Unit-6

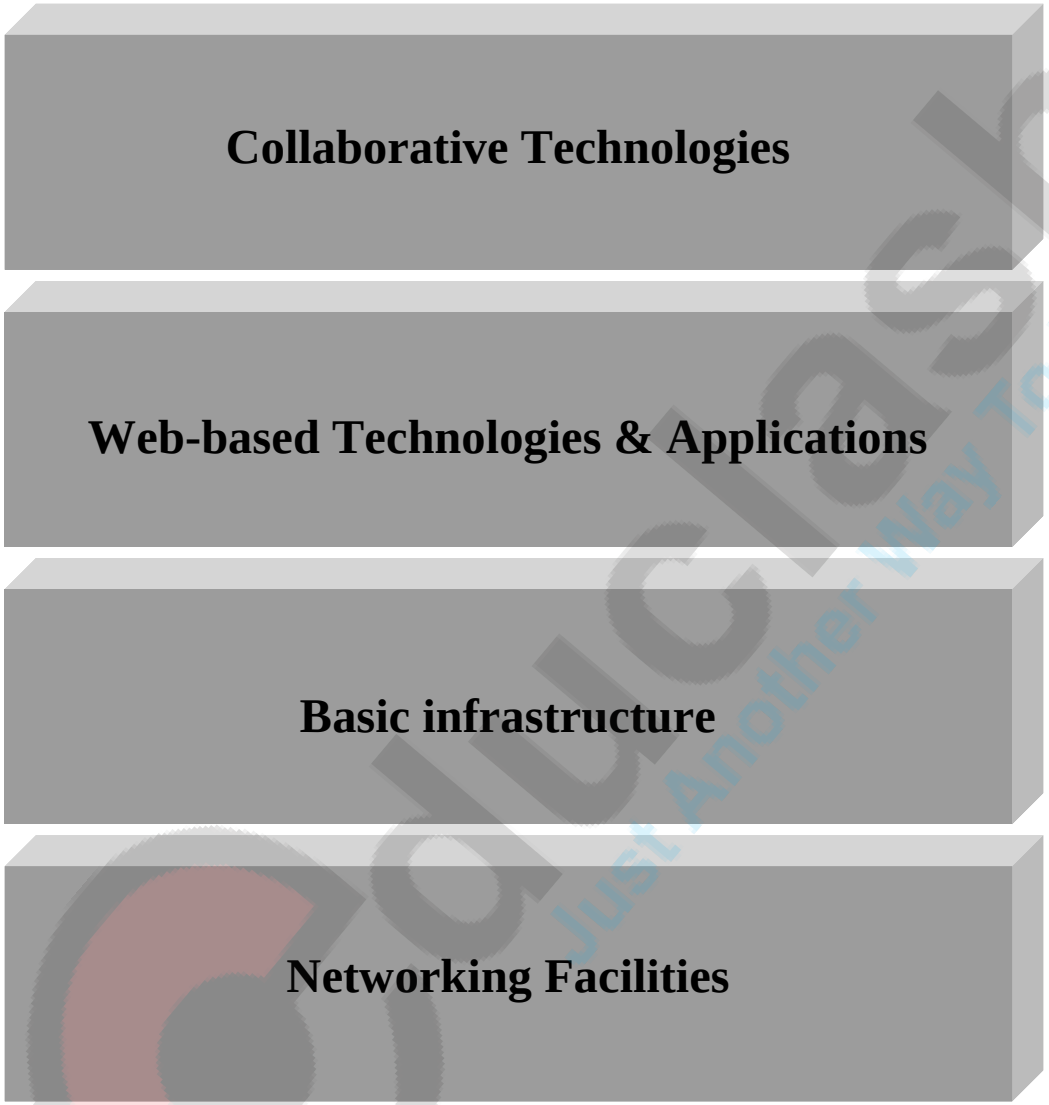
E-Business technological Infrastructure and Management

Technical e-Business challenges

- E-business means automating business processes across an extended enterprise, both inter and intra organizational relations are supported by modern information technologies.
- Typically, an e-business transaction such as transmitting an electronic purchase order , require both interacting partners' public processes to be closely coordinated, together with a detailed exchange of messages in an agreed format.
- Providing end-to-end process integration is not an easy undertaking.

- A major effort is required to leverage public processes to back-end applications , such as procurement, customer service, order processing and fulfillment, payroll processing, financial a/cing and so on.
- With the advent of e-business, end-to-end process integration becomes of paramount importance.

- The infrastructure for e-Business comprises technologies that can be seen as different layers that built upon each other:
  - The bottom layer includes networking topologies, the Internet, and protocols such as TCP/IP.
  - The layer above is the basic infrastructure layer that contains such as client/server and tiered architectures.
  - The layer above this contains the technologies that are required to develop web-based applications.
  - Finally, the top layer contains collaborative technologies such as workflow systems and EDI

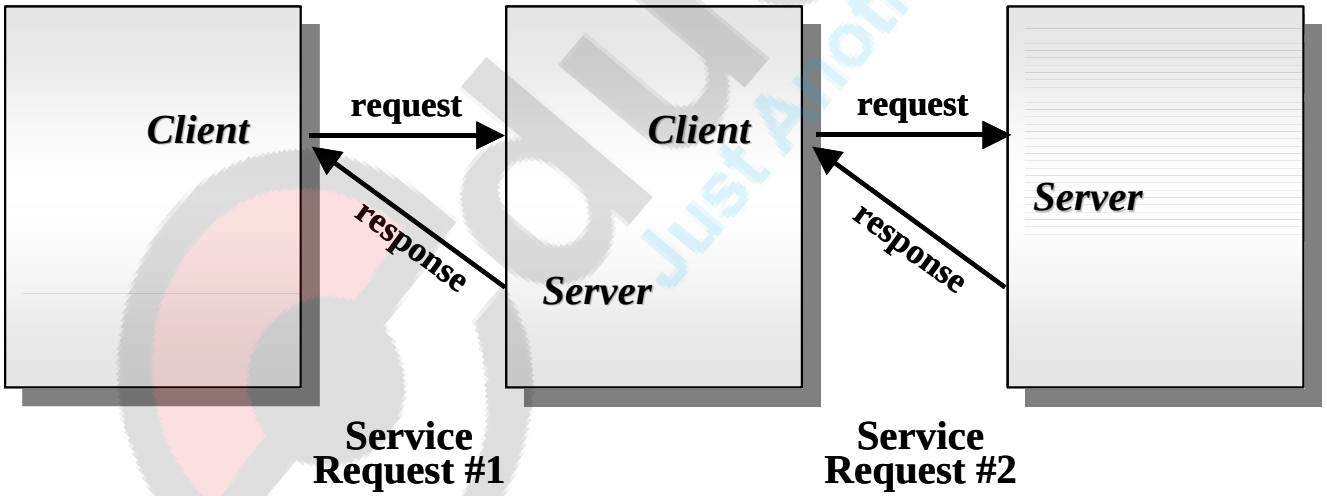


Technology stack for e-Business.

Basic Infrastructure: Client/Servers

- Distributed computing is the classical paradigm in support of e-Business processes & applications.
- A form of distributed processing is **client server computing**: it handles the need for both centralized data control and widespread data accessibility.
- Client/server is an architecture that involves client processes (service consumers) requesting service from server processes (service providers).
- Client/server computing does not emphasize hardware distinctions; it rather focuses on the applications themselves.
- The client/server model provides a typical way to interconnect programs that are distributed across different locations.

- There are different ways in which processing tasks can be divided between the client and the server. They range from:
  - Thin clients, with heavy servers to servers that only contain common data with all the processing executed at the level of the client.
- Solutions chosen depend on specific application requirements, e.g., local vs. central control, # of users, processing needs etc.



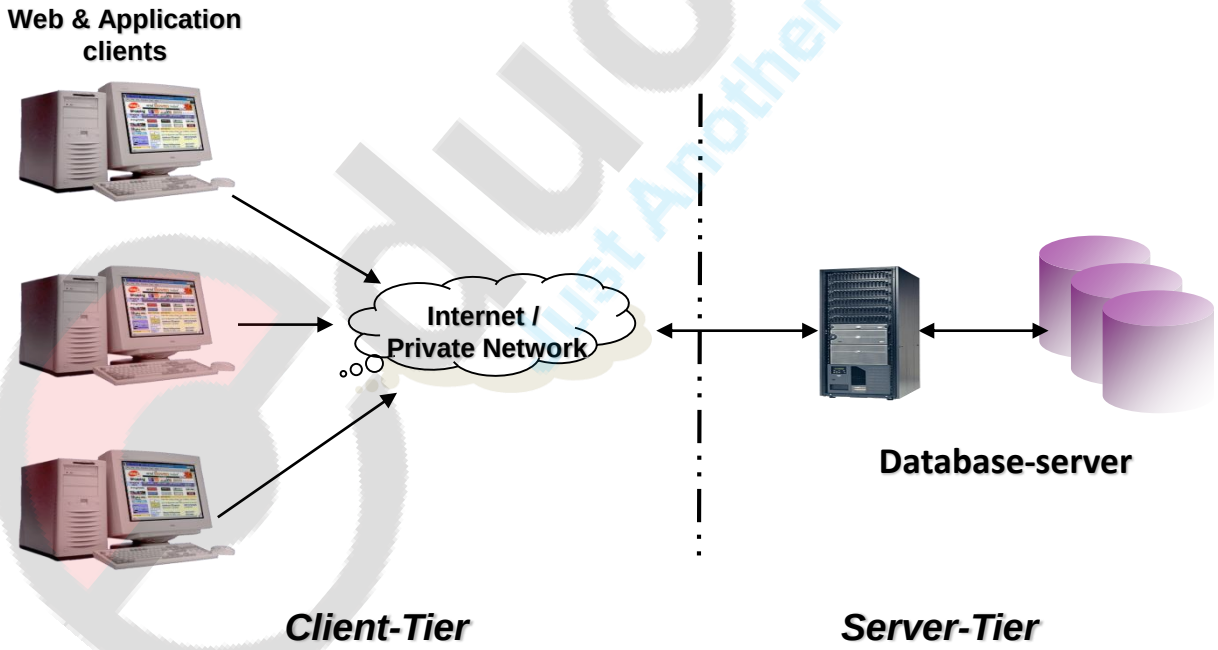
Client/Server architecture

Features of Client/Server Architecture

- The basic features of the client/server model are:
  - Clients and servers are functional modules with well defined interfaces. The functions of a client and a server can be implemented by a set of software modules, hardware components, or any combination thereof.
  - Each client/server relationship is established between two functional modules, where one module, the client, initiates service requests and the other module, the server, responds to these requests.
  - Information exchange between clients and servers, i.e., requests and responses, are strictly through messages.
  - Message exchange is typically interactive.
  - Clients and servers may run on separate dedicated machines connected through a network.

Two-tier Client/Server Architecture

- Client/server introduces a two-tier client/server architecture.
- The tiers in a client/server application refer to the # of elements into which the application is partitioned, not the # of platforms where the executables are deployed.
- The tiers into which an application is partitioned is known as the logical partitioning of an application as opposed to physical partitioning (# of platforms where the application executables are deployed).



- The client/server architecture performs most of the code that implements the GUI and business application logic on the client side of the tier and DB access mechanism on the server side of the tier.
- The client in such a two-tier system is known as “fat client” while the server is commonly referred to as the database server. Conversations occur at the level of the server’s database language.

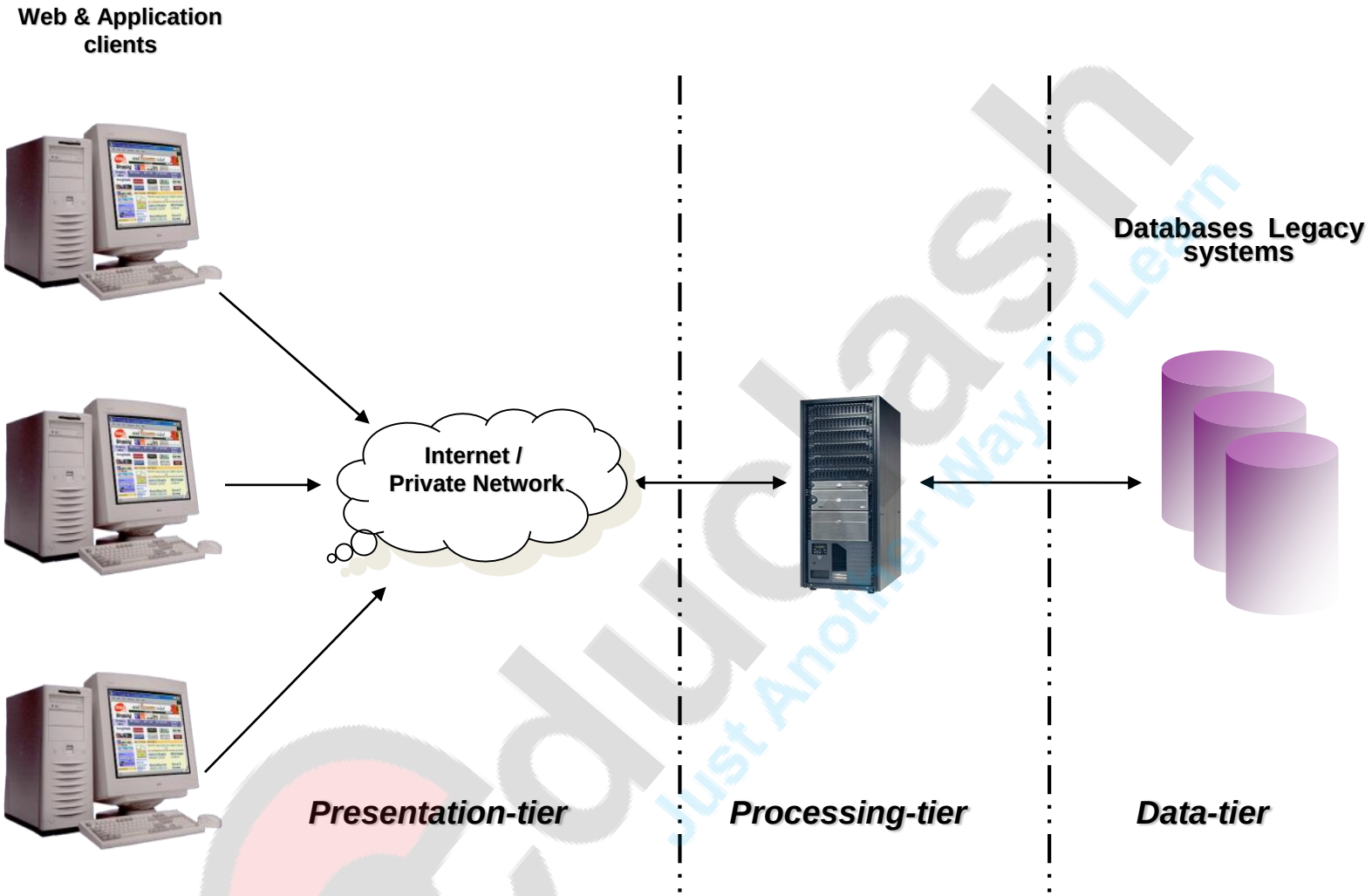
Drawbacks of the Two-tier Client/Server Architecture

- The two-tier architecture has several drawbacks, which are especially problematic for large and distributed applications:
  - **Scalability problems**: application performance can degrade rapidly when the no. of concurrent users reaches a threshold.
  - **Poor business logic sharing** :business logic is kept on the client side makes it difficult to re-use it between applications and amongst tools.
  - **Client reliance on the database structure:** applications depend on existing DB schema & structure making it more difficult to redesign it.
  - **Limited interoperability**: processing modifications and interoperation with more than one DBMS cannot happen unless applications are rewritten.
  - **High-maintenance costs:** if the no. of workstations are high or the workstations are geographically dispersed

Three-tier Architecture

- The three-tier architecture overcomes the limitations of the two-tier architecture. A middle tier is introduced between the user system interface client environment and the database management server environment.
- The application is partitioned into 3 logical tiers:
  - **presentation tier:** responsible for the graphical user interface (GUI) layer usually in the form of a web-browser
  - **processing tier** (or middle-tier): contains the business logic & is responsible for the processing associated applications supported.
  - **data tier:** holds the permanent data associated with the applications supported e.g., modern and legacy application databases, and transaction management applications. It interprets requests from a client and routes them to a suitable data resource.

- The processing tier enables developers to isolate the main part of an application that can change over time: data & relationships inherent in the data.
- This tier has the effect of logically and physically decoupling business logic from the presentation and database functions. Here we can find business objects that correspond to entities in the business domain, e.g., sales orders, invoices, products ..
- There are a variety of ways of implementing this middle tier, such as transaction processing monitors, message servers, or application servers.



Three-tier client/server architecture.

Web Technologies and Applications

- The WWW can be viewed as a vast information system consisting of software applications or processes that exchange info. & that act on behalf of a user or another application. The WWW architecture consists of:
  - Identifiers. A single specification to identify objects in the system: the Uniform Resource Identifier (URI).
  - Formats. A nonexclusive set of data format specifications designed for interchange between agents in the system. e.g., HTML, XML schemas, etc.
  - Protocols. A small and non-exclusive set of protocol specifications for interchanging information between agents, e.g., HTTP.

Resources and URLs

- The Web is a universe of resources (anything that has identity). Examples include documents, files, menu items, machines, and services, as well as people, organizations, & concepts.
- The Uniform Resource Identifier helps locate WWW resources:
  - A URI consists of a string of characters that uniquely identifies a network resources.
  - URIs include URLs, which use traditional addressing schemes such as http and ftp, and Uniform Resource Names (URNs), which is a newer Internet addressing scheme.
- The Web organises inter-linked pages of information residing on sites throughout the world.
- Web pages rely on markup languages to tag text files for display at Web browsers.

Web-Based Applications

- Web sites provide the content that is accessed by Web users. A Web site is a catalogue of info. for each content provider over the Web.
- In reality web site consists of three types of components:
    1. Web server,
    2. content files (Web pages), and/or
    3. gateways (programs that access non-Web content, e.g., databases).
- A Web server is an application (technically a server process) that receives calls from Web clients and retrieves Web pages and/or receives information from gateways.
- Web browsers are the clients that typically use graphical user interfaces to wander through the Web sites.

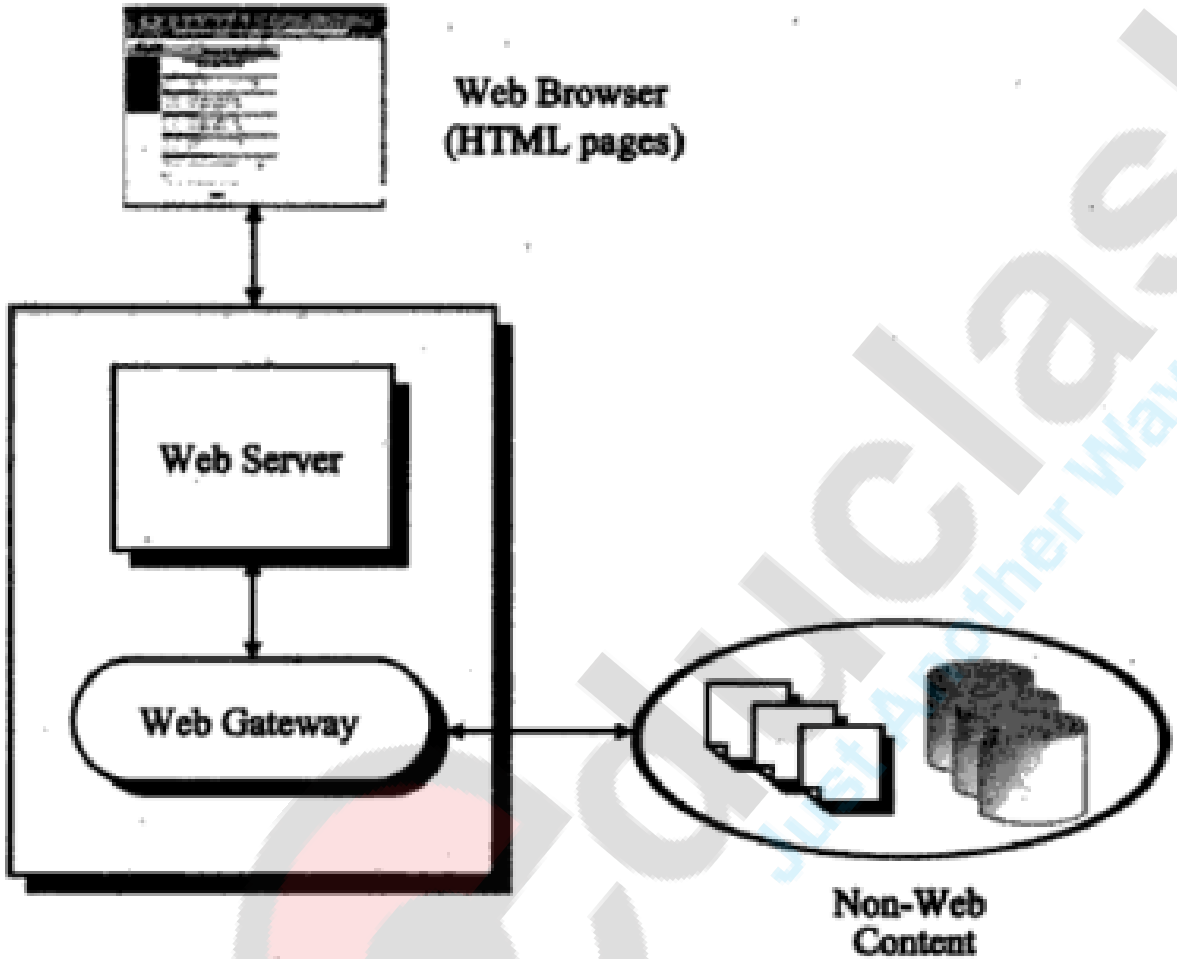
Types of Web Applications

Web applications distinguish between:

- Static documents delivered from the file system of the Web server.
- Dynamic documents that have an interactive and usually time-sensitive nature. These require the server to generate the document on the fly.
- Static documents can be read from an existing file, while dynamic documents may not exist on a disk at all, e.g., can be generated from databases, video capture systems and from scientific instruments such as whether monitoring systems.

Construction of Web applications

- Purely dynamic documents are generated when webserver invokes gateway programs.
- The web gateway receives user input associated with document and generates the documents along with any important information that identifies it.
- Web gateways are used to generate webcontent, i.e html pages and provide access to non-web contents such as databases i.e. gateways can be used to provide access to non-HTML info and convert it to HTML format for display at web browser.
- Traditional way of adding functionality to webserver is Common Gateway Interface(CGI), a language independent interface that allows a server to start an external process on behalf of client.
- This external process gets info about a request through environment variables, the command line and its std i/p stream and writes response data to its std o/p stream.



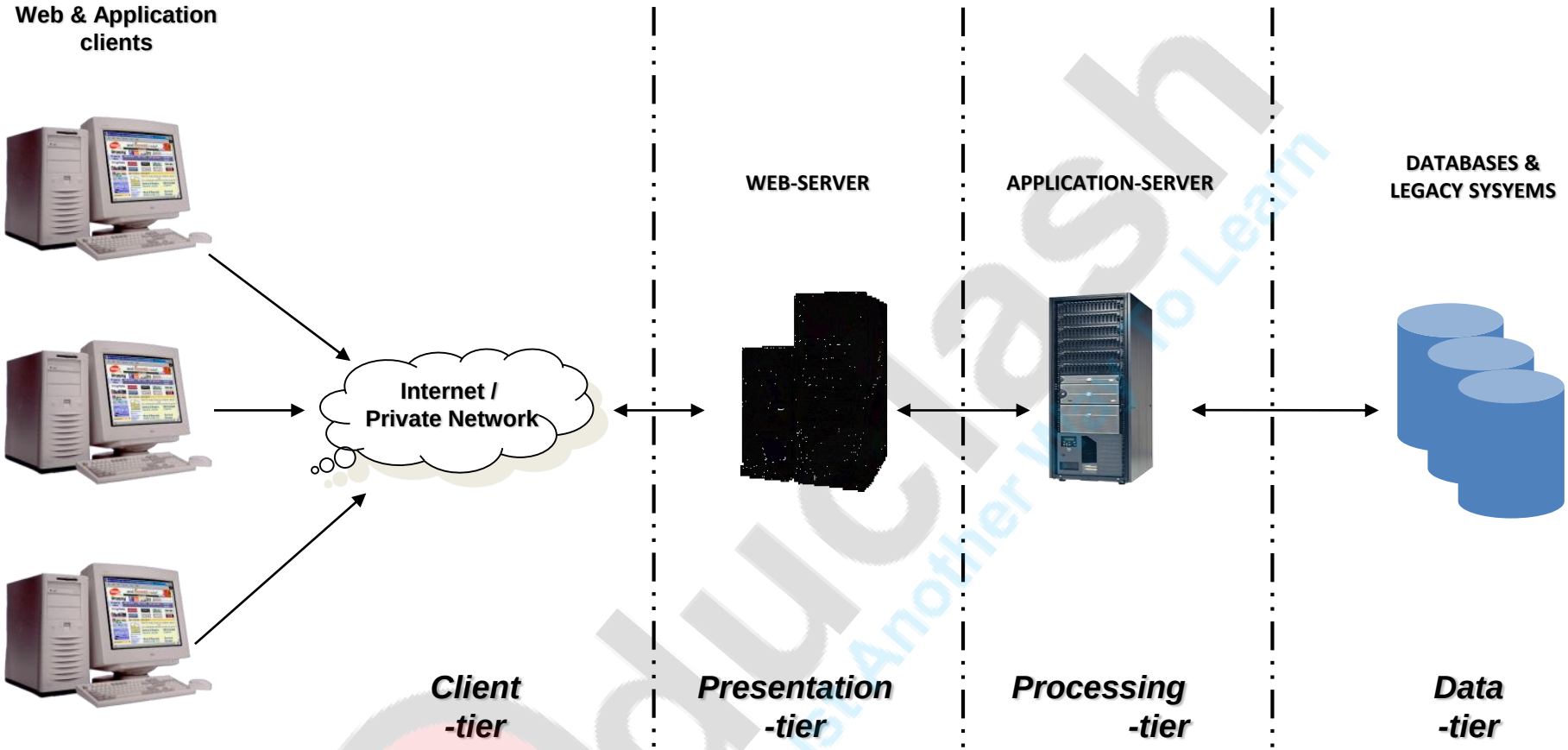
Generating Dynamic Web Documents

Architectural Features of Web-based Applications

- Web-enabled applications are a special case of client-server applications where the client is a standard Web browser ,e.g., Netscape /Internet Explorer.
- Modern Web-enabled applications leverage the three-tier architecture. The presentation tier of the three-tier architecture is subdivided into a client-tier and a new presentation-tier. The needs of this new presentation-tier is addressed by an infrastructure known as a Web-server.
- The presentation-tier receives requests from client apps & generates HTML using the services provided by the business (processing) tier. This tier provides further isolation between the application layout and the application logic.

- A customer, business partner or service provider may send a request from a web browser.
- This could be using a workstation or PC based browser, and the request is sent to the web server via the relevant network medium eg internet.
- The web server receives the request from the network and handles the request for traditional static pages while passes any request for other types of processing (dynamic pages) to the application server.
- The application server extracts info from a variety of back-end data sources in line with business rules.
- The results are finally sent back to the web server for passing on the client application.

- The client-tier is implemented as a web browser running on the user's client machine. It displays data & lets users & client applications enter/update data.
- The presentation-tier generates Web pages in which it includes dynamic content. It supports different types of clients, e.g., HTML & Java capable clients.
- The dynamic content typically originates from a database
- The webs server provides different ways to forward a request to an application server and forward a modified or new web page to the user.
- The data-tier is responsible for managing the data. It provides the business logic-tier with required data when needed & store data when requested.



Multi-tiered architecture for developing web-based applications.

Client-side Programming

- Program code with webpages that are downloaded into a client running a web browser, with code being run on client installation.
- Twp most popular approach for Client-side:
  - Applets
  - JavaScript

Applets

- Applets are snippets of Java code that are firmly anchored in a web document and run on the client side.
- It can be sent with a web page to a user.
- As soon as an applet supporting browser loads the web document, the applet displays the results in a pre-assigned position in the document.
- The execution is then done through client , which must be java enabled.
- It can perform interactive animations, immediate calculations etc without having to send a user request back to the server because of security problems.

Javascript

- Javascript statements are directly embedded in the HTML code.
- It has no. of features including conventional data types and operators, arrays, control structures and functions.

Server side programming

- Several technologies have been developed to alleviate the problems with CGI programming .
- The main approaches for server side programming include
  - java servlets and
  - java server pages.

Java servlets

- They are modules of java code that run in a server application to answer client requests.
- A servlet is a java component that can be plugged into java enabled web server to provide server extensions in the form of customized services.
- Such services include the development of new features, run time changes to info content, and presentation and so on.

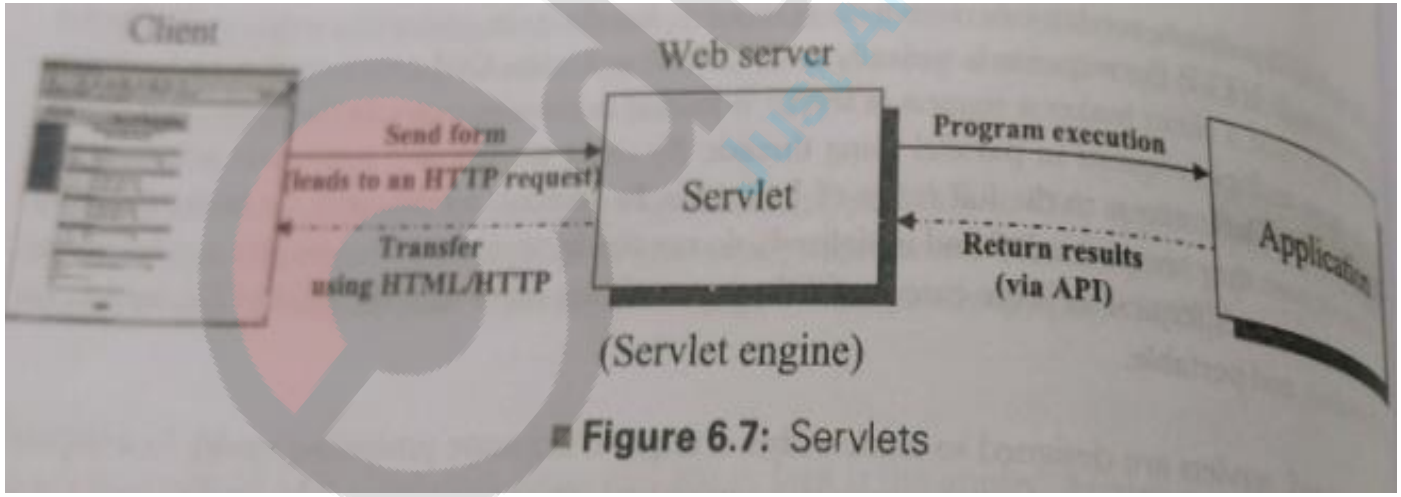


Figure 6.7: Servlets

- Servlets can receive a client requests, handle them and send a response.
- If a servlet is called through HTTP, the response is typically an HTTP flow.
- They are loaded in memory each time a client makes a request, a servlet is loaded in memory once by the application server, and can serve multiple requests in parallel using threads.
- By using servlets as a server side programming model, developers have access to the full range of Java APIs.

- Servlets are designed to work within a request/response processing model.
- Typical uses for servlets include:
  - Processing and/or storing data submitted by an HTML form
  - Providing dynamic content, eg. Returning of a database query to the client application.
- Servlets provide web developers with a simple, component based, platform independent mechanism for extending the functionality of a web server.

- JavaServer Pages(JSP)
  - JSP technology is an extension of the servlet technology created to support authoring of HTML and XML pages.
  - It enables rapid development of web based applications that are platform independent and makes it easier to combine fixed or static template data with dynamic pages.
  - It allows java code to be embedded into web pages to carry out the display of information dynamically on as and when needed basis.

- JSP technology allows web developers and designers to rapidly develop and easily maintain information-rich, dynamic web pages that leverage existing business systems.

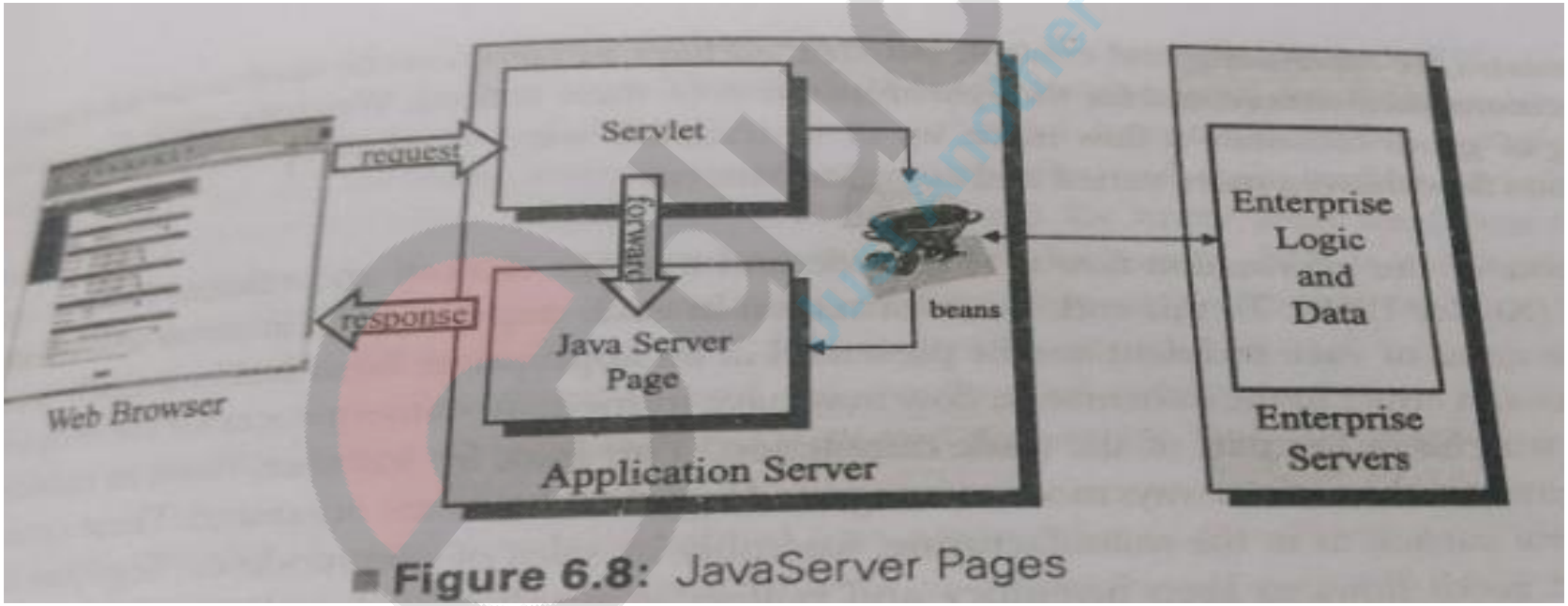


Figure 6.8: JavaServer Pages

Collaborative Technologies

- The objective of collaborative technologies is to eliminate the manual trading processes by allowing internal applications of different companies to directly exchange information and documents.
- Electronic Data Interchange(EDI) and workflows –to facilitate information flows within and across enterprise boundaries.
- Purpose - to provide and manage smooth and efficient flows of goods and payments and detect any inaccuracies and errors in information flow, report disturbances or exceptional situations for instance in production or transport to the consignees automatically.

EDI – The Infrastructure for e-Business

- Electronic Data Interchange (EDI) is defined as the transfer of structured data by agreed message standards between computer applications.
- A network for transmitting standard transactions
- A paperless trading environment
- Routine documents; purchase order, billings, shipping manifests
- Documents translated into standard business language
- In use since the 1970s on private VANs.

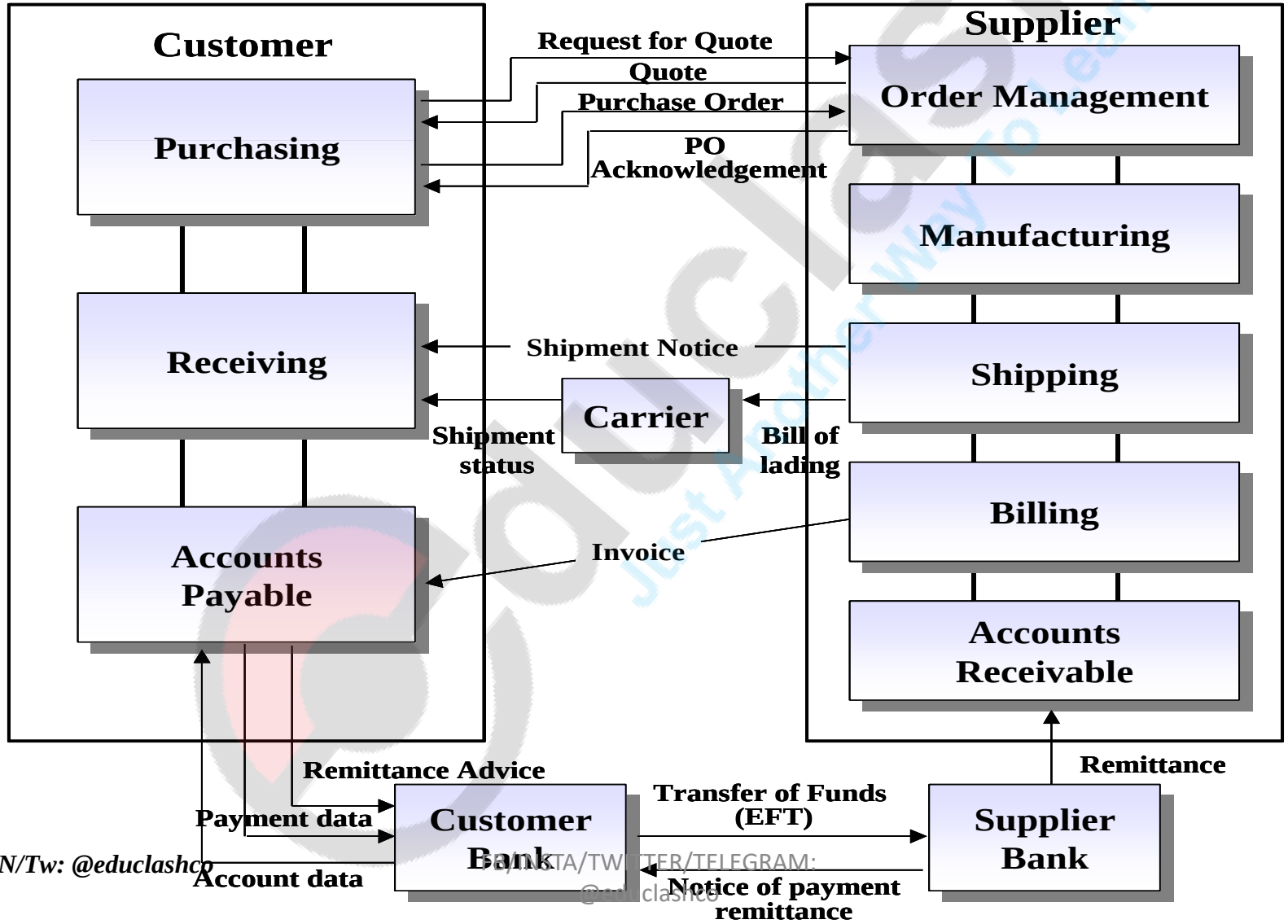
- The purpose of the information flow is to provide and manage smooth and efficient flows of goods and payments. To this end, the information in each step has to be accurate and reliable.
- lt has to meet the needs of each recipient and be presented in an appropriate form and in a timely manner.
- Any inaccuracies and errors in the information flow may have immediate consequences for the receipts‘ s ability to proceed with his or her part of the trade transaction.
- Result in enhancements in goods movement in the various ways modern integrated logistics chains are organized.
- These chains normally involve several parties, as in the manufacturing, assembly or sales of commodities.
- Together they develop sophisticated goods flows to keep inventory and buffers in production low.
- Examples of such strategies include just-in-time (JIT) manufacturing and Quick Response (QR).

- These logistics method use carefully streamlined procedures for the exchange of information.
- On the documentation side business documents define transactions conducted between trading partner.

EDI – The Infrastructure for e-Business

There are two key elements in basic EDI.

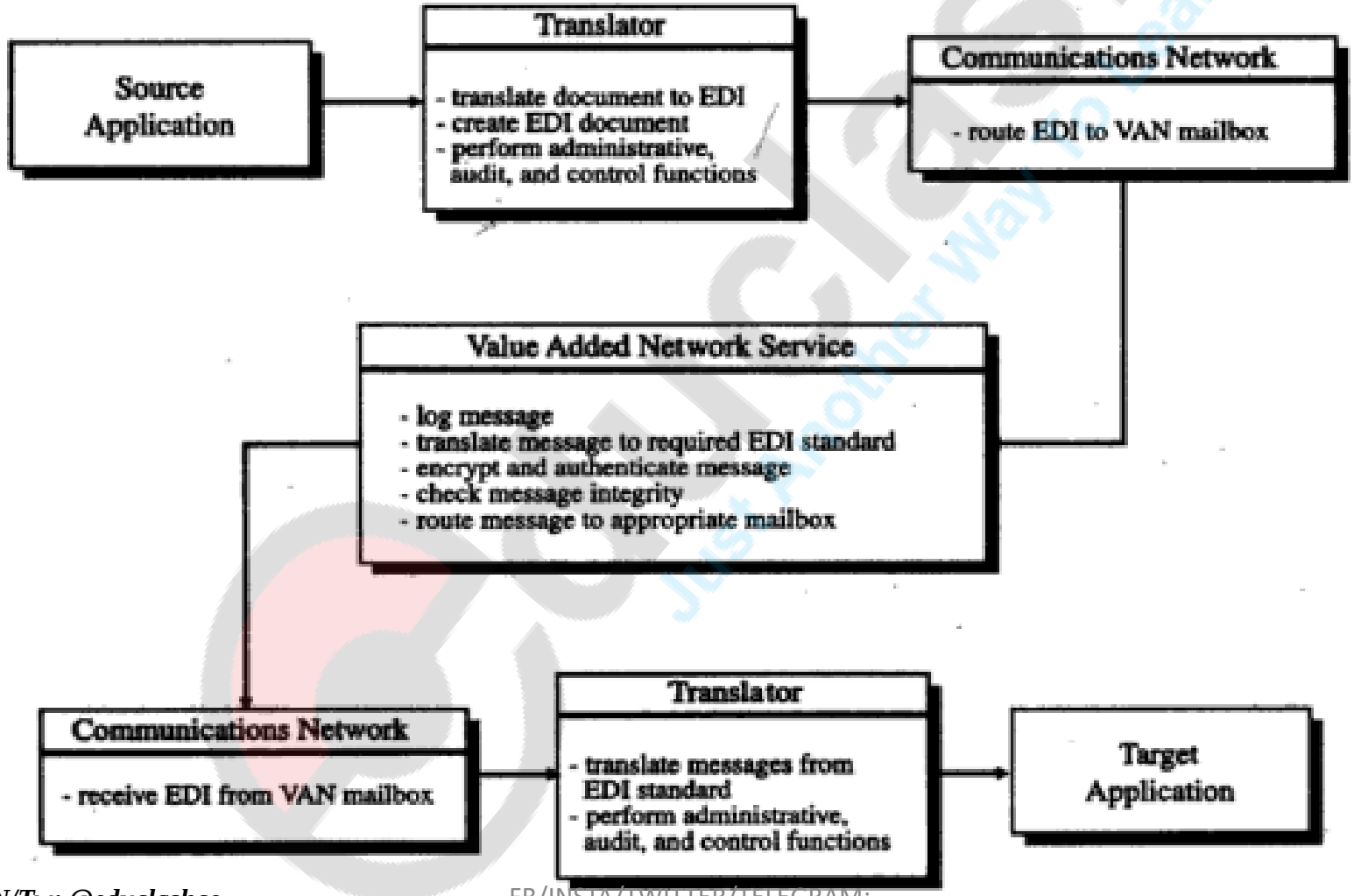
- **Electronic documents replace their paper counterparts.**
- **The exchange of documents takes place in a standardized format.**



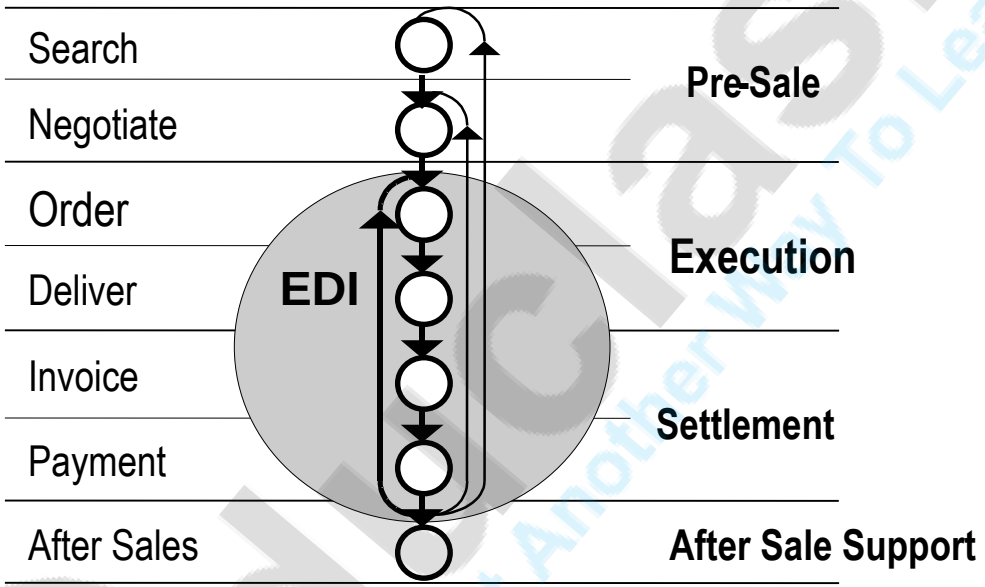
- Transaction sets define a set of fields, the order and length of field along with business rules that accompany the fields.
- To implement the EDI, trading partners would have to follow the following steps:
  - Trading partners enter into an agreement, called trade agreement.
  - They select value added network(VAN) which provides services such as data validation, logging for audit trails, error detection and faster response time.
  - The trading partners typically either contract for or build themselves, custom s/w that maps between the two formats that are used between the trading partners.
  - Each time a new trading partner is added, new s/w has to be written to translate the sender's data for the recipient.

- EDI is not simply a mechanism for exporting data from one system to another, but a bi-directional mechanism for interaction between systems.
- The fig of EDI transaction set shows that a source application prepares an electronic business doc, eg. A purchase order, which is being sent must be translated and structured according to the EDI format, eg EDIFACT, that is understood by the target application.

EDI Transaction set



EDI Trade Cycle



- Regular, repeat transactions between commercial trading partners
- Examples:
  - Supermarkets replenishing stocks
  - Vehicle assemblers purchasing components

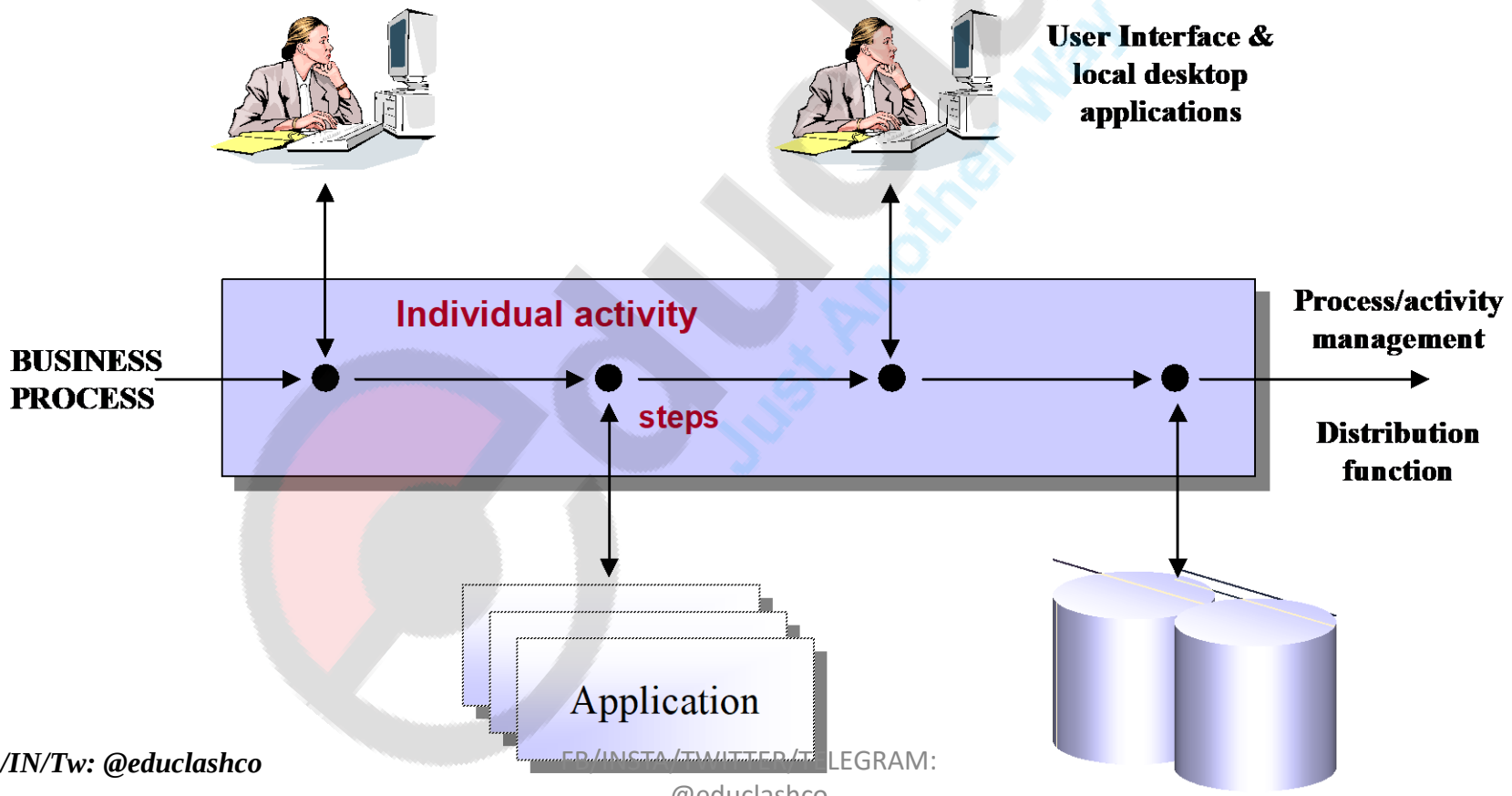
Problems with EDI

- **Fixed transaction sets**: it is based on the transfer of fixed transaction sets making extremely difficult to deal with the normal evolution necessary for companies introducing new products and services.
- **Resilience(toughness) to change** : EDI stds are defined by std bodied that are structurally ill equipped to keep up with the rapid pace of change in the various business sectors they impact.
- **Reliance on proprietary communications networks**: EDI messages are mainly carried on proprietary communication networks that are relatively expensive and have compatibility problems when communicating across networks.
- **Encapsulation of business rules in transaction sets :** business rules are encapsulated in the definition of transaction sets as implementation guidelines.

Workflow systems

- A workflow system automates a business process, in whole or in part, during which documents, information, or tasks are passed from one participant to another for action, according to a set of rules.
- A workflow normally comprises a number of logical steps (activities).
- A work item or data set is created, processed, and changed in stages at a no. of processing or decision points to meet a specific business goal.
- A workflow can depict various aspects of a business process including automated and manual activities, decision points and business rules, parallel and sequential work routes, and how to manage exceptions to the normal business process.

- Workflow technology enables developers to describe full intra- or inter-organisational business processes with dependencies, sequencing selection and iteration. It enables the developers to describe the complex rules for processing in a business process & allows people to be deployed more productively within an organisation.

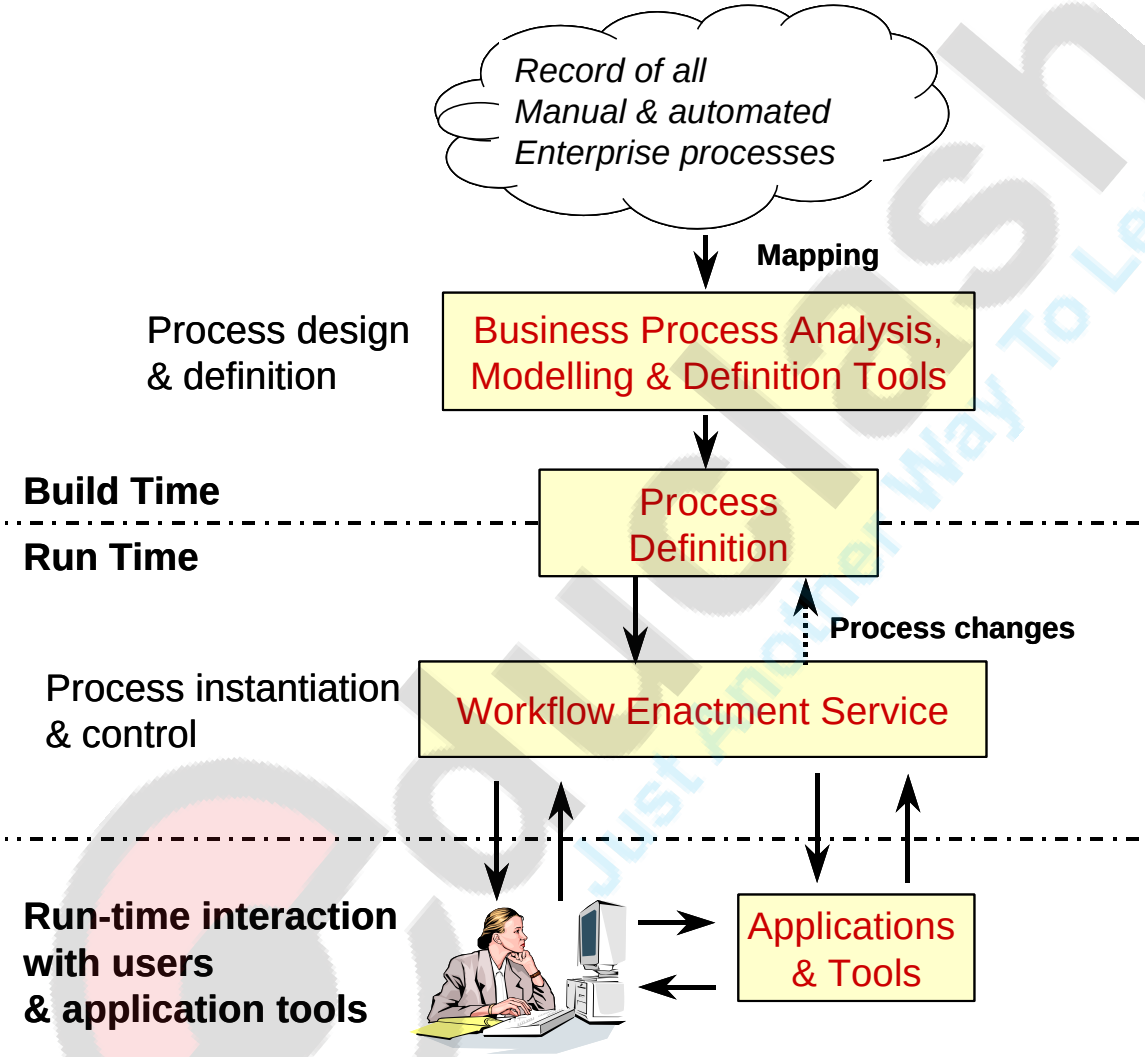


Simplified workflow for processing a client Initiated Order

Workflow characteristics

- Each workflow management system can be viewed at the highest level as providing support for the three functional areas:
  - Build time functions: these are concerned with defining, modelling and analyzing workflow processes and related activities.
  - Run-time process control functions: these are concerned with managing the sequencing and execution of workflow processes.
  - Run-time interactions: these are concerned with supporting interactions with human users and applications and tools for processing activity steps in workflow processes.

- Build time functions are used to define business processes in a way that can be interpreted and executed by workflow management system.
- A workflow design solution incorporates two basic phases: mapping and modeling.
- Mapping is the first stage in adoption of workflow solution and involves the crucial task of revealing and recording all of the manual and automated internal business process of enterprise.
- Based on outcomes of mapping phase, the enterprise develops a model that help streamline internal processes irrespective of whether they are based on person to person ,person to application or application to application interaction.



Architectural characteristics of a workflow system

Types of workflow

- Classification of workflow products:
  - Production workflow
    - Autonomous workflow management system
    - Embedded workflow management system
  - Administrative workflow
  - Adhoc workflow
  - Collaborative workflow

Production workflow

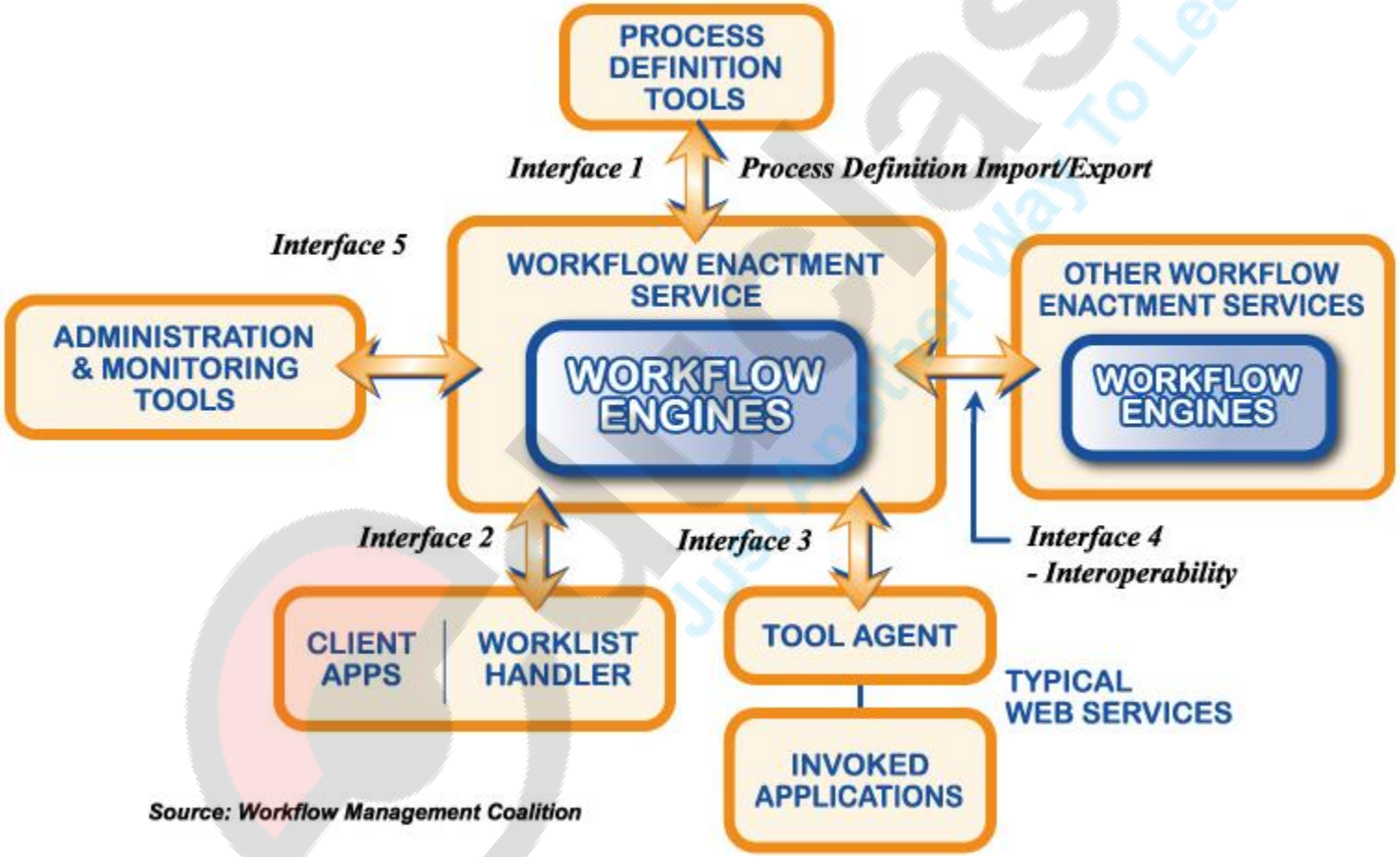
- It make up the traditional part of the workflow market.
- They have evolved from first systems on the market and route folders consisting of one or more forms or different types of documents through the organization.
- They typically store central repository and provide check-in, check-out and version control mechanisms for those documents.
- Key goal of production workflow is to manage large numbers of core tasks and to optimize productivity in an enterprise.

- Autonomous workflow management system: that are separate pieces of application software providing the entire workflow functionalities.
- Embedded workflow management system:that are operational only if they are employed by their surrounding system-such as ERP,payment or a settlement system.

- Administrative workflow:
  - Exhibits low business value
  - Repetition rate is high
  - Flow is predefined
- Ad-hoc workflow:
  - Allow users to create and amend processes
  - Exhibit low business value
  - Low repetition rate
  - Process definition change frequently
- Collaborative workflow:
  - High business value but infrequent execution
  - Focuses on team of people working together towards common goals.

Workflow reference model

- The reference model identifies the fundamental functions and the interfaces of a WfMS which greatly contributes to the workflow research in past two decades.
- Components of workflow systems:
  - essential element is the enactment service.
  - This component may utilize multiple workflow mgmt engines that create , manage and execute multiple workflow instances related to business processes.
- Figure outlines the components and interfaces of the reference model.


PROCESS DEFINITION TOOLS
Interface 1
Process Definition Import/Export
Interface 5
WORKFLOW ENACTMENT SERVICE
WORKFLOW ENGINES
ADMINISTRATION & MONITORING TOOLS
OTHER WORKFLOW ENACTMENT SERVICES
WORKFLOW ENGINES
Interface 2
Interface 3
Interface 4
- Interoperability
CLIENT APPS
WORKLIST HANDLER
TOOL AGENT
TYPICAL WEB SERVICES
INVOKED APPLICATIONS
Source: Workflow Management Coalition

- **Process definition tools**: A variety of tool kits may be used to model, transfer, analyze, describe and document a process definition. The tools may interface (import/export process definitions) to the workflow enactment service via the process definition import/export interface (***Interface 1***).
- **Workflow engine**: A service or "engine" that provides the runtime execution environment for a process instance.
- **Workflow enactment service**: A service that may consist of one or more workflow engines in order to create, manage and execute process instances. The service may interface to other components via the interfaces (***Interfaces 1-5***).

The role of enterprise information system in e-Business

- An EIS encompasses the business processes and information technology infrastructure used within enterprises, and delivers the information infrastructure internal to the enterprise.
- An EIS exposes set of services to its users: these can be differing levels of abstraction – including- data level, function level and process level

- Many different applications and system qualify collectively as EIS. These includes:
  - Enterprise applications that have been developed using programming language.
  - Legacy systems and applications that manage mission critical data.
  - ERP
  - CRM
  - Transaction processing systems and applications.

THE NEW INFORMATION TECHNOLOGY (IT) INFRASTRUCTURE FOR THE DIGITAL FIRM

Enterprise Networking and Internetworking

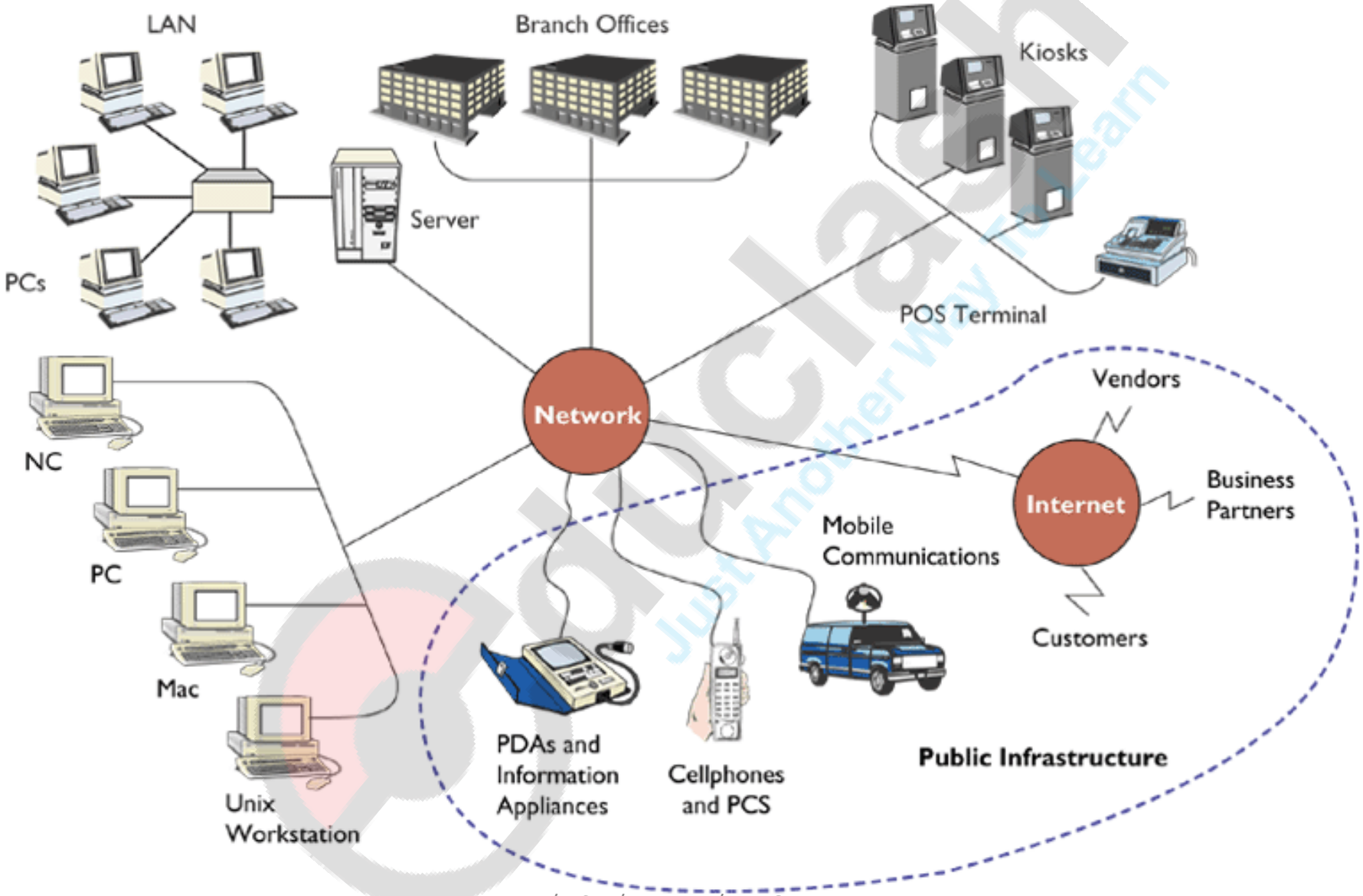
Enterprise Networking

- Arrangement of organization's hardware, software, network, and data resources to put more computing power on the desktop & to Create a company-wide network linking many smaller networks.

Internetworking

- Links separate networks into an interconnected network

Figure 9.1 The new information technology (IT) infrastructure: The new IT infrastructure links desktop workstations, network computers, LANs, and server computers in an enterprise network so that information can flow freely throughout different parts of the organization.



Standards and Connectivity for Digital Integration

Connectivity

- The ability of computers and computer based devices to communicate with one another and share info in a meaningful way without human intervention is called connectivity.
- Internet Technology, Java and XML provides some of the connectivity.

Open System

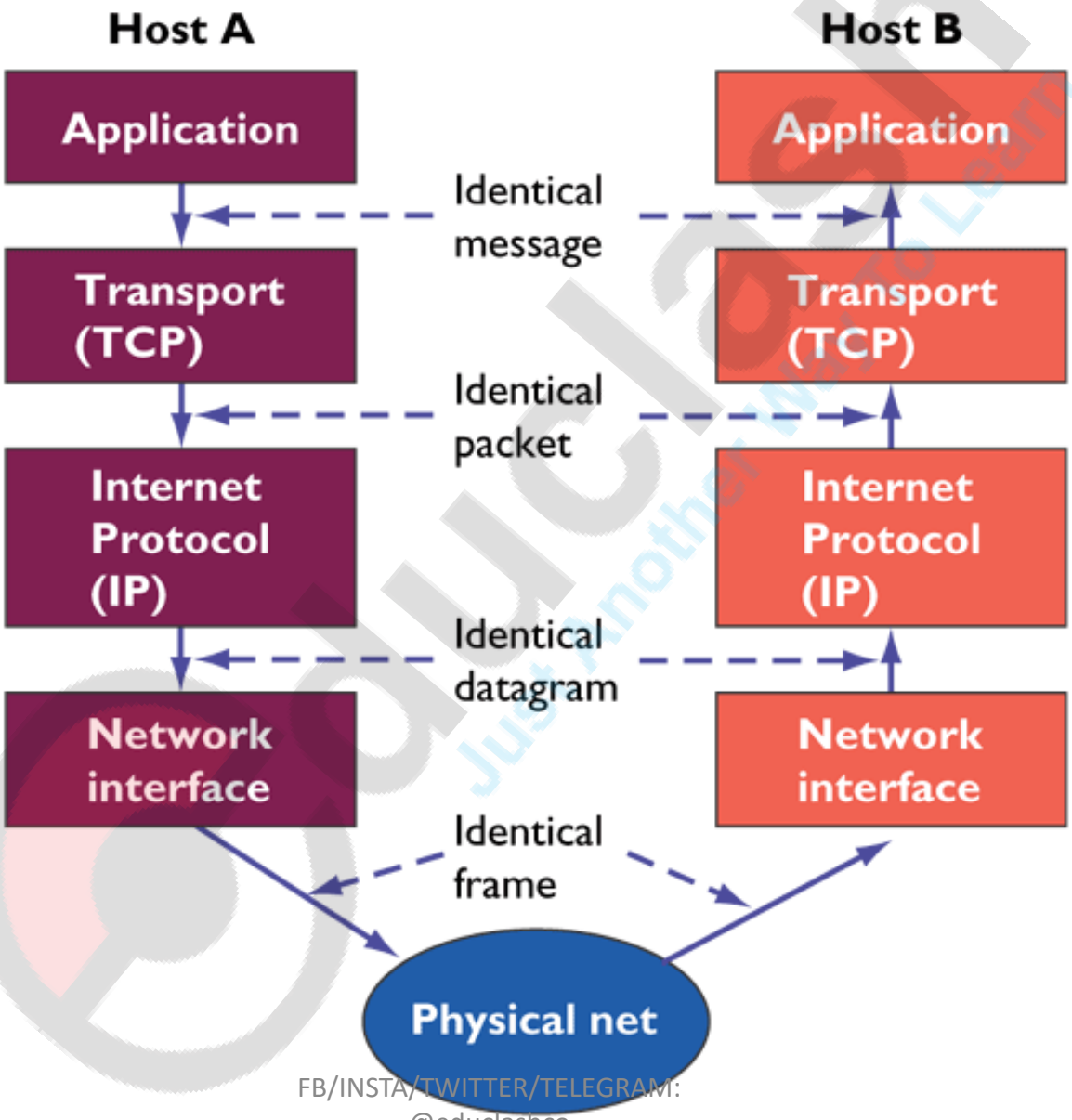
- Software systems that can operate on different hardware platforms because they built on public nonproprietary operating systems, user interfaces, application standards and networking protocols.
- s/w can operate on different h/w platforms, means are portable. Eg UNIX OS supports open systems.

Models of Connectivity for Networks

- Transmission Control Protocol/Internet Protocol (TCP/IP):
  - Five layers
    - Application
    - Transmission control protocol(TCP)
    - Internet Protocol(IP)
    - Network interface
    - Physical net

- Open Systems Interconnect (OSI)
  - Seven layers

Figure 9.2 The Transmission Control Protocol/Internet Protocol (TCP/IP) reference model.



SUPPORT TECHNOLOGY FOR ELECTRONIC COMMERECE AND ELECTRONIC BUSINESS

Web Servers and Electronic Commerce Servers

- The core capabilities of web server s/w revolves around locating and managing stored web pages.
- Webserver s/w locates web pages requested by client computers by translating the URL web address into the physical file address and sends requested web page to the client.
- Each request to the server for a file is recorded as an entry in the web server log and is called a hit.

Electronic commerce server software

- Provides functions essential for running e-commerce Web sites

Functions software must perform for both business-to-consumer and business-to-business e-commerce include:

- Setting up electronic storefronts and electronic catalogs to display product and pricing information
- Designing electronic shopping carts so customers can collect and pay for the items they wish to purchase.
- Making shipping arrangement
- Linking to electronic payment processing systems
- Displaying product availability and tracking shipments
- Connecting to back-office systems where necessary

Customer Tracking and Personalization Tools

Main goal:

- Collecting and storing data on the behavior of online customers & combining data with already stored data
- Analyzing the data to understand the behavior of online customers.
- Identifying customer preferences and trends.

Tools:

- Clickstream tracking: used to collect data on customer activities at web sites and store them in a log.
- Collaborative filtering s/w tracks users' movement on a website, comparing info it gains about a user's behavior against data about other customers with similar interests to predict what the user would like to see next.

Web Content Management Tool

- Software to facilitate collection, assembly, and management of content on Web site, intranet, or extranet.
- Web content management tools exists because many companies have sites with thousands of pages to manage.
- The materials on websites are often complex and include many forms of data such as documents, graphics and sound.
- Often contents may be dynamic.

Dynamic Page generation

- Technology for storing the contents of WebPages as objects in a database rather where they can be assessed and assembled to create constantly changing webpages.

Web Site Performance Monitoring Tool

- Most web sites are plagued by problems such as slow performance, content errors and broken links.
- Monitors time taken for downloading Web pages
- Identifies broken links between Web pages, Web site problems, and bottlenecks.
- Measure the response times of specific transactions such as inquiries, checking out purchases etc.

Web Hosting Services

- Companies that lack the financial or technical resources to operate their own web sites or e-commerce services can use web hosting services.
- Maintains a large Web server computers or series of servers and provides fee-paying space to maintain their websites.

MANAGEMENT ISSUES AND DECISIONS

The Challenge of Managing the New Information Technology Infrastructure

OR

Problems posed by the new information technology(IT) Infrastructure

- Loss of management control
- Connectivity and application integration challenges
- Organizational change requirements
- Hidden costs of enterprise computing
- Scalability, reliability, and security

- Loss of management control
  - Distributed client/server networks, new mobile wireless networks and internet computing have empowered end users to become independent sources of computing power capable of storing and disseminating data and s/w.
  - Data and s/w are no longer confined to mainframe, but reside in many different computing platforms throughout the organization.

- Connectivity and application integration challenges
  - Digital firm organizations depend on enterprise wide integration of their business processes and applications so that they can obtain their info from any point in the value chain.
- Organizational change requirement
  - Enterprise wide computing is an opportunity to reengineer the organization into a more effective unit, but it will only create problems , if underlying organizational issues are not fully addressed.

- Hidden costs of Enterprise computing
  - Many companies have found that the savings they expected from distributed client/server computing did not materialize b'coz of unexpected costs.
  - Considerable time is spent on tasks such as network maintenance, s/w update, data backup, technical problem solving, h/w & s/w installations.

- Scalability, reliability, and security
  - Network infrastructures need not only to be able to handle current e-business demands but also be able to scale rapidly to meet future demands.
  - Downtime- periods of time in which the system is not operational.
  - Security is of paramount importance in firms with extensive networking and electronic transactions.

MANAGEMENT ISSUES AND DECISIONS

Some Solutions

- Change management
- Education and training
- Data administration disciplines
- Planning for connectivity and application integration

- Change management
  - To gain the full benefit of any new technology, organizations must carefully plan and manage the change.
  - Business processes may need to be reengineered to accompany infrastructure changes.
- Education & Training
  - A well developed training program can help end users overcome problems

- Data Administration Disciplines
  - The role of data administration becomes even more important when networks link many different applications, business areas and computing devices.
- Planning for connectivity and Application Integration
  - Senior management must take a long term view of the firm's IT infrastructure and information architecture, making sure they can support the required level of process .