI notifies the communicating applications of error conditions
- **Blocking interaction: when a client makes a request, it will not continue execution until the response from the server is received**
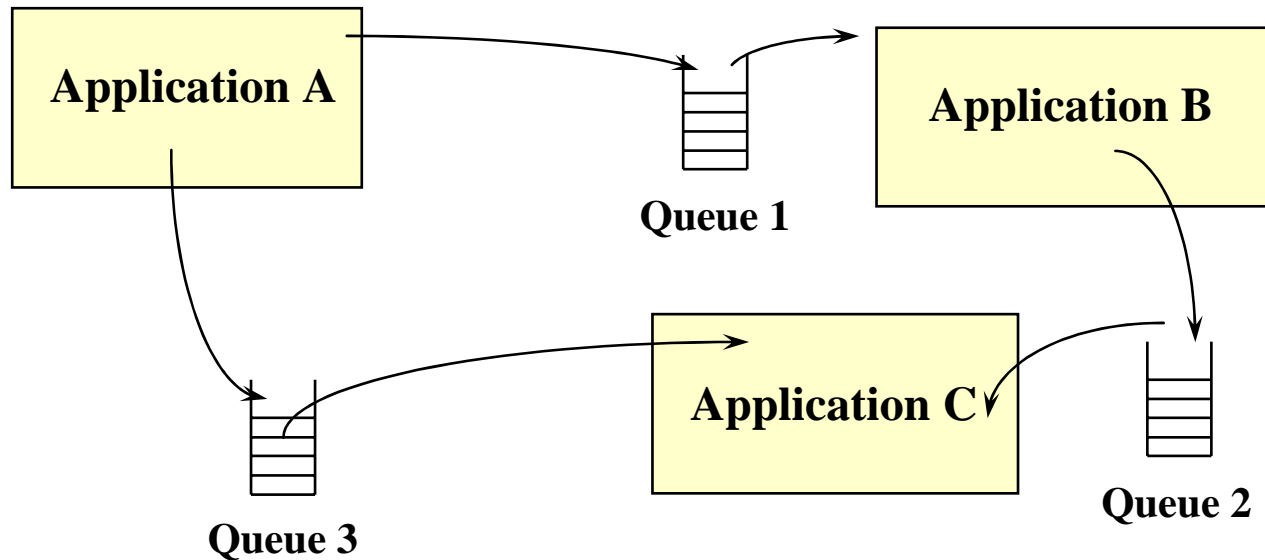
Non-Blocking Request/Response Interactions

Client Application	CCN/CSI Infrastructure	Server Application

Request Data

client do other processing

Response Data

- **Non-blocking request/response interaction: client can do other processing (including initiating other request/response interactions) while the server is processing its request**

- **The client becomes synchronised with the response to the request by checking or waiting for a response**

- **The server does not know whether the client is blocked awaiting its results or has performed other work**
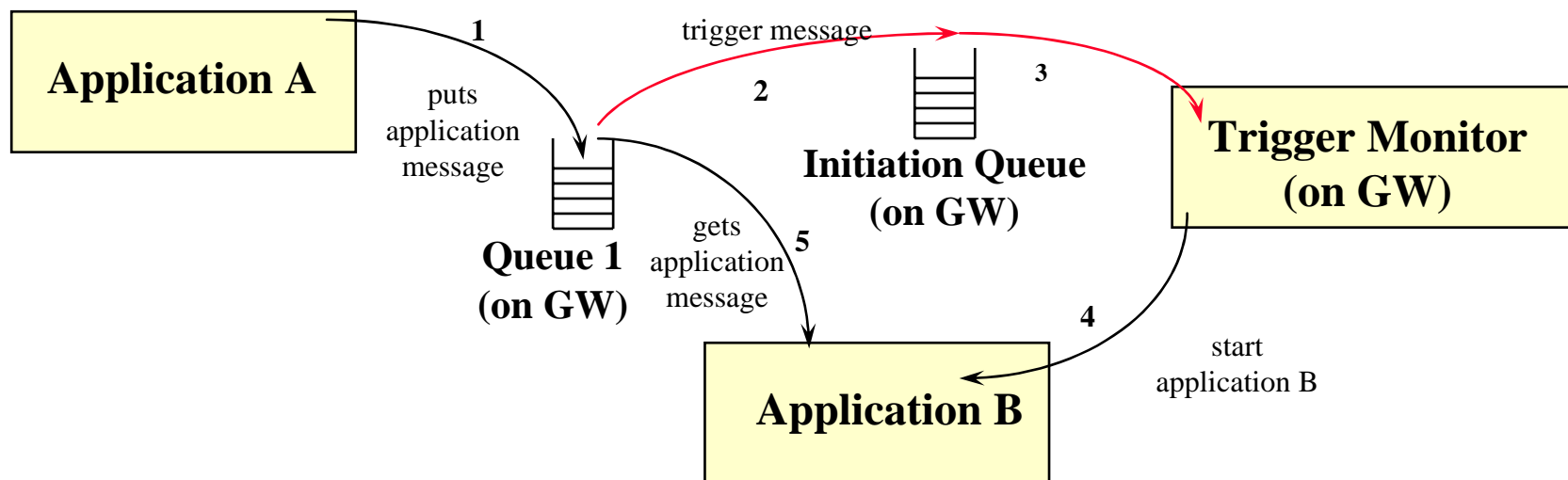
- **The main services offered by the CSI are**
  - synchronous data exchange services
  - ⇨ asynchronous data exchange services
  - security services
  - routing and addressing services
  - data presentation services
  - generic application services
  - quality of service handling

Asynchronous Services

- **CSI provides APIs allowing applications to perform <u>asynchronous</u> interactions** (store-and-forward technique)

Application A

1   trigger message

puts
application
message

2

3

**Initiation Queue
(on GW)**

**Trigger Monitor
(on GW)**

**Queue 1
(on GW)**

gets
application
message

5

4

start
application B

Application B

- **The Triggering is the mechanism by which an application is started when a message is put on a given application queue**

- **What is a message ?**

  – In message queuing, a message is a collection of data sent by one CSI application and intended for another one
  – CCN/CSI defines four types of messages:

    • **Datagram**

    • **Request**

    • **Reply**

    • **Report**

  – CCN/CSI message is composed of two parts:

    • **Control information**
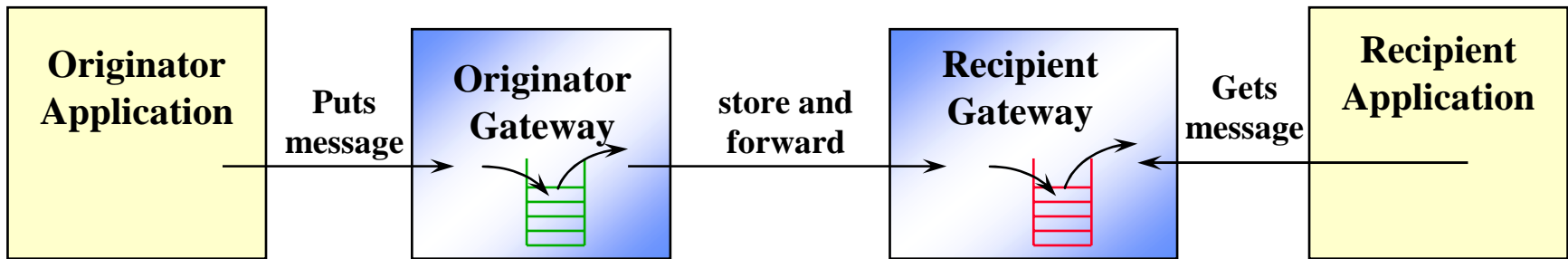
    • **Application data**

- **What is a message queue ?**

    – **A message queue is a receptacle for application messages**

    – **Messages accumulate on queues**

    – **Queues are managed by a queue manager**

    – **A queue can be either volatile or permanent**

    – **Applications access their queues through the CSI interfaces**

Message Queuing (3)

| Originator Application | → Puts message → | Originator Gateway | → store and forward → | Recipient Gateway | ← Gets message ← | Recipient Application |

CCN/CSI Infrastructure

- **The CCN/CSI infrastructure takes in charge the transmission of the message from the *originator* gateway to the *recipient* gateway**

- **The main services offered by the CSI are**
  - synchronous data exchange services
  - asynchronous data exchange services
  - → security services
  - routing and addressing services
  - data presentation services
  - generic application services
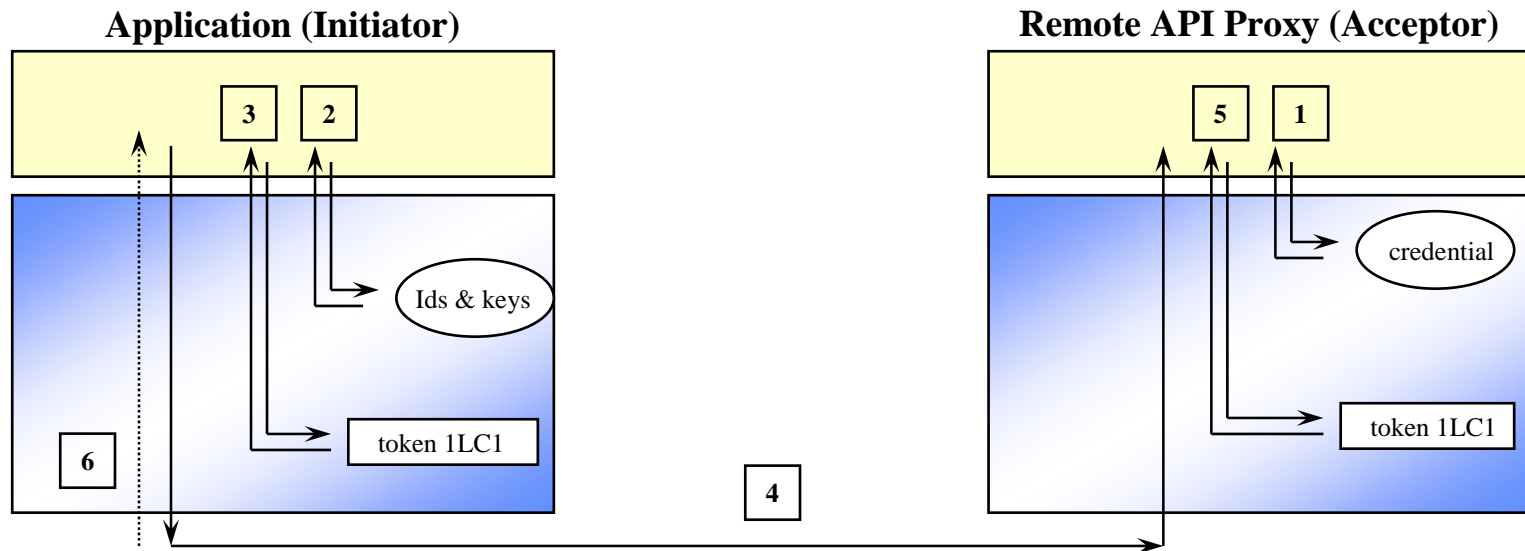 - quality of service handling

- **CSI provides APIs (close to GSS) to perform the following security services in the National Domains:**

  – **authentication**

  – **access control lists**

  – **confidentiality**

  – **integrity**
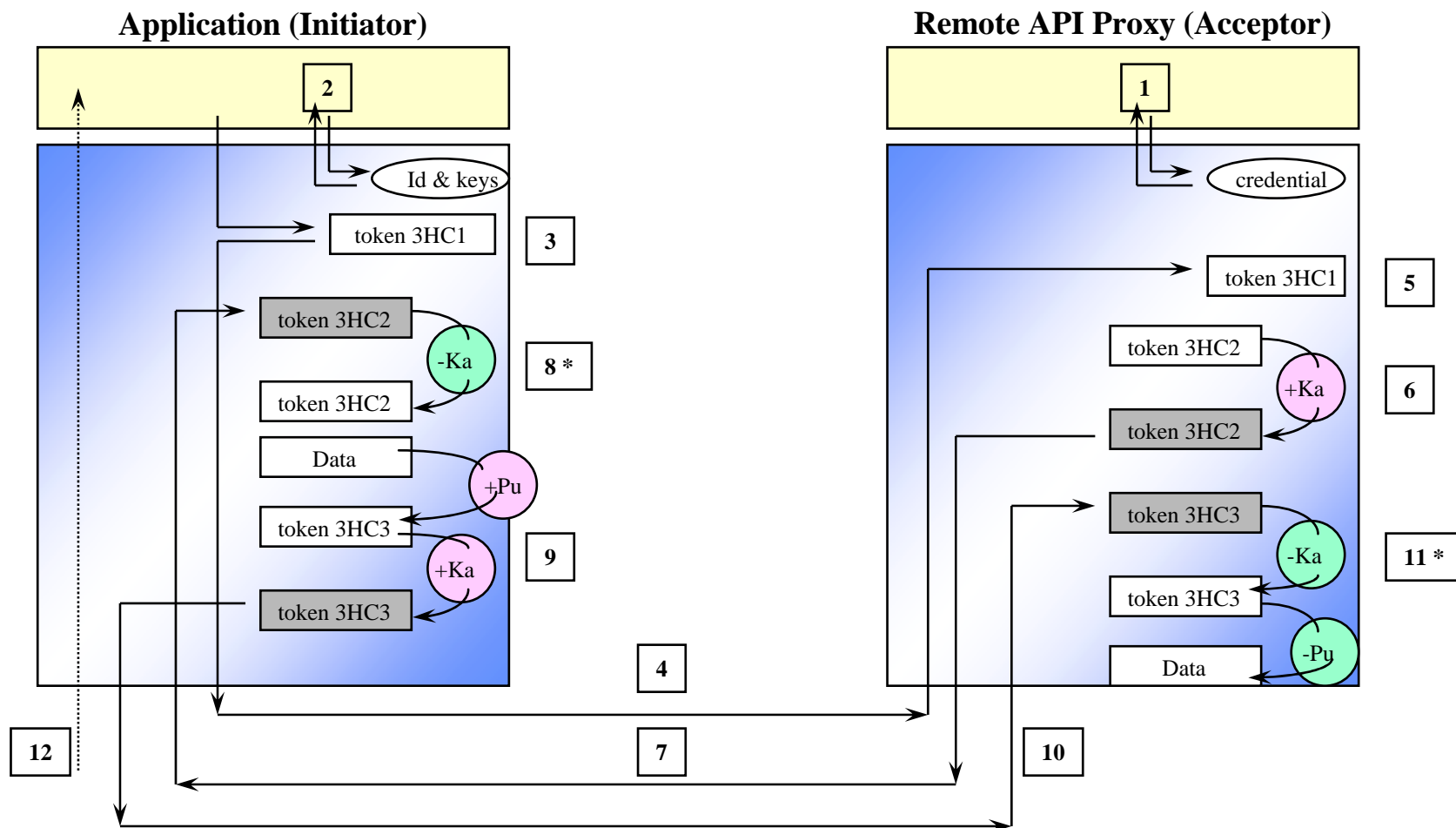
Authentication Mechanisms

- **CCN/CSI security mechanisms are not symmetrical**

- **Secure links versus non-secure links**

- **For secure links, a 1-way handshake is used for authentication**

- **For non-secure links, a 3-way handshake is used for authentication**

1-Way Handshake Authentication

Application (Initiator)

| 3 | 2 |

Ids & keys

token 1LC1

6

Remote API Proxy (Acceptor)

| 5 | 1 |

credential

token 1LC1

4

- **The authentication on a secure link is a one-pass process**

3-Way Handshake Authentication

Application (Initiator)

Remote API Proxy (Acceptor)

2

1

Id & keys

credential

token 3HC1 3

token 3HC1 5

token 3HC2 -Ka 8 *

token 3HC2 +Ka 6

token 3HC2

token 3HC2

Data +Pu

token 3HC2

token 3HC3 9

token 3HC3 -Ka 11 *

token 3HC3 +Ka
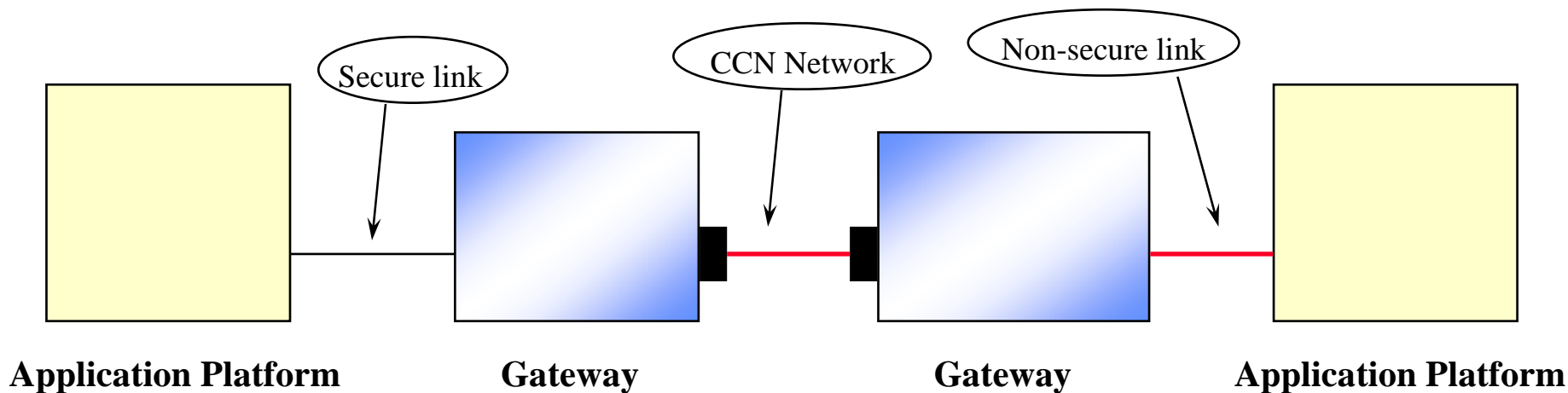
token 3HC3

token 3HC3 -Pu

Data

4

12

7

10

Mutual authentication on a non-secure link
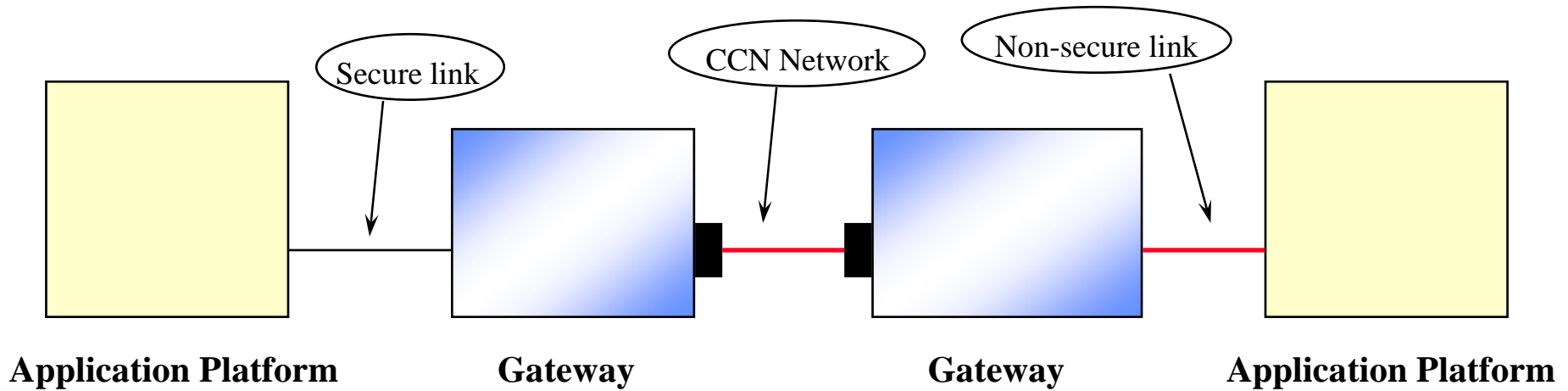
Access Control Lists

- **Access Control List is a list of *actors* (users) who can access a given application *resource* (service or queue)**

- **Access is granted only if the user is <u>explicitly</u> authorised to use the resource**

- **ACLs are organised in two parts:**
  - users / user profiles
  - user profiles / resources (services and queues)

- **Access controls are performed on the Gateways in two steps**

Confidentiality

Secure link

CCN Network

Non-secure link

Application Platform   **Gateway**   **Gateway**   **Application Platform**

- **The confidentiality service protects against the eavesdropping of classified or restricted information**

Integrity

Application Platform   Gateway   Gateway   Application Platform

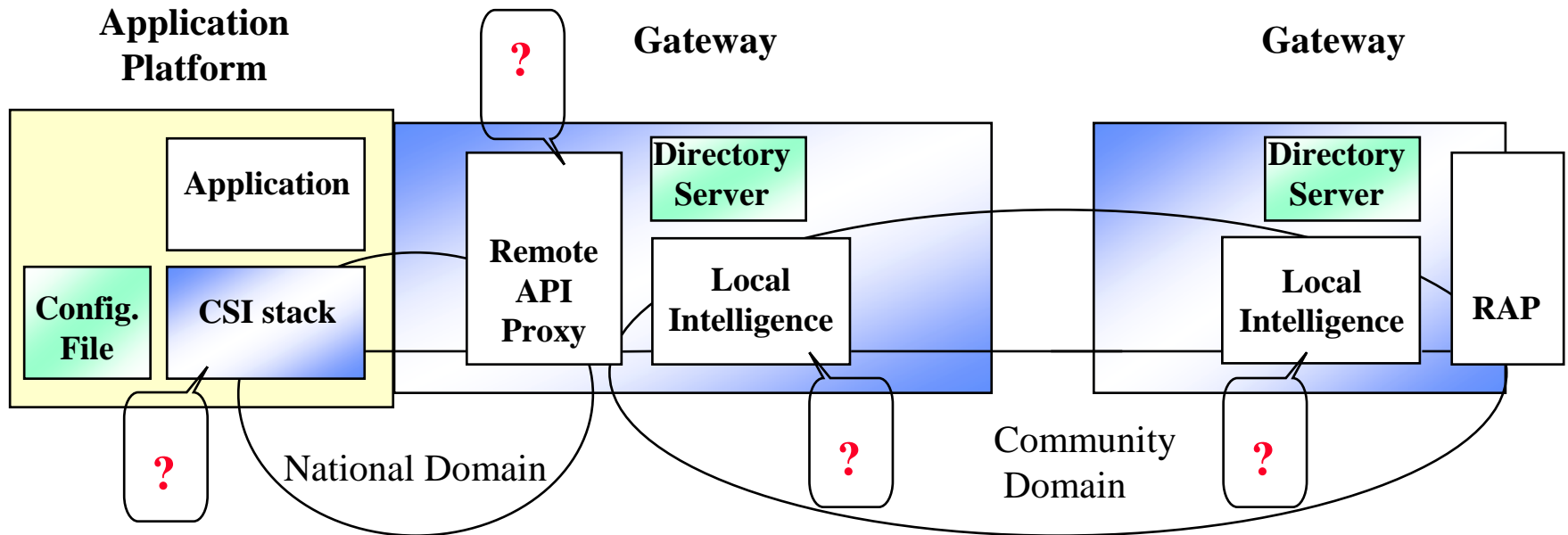- **Data integrity guarantees that the data recipient will be able to detect a non-authorised alteration or replay of the data**

- **The main services offered by the CSI are**
  - synchronous data exchange services
  - asynchronous data exchange services
  - security services
  - routing and addressing services
  - data presentation services
  - generic application services
  - quality of service handling

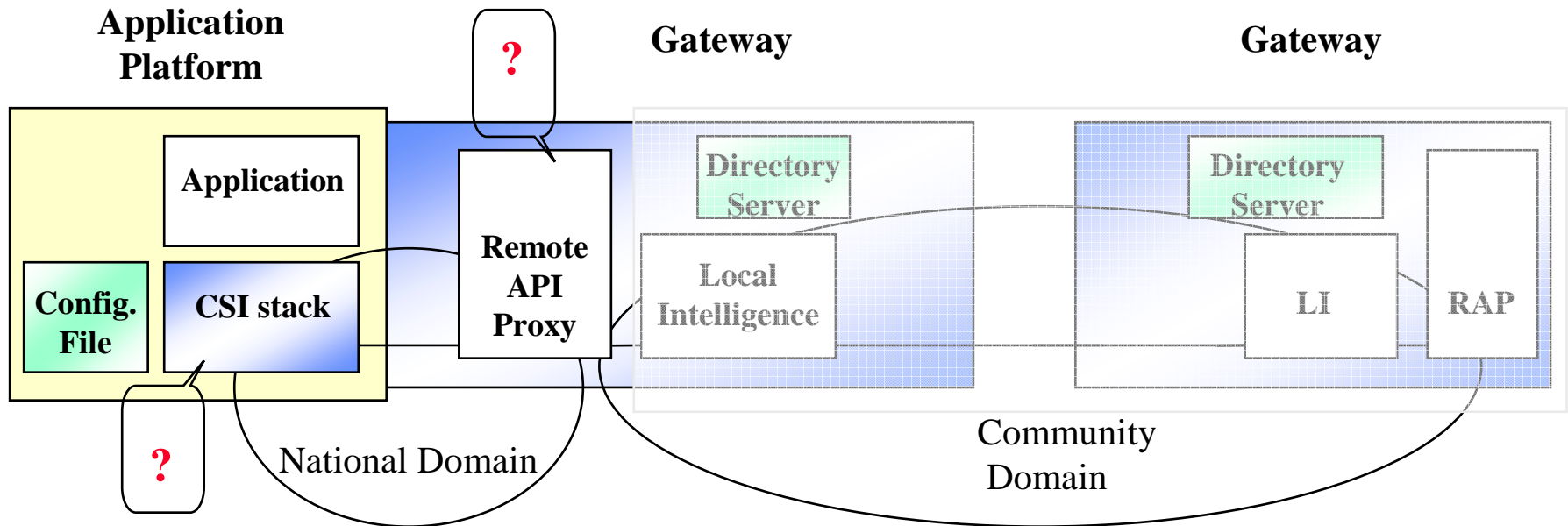- **CCN/CSI is responsible for the routing/addressing resolution of the messages sent by the applications to their destination**

AP and GW Address Resolution

- **Application Platform and Gateway Addresses are resolved during the binding phase.**

- **Service and Queue locations are resolved after the binding phase, at the invocation of the service (or queue).**

CCN Directory (1)

- **On Gateways, the routing and addressing information is stored in the CCN Directory Server:**
  - Application Platform

  - Gateway

  - Application

  - Service and URL

  - Queue

- **The CCN Directory also contains:**

  – Security information

  – Default QoS (Quality of Service)

  – Message format description

Configuration Files on AP (1)

- **On Application Platforms, routing and addressing information are stored in configuration files**
  (or Windows Registry - this is system dependent)

- **The configuration files are generated from the information contained in the CCN Directory Server**

- **Configuration files are divided into sections and entries**

- **Applications sections contain the following entries:**

  - ApplicationActivationMode   "Initiator", "OnDemand" or "PreStarted"

  - RapName   *The RAP the application has to bind to*

  - AddressType   "TCP/IP" or "LU6.2"

  - Address   *The value of the address*
    - e.g. "172.0.0.1:9999" for TCP/IP

  - DefaultSecurityMechanism   "1LC" (recommended for Secure Links)
    - "3HE" (recommended for Non-Secure Links)

  - AuthorizedSecurityMechanisms   "1LC" or "1LC-3HE"

- **Proxies sections contain the following entries:**

  - AddressType   "TCP/IP" or "LU6.2"

  - Address   *The value of the address*
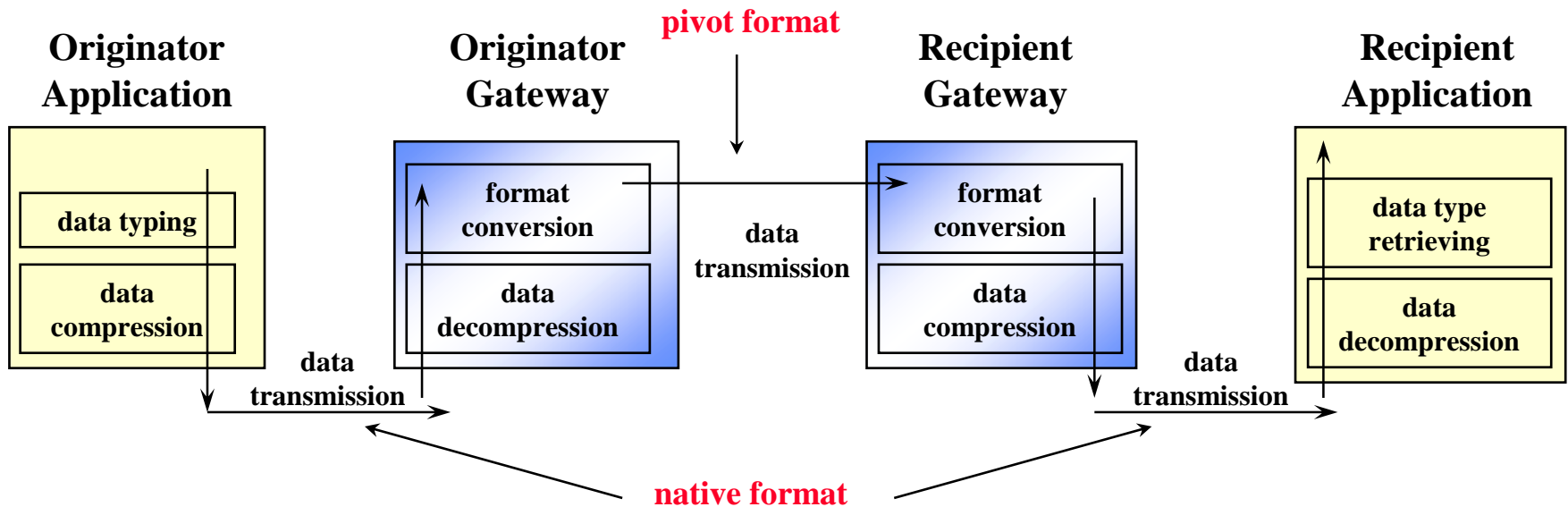   - e.g. "172.0.0.100:8888" for TCP/IP

- **A default section "[Application Defaults]"can contain values not specified in the application sections.**

- **A default section "[Proxy Defaults]"can contain values not specified in the proxy sections.**

- **A default section "[Platform Defaults]"can contain values not specified in the [Application Defaults] section neither in the [Proxy Defaults] section.**

Services offered by the Common System Interface

- **The main services offered by the CSI are**
  - synchronous data exchange services
  - asynchronous data exchange services
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  - data presentation services
  - generic application services
  - quality of service handling

- **CSI allows applications running on heterogeneous platforms to exchange data in their native format**

    – ASCII - EBCDIC, little endian - big endian, bit order, …

- **CSI provides an harmonised API to use the presentation services**

- **Application messages are composed of two parts:**
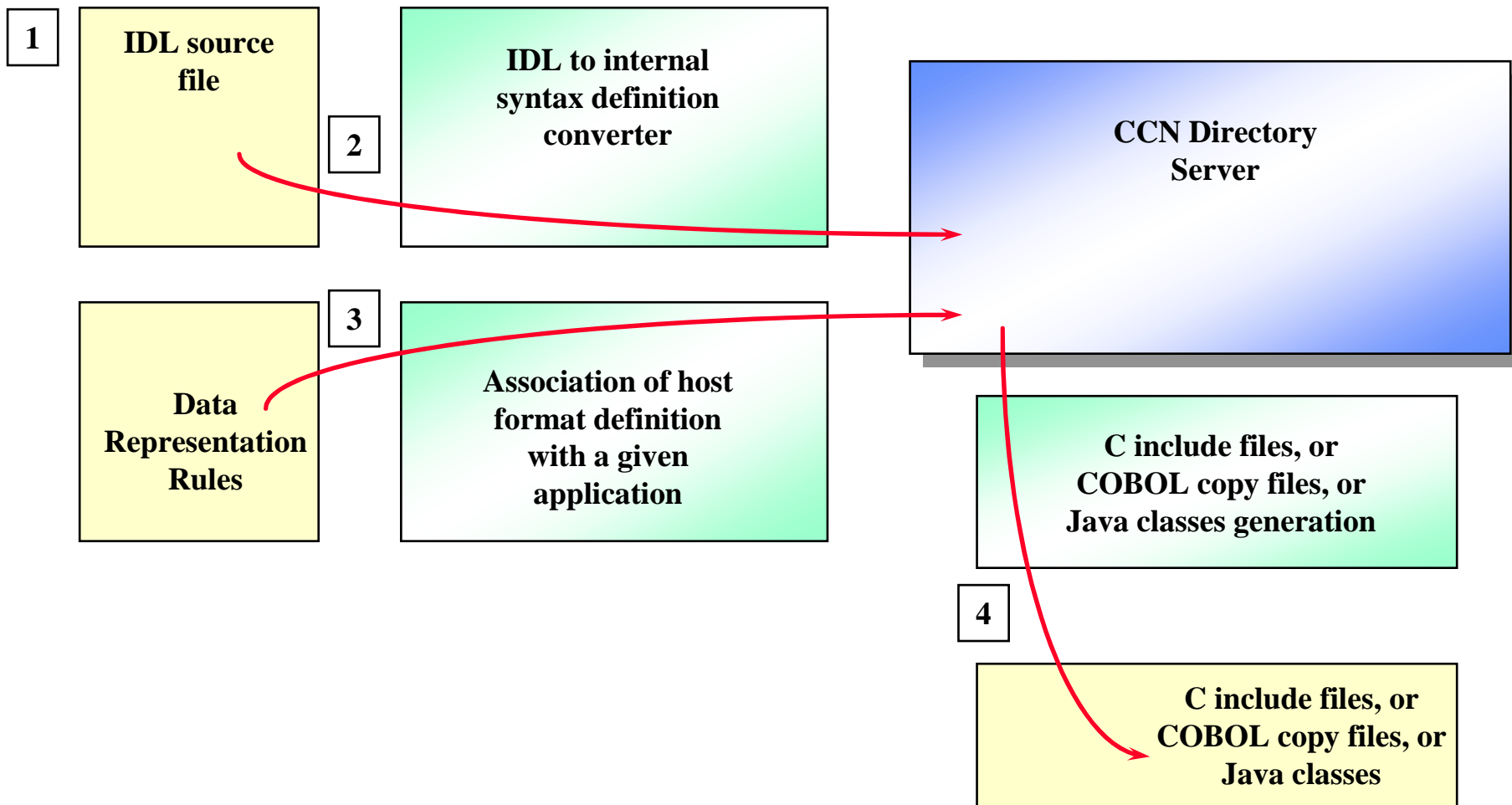 - header part : one structure (optional)
  - body part   : one-dimensional array of structure, or one-dimensional array of base type item (the number of structures or items is not fixed)

- **Nested structures are not supported**

- **Base types supported by CCN/CSI are as follows:**

  – char

  – short, unsigned short

  – long, unsigned long

  – boolean

  – byte

CCN/CSI

1   **IDL source file**

IDL to internal syntax definition converter

2

CCN Directory Server

3

Data Representation Rules

Association of host format definition with a given application

C include files, or COBOL copy files, or Java classes generation

4

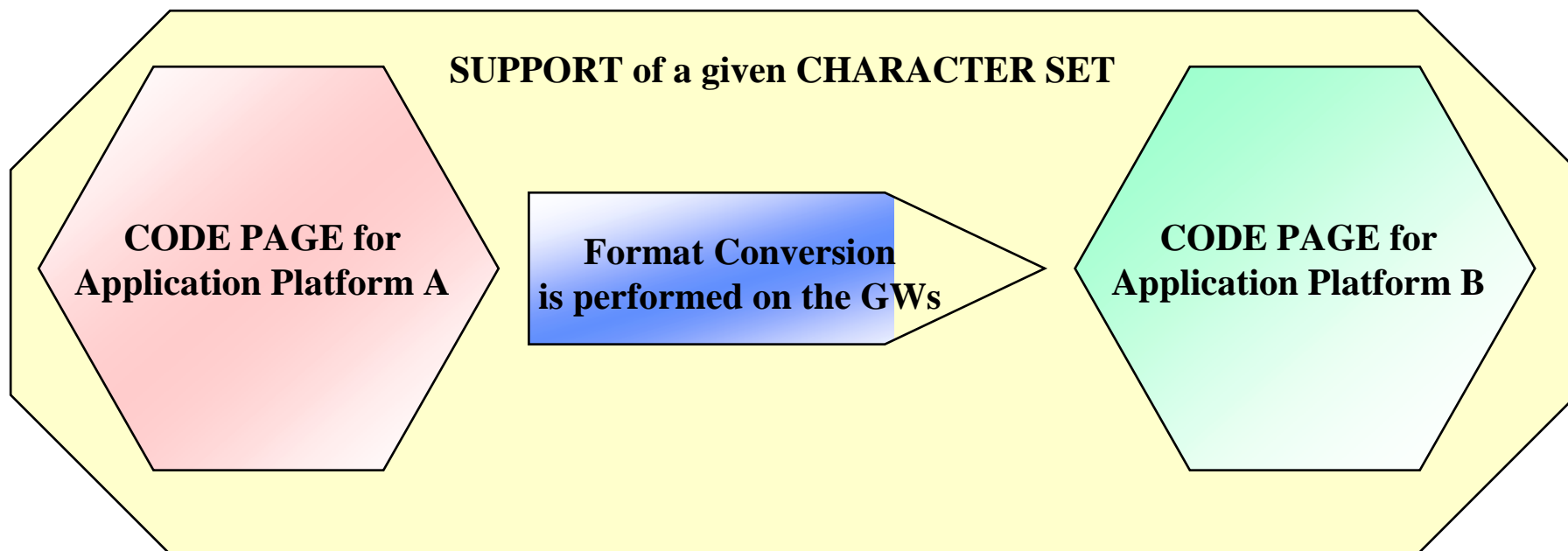**C include files, or COBOL copy files, or Java classes**

- **Application developer writes *CCN/IDL* source files using a simplified version of IDL (from OSF/DCE)**

- **An IDL file contains a header section and an interface definition**

- **All interface attributes are recognised - to ensure compatibility with the DCE/IDL - but ignored by the compiler**

- **Data Representation Rules is a set of rules on hardware representation of data**

- **The Data Representation Rules Set covers:**
  - language used (C/COBOL/Java)
  - host/operating system
  - bit order (high-order-bit first vs. low-order-bit first :1000 0000 or 0000 0001)
  - byte order (big-endian vs. little-endian)
  - sign management (i.e. 2-complement vs. 1-complement)
  - packing method
  - boolean, byte, char, short, long size and alignment

Character Strings Conversion

SUPPORT of a given CHARACTER SET

**CODE PAGE for
Application Platform A**

**Format Conversion
is performed on the GWs**

**CODE PAGE for
Application Platform B**

- **Character Set = language support**
- **Code Page = Application Platform support**
- **Presentation services = Code Pages conversion**

Code Pages Support

- **PC and ISO code pages are ASCII-based**

- **Mainframe code pages are EBCDIC-based**

- **No conversion on the *byte* type data**

- **Intermediate Code Page on the Community Domain**
  => Double-byte Unicode Code Page

- **Substitute characters in some conversions**

Languages Support

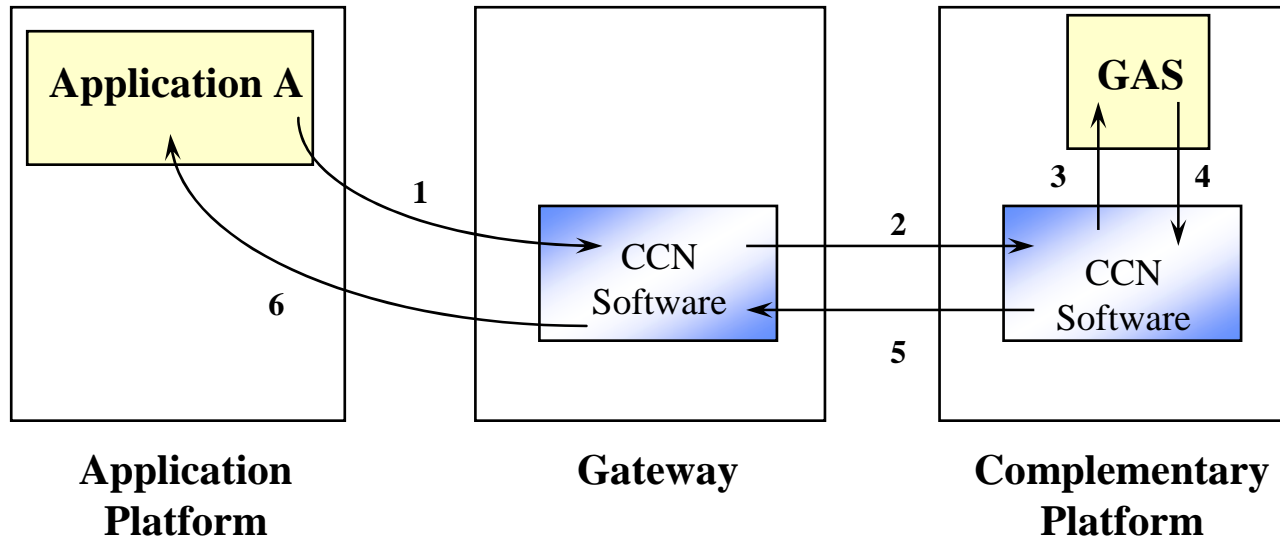| Character Set	Languages	PC	ISO	EBCDIC
Latin-1	US English, Portuguese, Canadian French	IBM-850	ISO8859-1	IBM-037
Latin-1	Danish, Norwegian	IBM-850	ISO8859-1	IBM-277
Latin-1	Finnish, Swedish	IBM-850	ISO8859-1	IBM-278
Latin-1	Italian	IBM-850	ISO8859-1	IBM-280
Latin-1	Spanish	IBM-850	ISO8859-1	IBM-284
Latin-1	U.K. English	IBM-850	ISO8859-1	IBM-285
Latin-1	German	IBM-850	ISO8859-1	IBM-273
Latin-1	French	IBM-850	ISO8859-1	IBM-297
Latin-1	Belgian, Swiss German	IBM-850	ISO8859-1	IBM-500
Greek	Greek	IBM-869	ISO8859-7	IBM-875

- **The main services offered by the CSI are**
    - synchronous data exchange services
    - asynchronous data exchange services
    - security services
    - routing and addressing services
    - data presentation services
    - generic application services
    - quality of service handling

- **Generic Application Services (GAS)**
  - are CSI applications
    (request/response mode)
  - located in the Community Domain
  - they implement generic services accessible explicitly by any user application
  - the right to call a GAS is subject to the authorisations registered in the ACLs
  - the architecture of GAS does not differ from the architecture of applications located on Application Platforms

Generic Application Services (2)

Application A

GAS

1

2

3   4

CCN Software

CCN Software

6

5

Application Platform

Gateway

Complementary Platform

Services offered by the Common System Interface

- **The main services offered by the CSI are**
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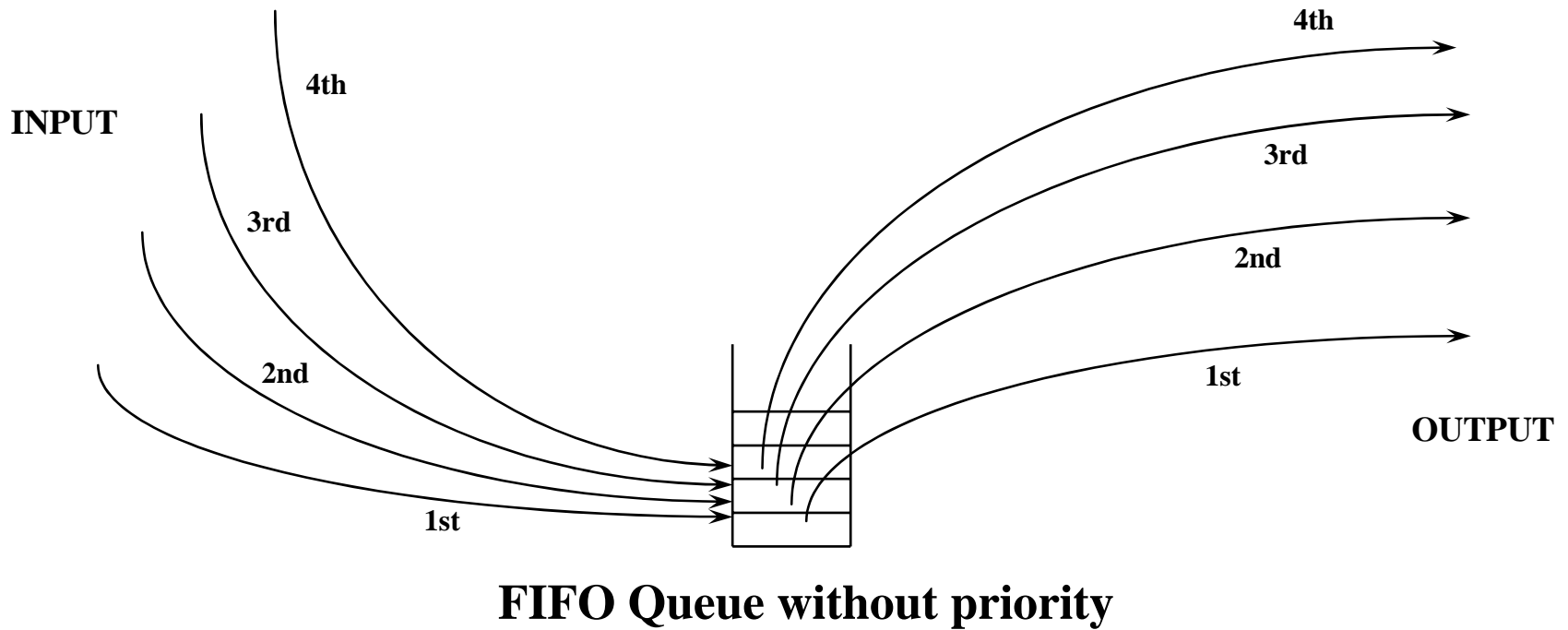   - ⇨ quality of service handling

- **CSI applications can require the implementation of a QoS (Quality of Service)**

  – priority

  – report notification

  – confidentiality, integrity, compression

  – class of traffic

- **The QoS is conveyed through the whole CCN/CSI infrastructure**

- **Per-message QoS versus default QoS**

- **The calls and messages with high *Priority* QoS will be processed by Tuxedo and MQSeries before the calls and messages with low *Priority***

- **For synchronous calls, the *Priority* CSI QoS corresponds to the Tuxedo priority**

- **For asynchronous calls, the *Priority* CSI QoS corresponds to the MQSeries priority**

Priority QoS (2)

INPUT

4th

3rd

2nd

1st

4th

3rd

2nd

1st

OUTPUT

FIFO Queue without priority

Priority QoS (3)

4th (high)

3rd (low)

2nd (high)

1st (low)

INPUT

2nd

1st

4th

3rd

OUTPUT

Priority 2(higer)

Priority 1(lower)

FIFO Queue with priorities

Report Notification QoS (1)

- **Report**

  – is a message about another message

- *ReportRequest* **QoS**

  – indicates which report messages are required

  – indicates whether the application message data is to be included in them

- **Any subset of the following report types can be requested:**

    – Exception

    – Expiration

    – Confirm on arrival

    – Confirm on delivery

- *ReportRequest* **QoS**
  - enables the application to specify how the message and correlation identifiers in the report message are to be set

- *ReplyToQ* **QoS**
  - is the name of the queue where the expected report or reply must be sent

Integrity and Confidentiality QoS

- *Integrity* **QoS**
  - indicates that data integrity is ensured on the National Domains

- *Confidentiality* **QoS**
  - indicates that data confidentiality is ensured on the National Domains

- *Integrity* **and** *Confidentiality* **QoS**
  - are always ensured on the Community Domain
  - can be applied on the National Domains only if 3-way handshake authentication was performed

- *Compression* **QoS**
  - indicates whether the data must be compressed before transmission on the National Network

- *CompressionId* **QoS**
  - indicates which algorithm to use to compress and decompress the data.
  - In the current version, only one algorithm - LZW - is supported.

- **Default CCN *Class of Traffic***

  – Every application domain can use the default CCN CoT. The name of this CoT is *DEFAULTCOT*.

- **Dedicated *Class of Traffic* for each application domain**

  – A given application domain "APPD" have a dedicated CoT called *DEFAULT.APPD*.

- **The Class of Traffic is used to build the name of the Dead Letter Queue**

  – The Dead Letter Queue name associated with the *DEFAULT.APPD* CoT is *DEAD-LETTER-QUEUE.APPD*

- **When required, messages are put into a *Dead Letter Queue* if they cannot be put in the recipient queue**

- **CCN *Dead Letter Queue***

  - Dead messages are put into the CCN Dead Letter Queue for all applications using the *DEFAULTCOT* CoT

- **Dedicated *Dead Letter Queue***

  - A dedicated Dead Letter Queue exists for each application domain. The *DEFAULT.APPD* Class of Traffic has to be set in order to use this dedicated Dead Letter Queue.
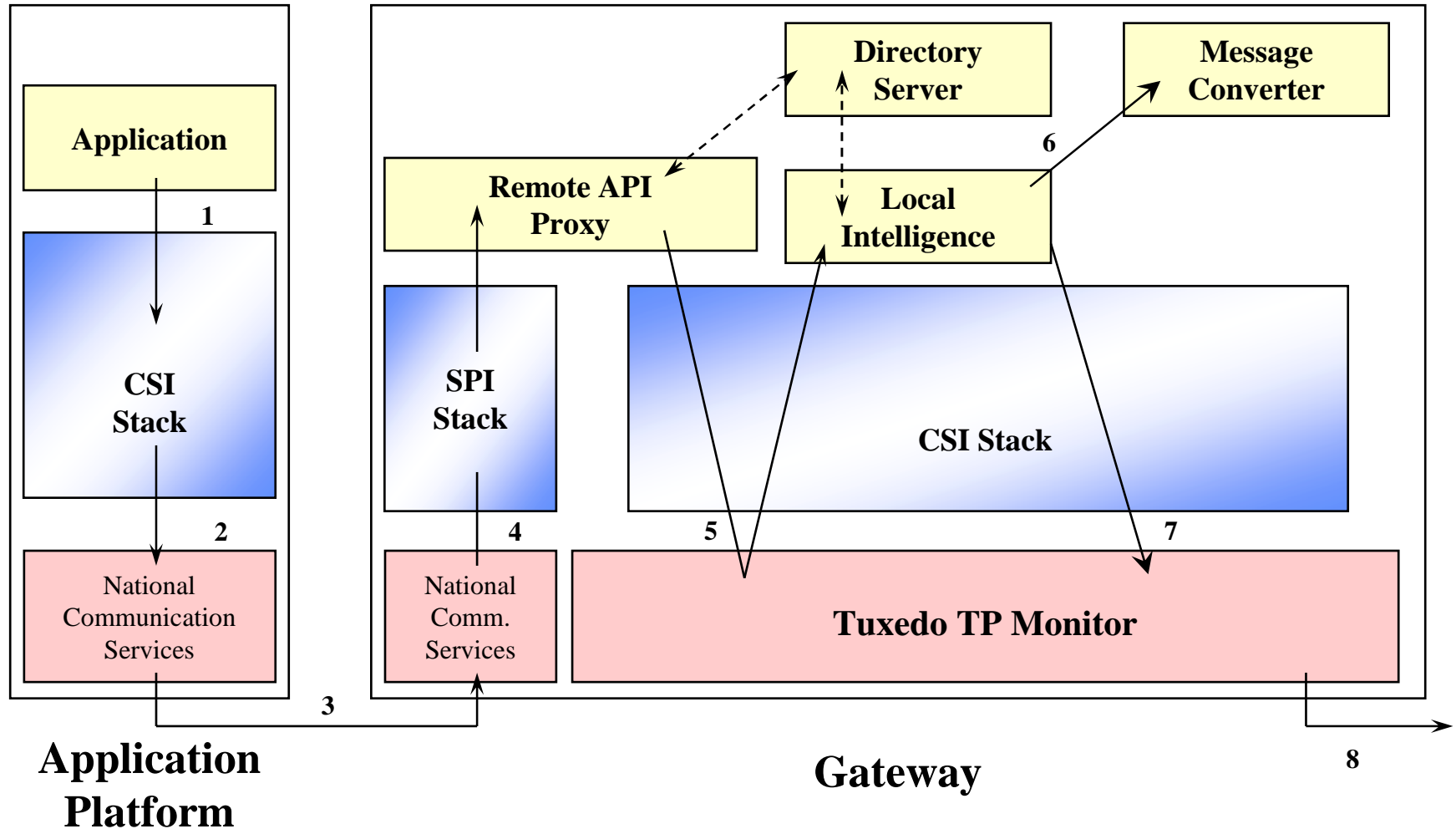
General Concepts

- **CCN/CSI definitions**
- **CCN/CSI overall architecture**
- **CCN/CSI benefits**
- **CCN/CSI functional model**
- **Services offered by the Common System Interface**
- ⇨ **Synchronous and Asynchronous Data Exchange**

Synchronous Data Exchange

CCN/CSI

Application Platform

Gateway

Asynchronous Data Exchange

CCN/CSI

Application

CSI Stack

National Comm. Services

1

2

3

Application Platform

Remote API Proxy

SPI Stack

National Comm. Services

4

Directory Server

CCN Trigger Monitor

MQ-Series Queue Manager

5

Local Intelligence

CSI Stack

Tuxedo TP Monitor

6

7

Message Converter

MQ-Series Queue Manager

8

9

Gateway