Universitas
Esa Unggul

Smart, Creative and Entrepreneurial

Digital Network

Pertemuan-14

Dosen :Kundang K Juman
Prodi Teknik Informatika ,
Fakultas Imu Komputer

Integrated Services Digital Network

Public networks are used for a variety of services

- Public Switched Telephone Network
- Private Lines (leased)
- Packet Switched Data Networks
- Circuit Switched Data networks

ISDN

Users have a variety of equipment to connect to public networks

- Telephones
- Private Branch Exchanges
- Computer Terminals or PCs
- Mainframe Computers

A variety of physical interfaces and access procedures are required for connection

ISDN

The telephone network has evolved into a digital one with digital exchanges and links

The signalling system has become a digital message-oriented common channel signalling system (SS#7)

The term ‘Integrated Digital Network’ is used to describe these developments

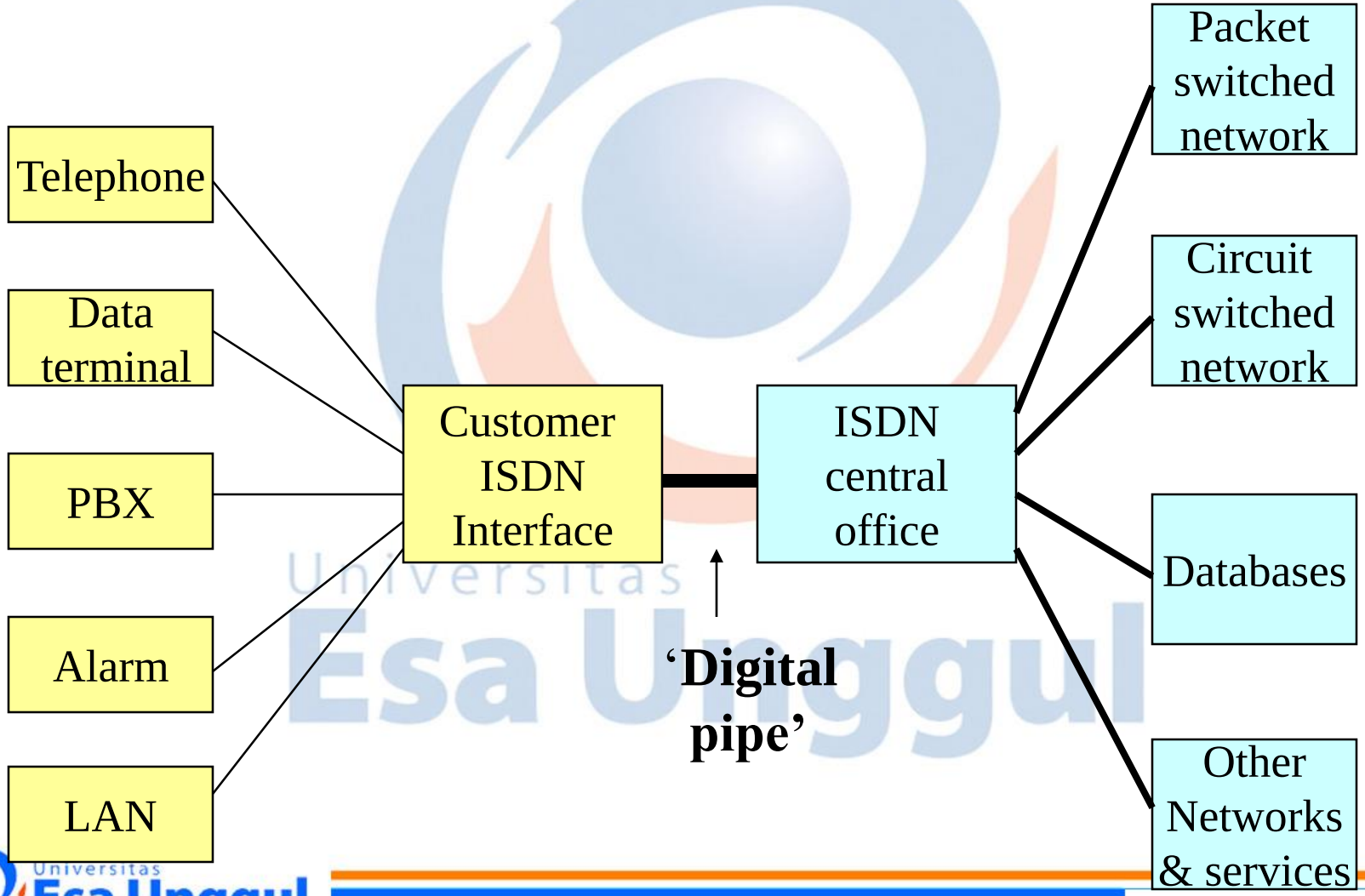
ISDN

The Public Switched Telephone network is still analogue from the subscriber to the local exchange

The need has arisen to extend the digital network out to subscribers and to provide a single standardised interface to all different users of public networks

ISDN fulfils that need

Integrated Services Digital Network



ISDN

In Practice there are multiple networks providing the service nationally

The user however, sees a single network

Benefits to Subscribers

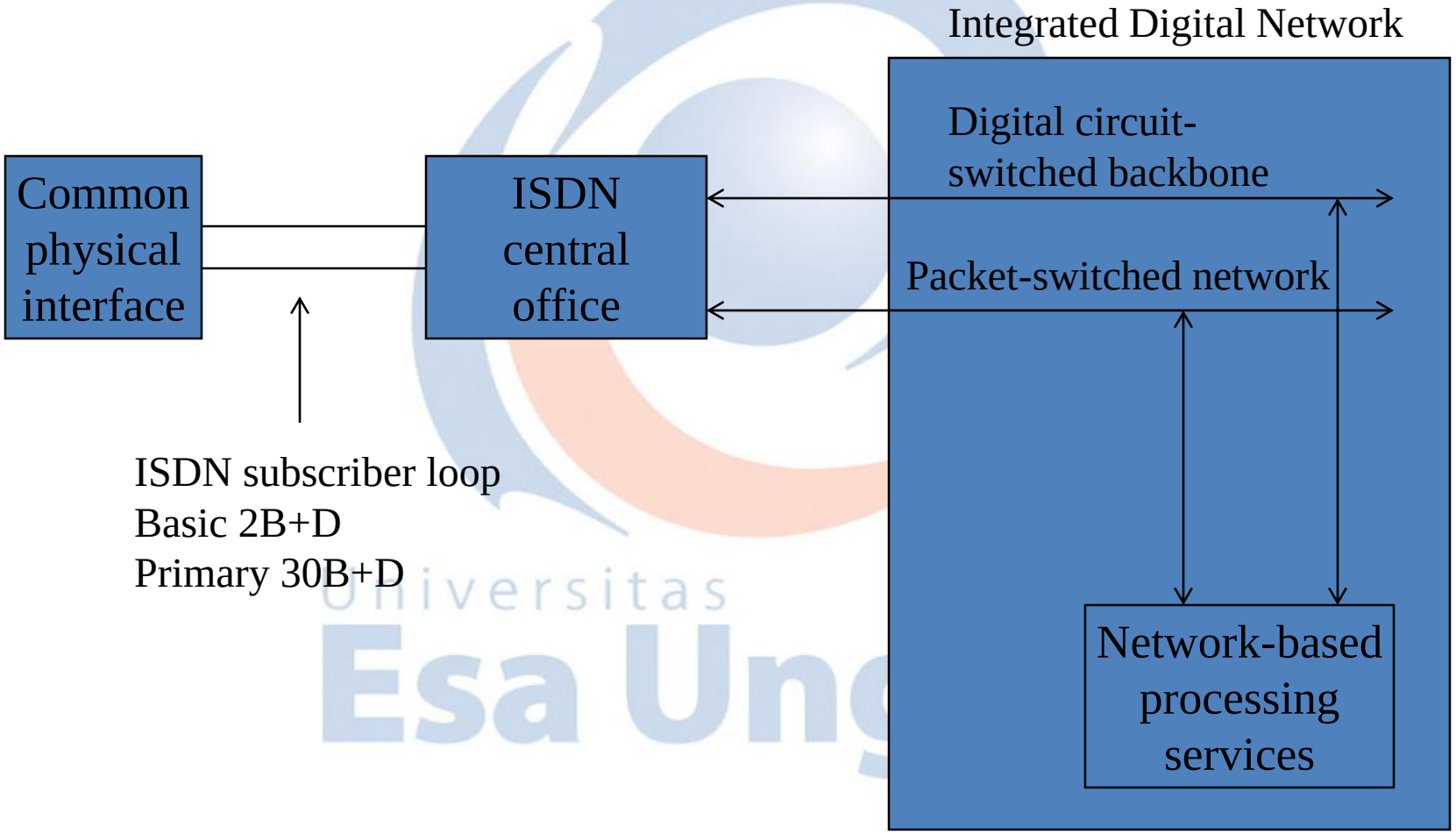
Single access line for all services

Ability to tailor service purchased to suit needs

Competition among equipment vendors due to standards

Availability of competitive service providers

Architecture



ISDN Standards

Contained in the I-series recommendations

Issued by CCITT (now ITU-T)

Six main groupings I.100 to I.600 series

I.100 series - General Concepts

I.200 series - Service Capabilities

I.300 series - Network Aspects

I.400 series - User-Network Interfaces

I.500 series - Internetwork Interfaces

I.600 series - Maintenance Principles

ISDN Channels

The Digital pipe is made up of channels - one of three types

B channel, D channel or H channel

Channels are grouped and offered as a package to users

B Channel

B channel-64 kbps

B is basic user channel

– can carry digital data or PCM-encoded voice

– or mixture of lower rate traffic.

B Channel

Four kinds of connection possible

Circuit-switched

Packet-switched - X.25

Frame mode - frame relay (LAPF)

Semipermanent - equivalent to a leased line

D Channel

D Channel - 16 or 64 kbps

Carries signalling information to control circuit-switched calls on B channels

Can also be used for packet switching or low-speed telemetry

H Channel

Carry user information at higher bit rates 384kbps or 1536kbps or 1920kbps

Can be used as a high-speed trunk

Can also be subdivided as per user's own TDM scheme

Uses include high speed data, fast facsimile, video, high-quality audio

ISDN Channels and their Applications

B Channel (64 kbps)	**D Channel (16/64 kbps)**	**H Channel (384/1536 kbps)**
Digital voice	Signalling (using SS#7)	High-speed trunk
High-speed data (e.g. packet and circuit switched data)	Low- speed data, (e.g. packet, terminal, videotex)	Very high speed data
Other (e.g. fax, slow video)	Other (e.g. telemetry)	Other (e.g. fast fax. Video)

ISDN Channel Groupings

Basic Access -

- two 64 kbps B channels
- plus one 16kbps D channel

B channels can be used for voice and data

simultaneous calls to separate destinations supported

D channel used for signalling and also for data using X.25

ISDN Basic Access

Intended for small business and residential use

A single physical interface is provided

Data rate is 144kbps plus 48kbps overhead bits totalling 192 kbps

Most existing subscriber loops can support basic access

ISDN Primary Access

Intended for users with greater capacity requirements

Example would be a digital PBX

Two standards exist

- 1.544 Mbps American
- 2.048 Mbps European

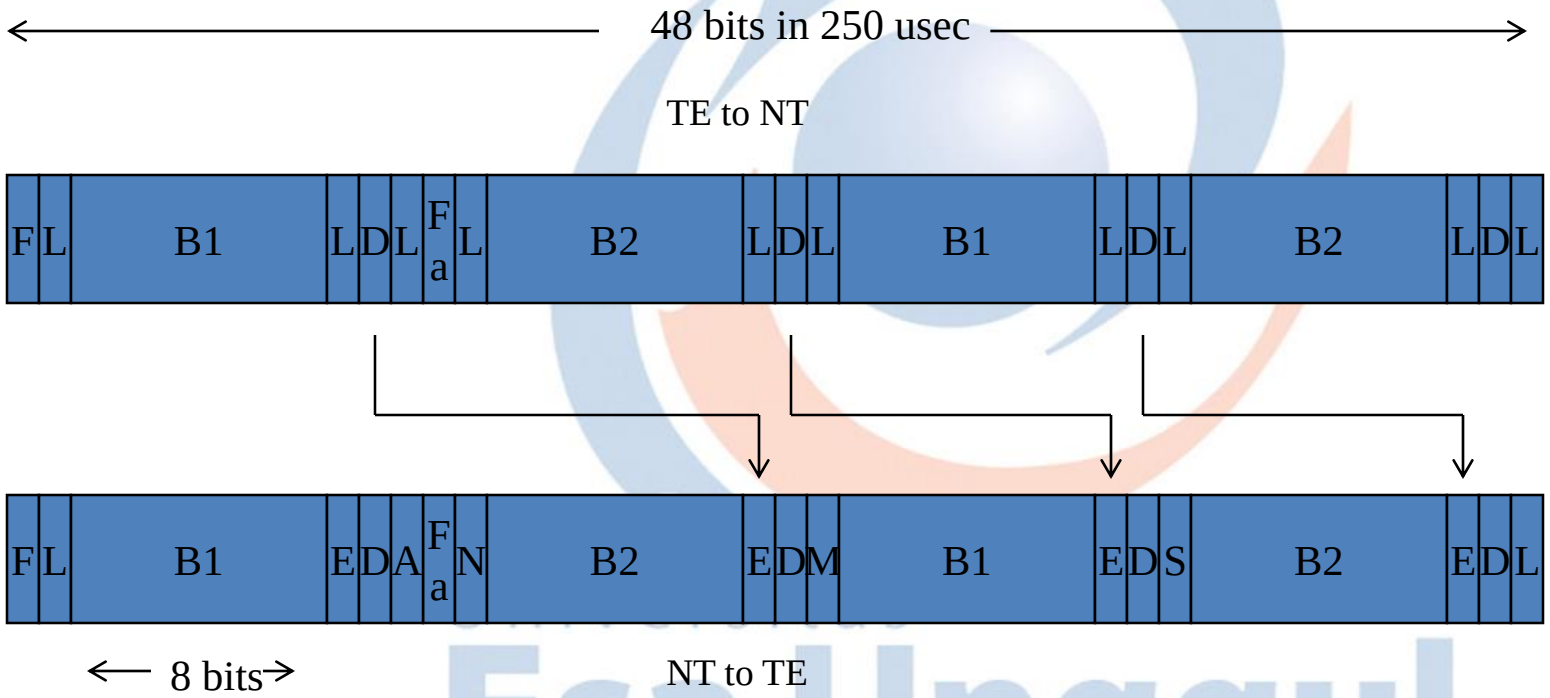
ISDN Primary Access

Typically it is structured as 30 B channels plus one 64kbps D channel (Europe)

Can also be structured as H channels

- 5H0 +D for a 2.048 Mbps interface
- or 1H12 +D

ISDN Frame Structure Basic Rate Access



F= Framing bit
L = dc balancing bit
E = D-echo channel bit
A = Activation bit
Fa = Auxiliary Framing bit
N = opposite of Fa
M = multiframing bit
B1 = B channel bits
B2 = B channel bits
D = D channel bits
S = Spare bits

ISDN Contention Resolution

Several TE's can share a single line

How is contention resolved?

B-channel Traffic

– No contention as each channel dedicated to particular TE

D - Channel used for data and control so requires a contention resolution mechanism

D Channel Contention

Incoming Traffic

– LAPD protocol resolves contention

Outgoing Traffic

– Multiple devices share D channel

– Contention resolution algorithm required

D Channel Contention

Idle TEs sends binary 1s on D channel

This means no signal (pseudoternery)

NT echos received binary value back as echo bit

When NT wishes to send on D channel, it listens to echo bits

If it hears a string of 1’s equal in length to a threshold value Xi, it may transmit

Otherwise it must wait

D Channel Contention

If two TE's start transmitting simultaneously a collision occurs

This is detected by each TE by monitoring E bits

If E bits are identical to D bits sent then no collision

If discrepency detected TE stops and listens

D Channel Contention

Priority mechanisms based on threshold values

- Control information has priority over user data
- When TE has sent data its priority is lowered until other terminals transmit

D Channel Priorities

Control Information

- Normal Priority X1 =8
- Lower Priority X1 =9

User Data

- Normal Priority X2 =10
- Lower Priority X2 =11

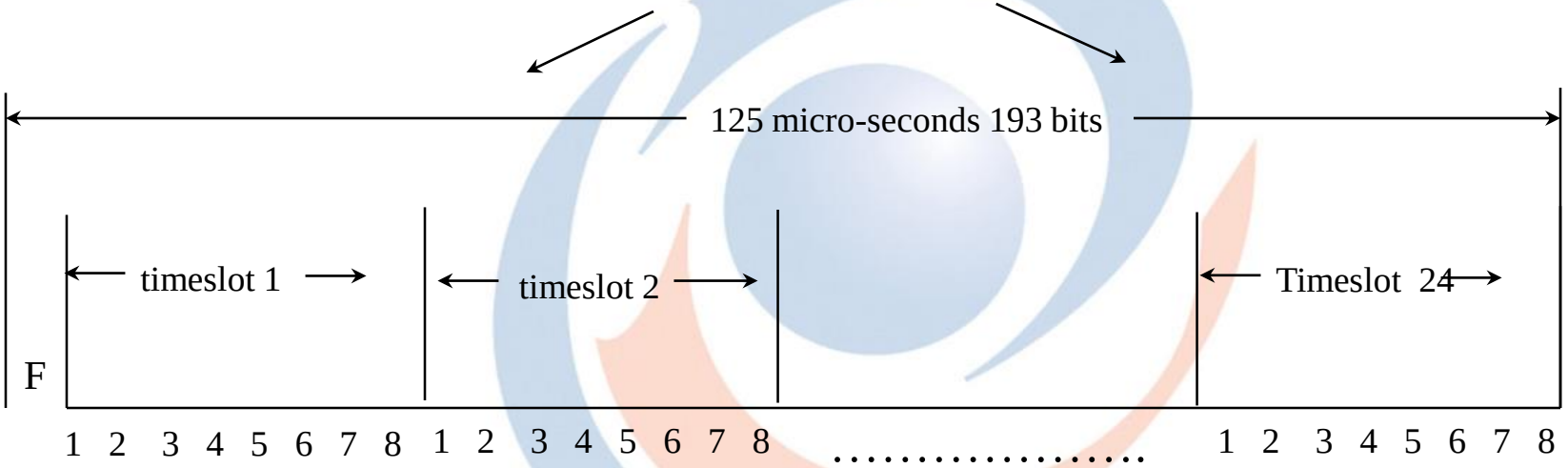
ISDN Primary Interface

Multiple channels multiplexed on single medium

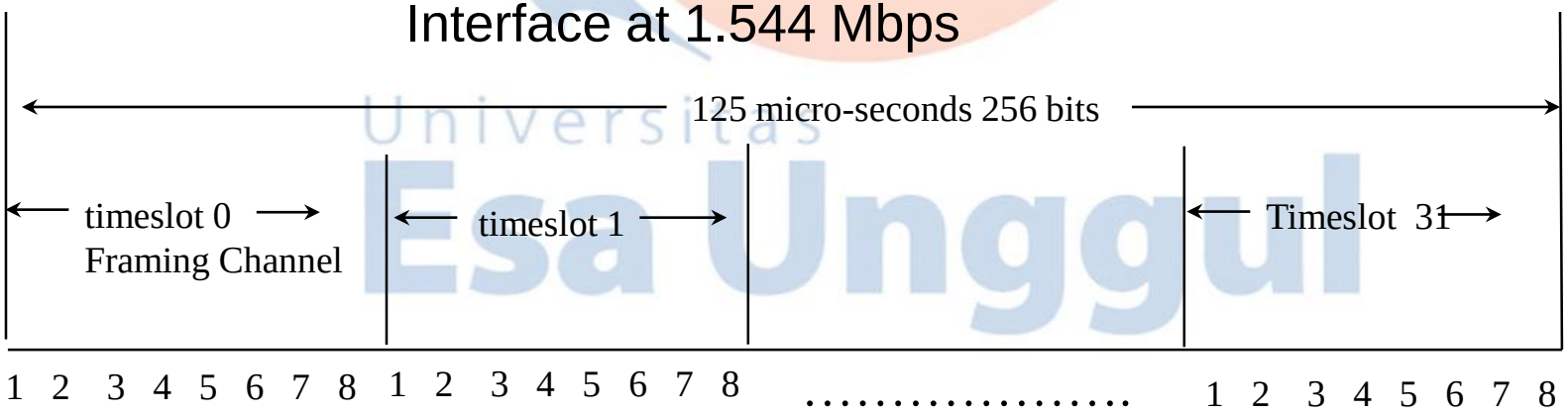
Only point to point configuration is allowed

Typically supports a digital PBX and provides a synchronous TDM facility

ISDN Primary Access Frame Formats



Interface at 1.544 Mbps



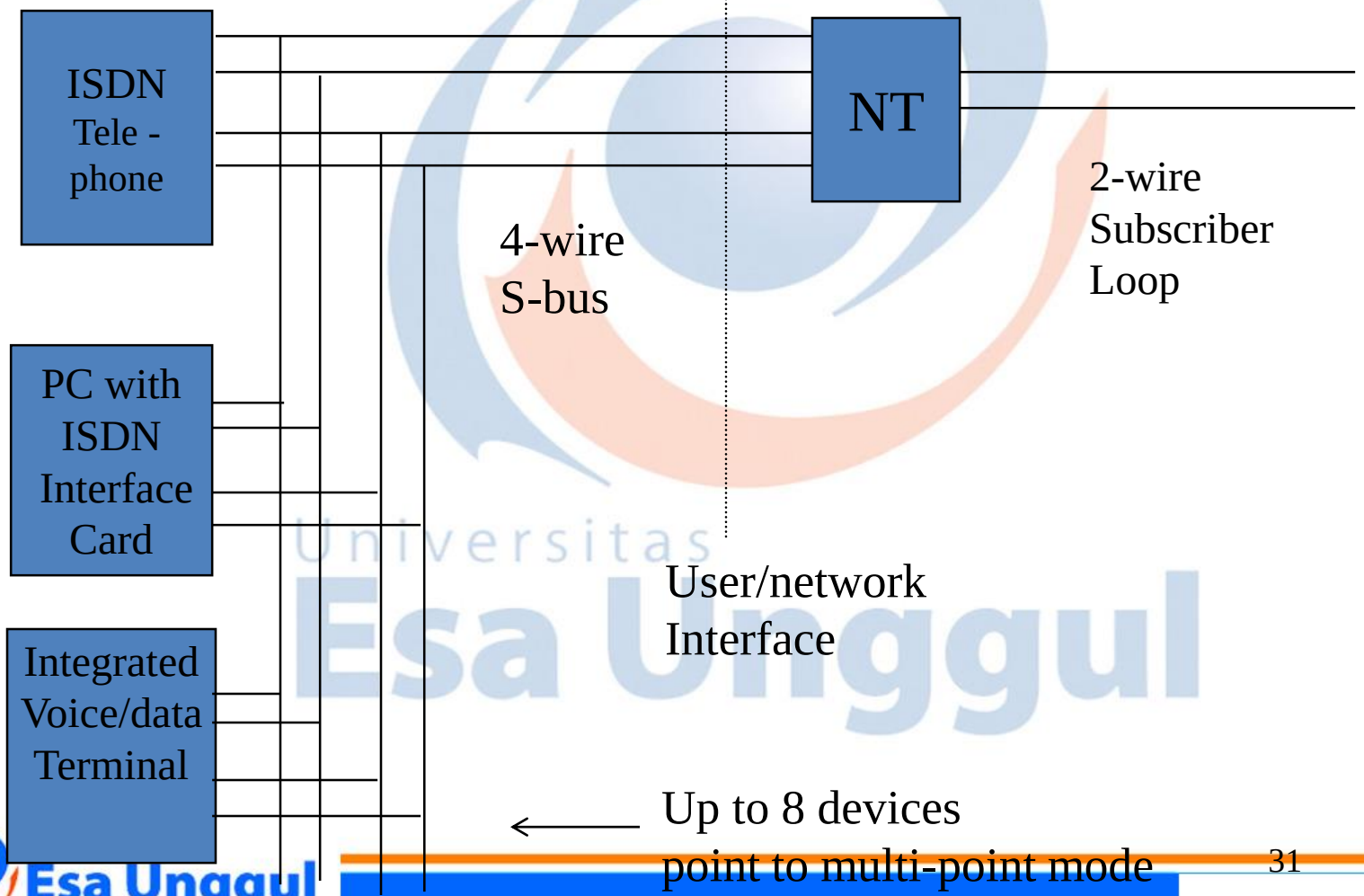
Interface at 2.048Mbps

User Access

Defined using two concepts

- Functional groupings of equipment
- Reference points to separate functional groupings

Typical User Access Layout



ISDN Protocol Architecture

<table>
<tr><td>Application</td><td rowspan="4">End-end user signalling</td><td colspan="3" rowspan="4"></td><td colspan="2" rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>Presentation</td></tr>
<tr><td>Session</td></tr>
<tr><td>Transport</td></tr>
<tr><td>Network</td><td>I.451/Q.931 call control</td><td>X.25 packet level</td><td>for further study</td><td colspan="2"></td><td>X.25 packet level</td></tr>
<tr><td>Datalink</td><td colspan="3">LAPD (Q921)</td><td>Frame Relay</td><td>LAPB</td></tr>
<tr><td>Physical</td><td colspan="6">I.430 basic interface + I.431 primary interface</td></tr>
</table>

ISDN Data Link Layer

Link Access Protocol for the D channel (LAPD) defined for ISDN

Three applications are supported

- Control Signalling
- Packet Switching
- Telemetry

Network Layer Above LAPD

Control Signalling

- Call Control Protocol (I.451 / Q.931)
  - Establishes, maintains and terminates connections on B channels
  - Possibility of user - user control signalling above this layer

B-Channel

Uses

- Circuit Switching
- Semi-permanent circuits
- Packet switching

B-Channel

Circuit Switching

- Circuit is set up on B-channel on demand
- D-channel call control protocol is used
- Transparent full-duplex digital data path established between users
- Layers 2 to 7 are not visible to ISDN or specified

B-Channel

Semipermanent circuit can be set up by prior agreement between users and network operator

Can be for indefinite time or at specified times during day or week

As with circuit switched connection, full duplex digital data path is established

Layers 2 to 7 are not visible to ISDN or specified

B-Channel Packet Switching

Circuit-switched connection is established between user and packet-switched node using D-channel call control protocol

The packet switching node can be integrated into ISDN or be a separate network

User then employs X.25 layers 2 and 3 to establish virtual circuit to other user

Frame relay can also be used instead of X.25

D-Channel Packet Switching

Integrated X.25 service can be accessed by D-Channel in addition to B-Channel

ISDN provides a semi-permanent connection to a packet switching node within ISDN

The X.25 level 3 protocol is used for the packet layer

LAPD is used for the link layer

ISDN Call Control Protocol

Defined in recommendation I.451/Q.931

Network layer protocol

Uses services of LAPD link layer

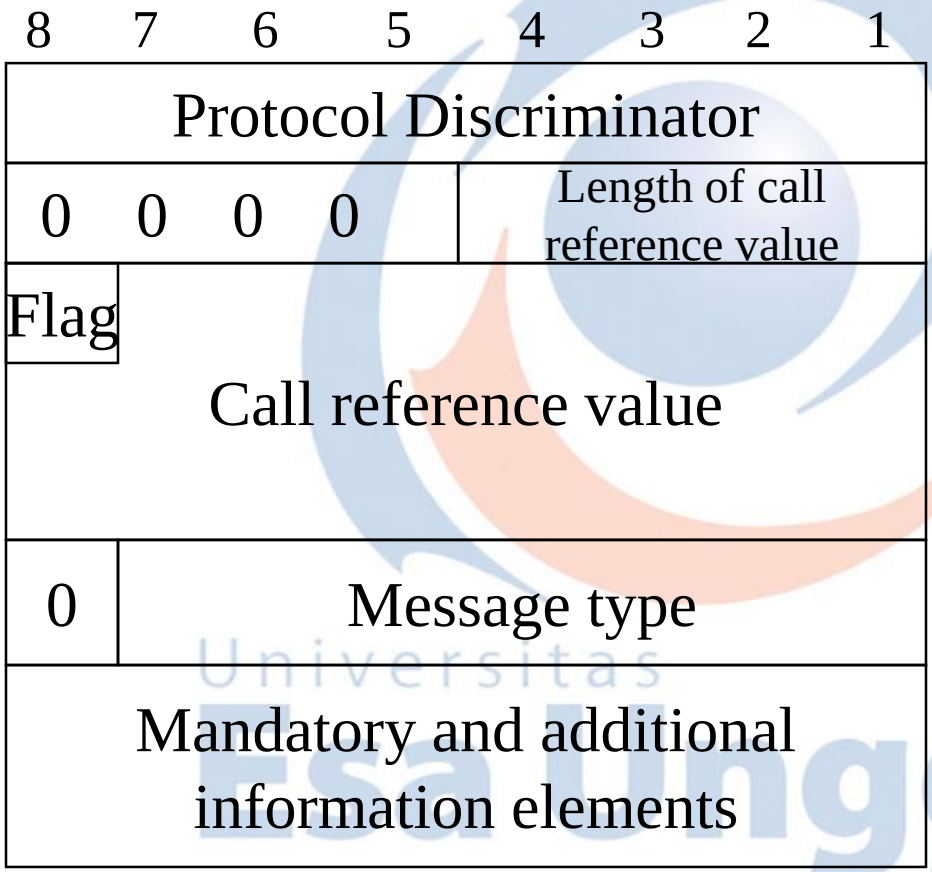
Specifies procedures for establishing, maintaining clearing connections on B-channels sharing D-channel

ISDN Call Control Protocol

Message Types

- Call establishment messages to set up a call
- Call information messages during a call (e.g. suspend a call and resume a call)
- Call clearing messages to clear a call
- Miscellaneous messages (congestion control, requesting supplementary services etc)

I.451 Formats



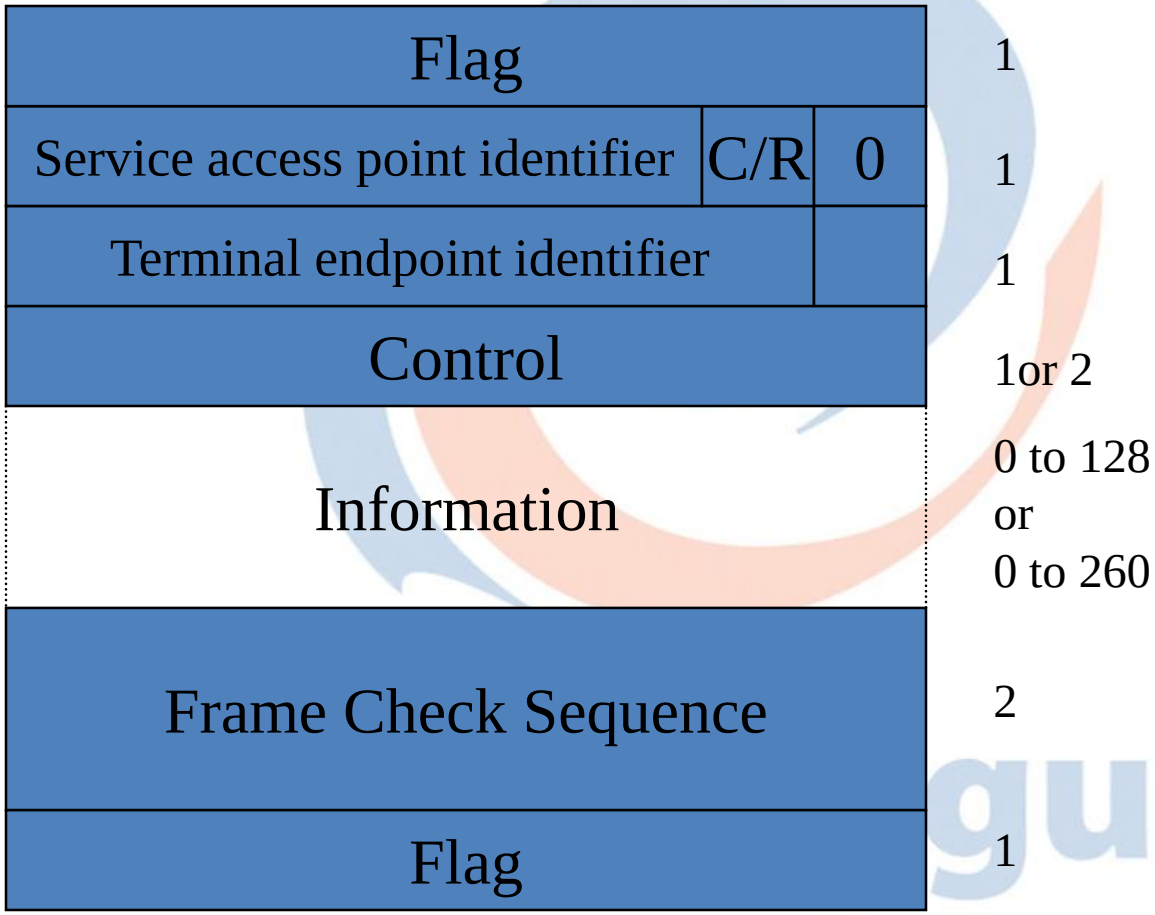
General message format

LAPD

Provides two types of service

- Unacknowledged information transfer
  - No guarantee of delivery
  - Frames with error are discarded
- Acknowledged information transfer
  - Similar to HDLC
  - Flow and error control
  - Logical connection established prior to data transfer
  - Also called multiple-frame operation

LAPD Format


Flag
Service access point identifier
C/R
0
Terminal endpoint identifier
Control
Information
Frame Check Sequence
Flag
1
1
1
1or 2
0 to 128
or
0 to 260
2
1
Length in octets

ISDN Physical Interface

There are no separate control circuits

Transmit and receive circuits carry data and control signals

Pseudoternery coding scheme is used for basic access signals

- Voltage level is + or - 750 mV
- Data rate is 192 kbps

HDB3 code is used for 2.048 Mbps access

B8ZS code is used for 1.544 Mbps access

ISDN INTERFACE PLUG PINOUT

PIN	TERMINAL EQUIPMENT	NETWORK TERMINATING EQUIPMENT
1	Power Source 3	Power Sink 3
2	Power Source 3	Power Sink 3
3	Transmit	Receive
4	Receive	Transmit
5	Receive	Transmit
6	Transmit	Receive
7	Power Sink 2	Power Source 2
8	Power Sink 2	Power Source 2

Broadband ISDN

Recommendations to support video services as well as normal ISDN services

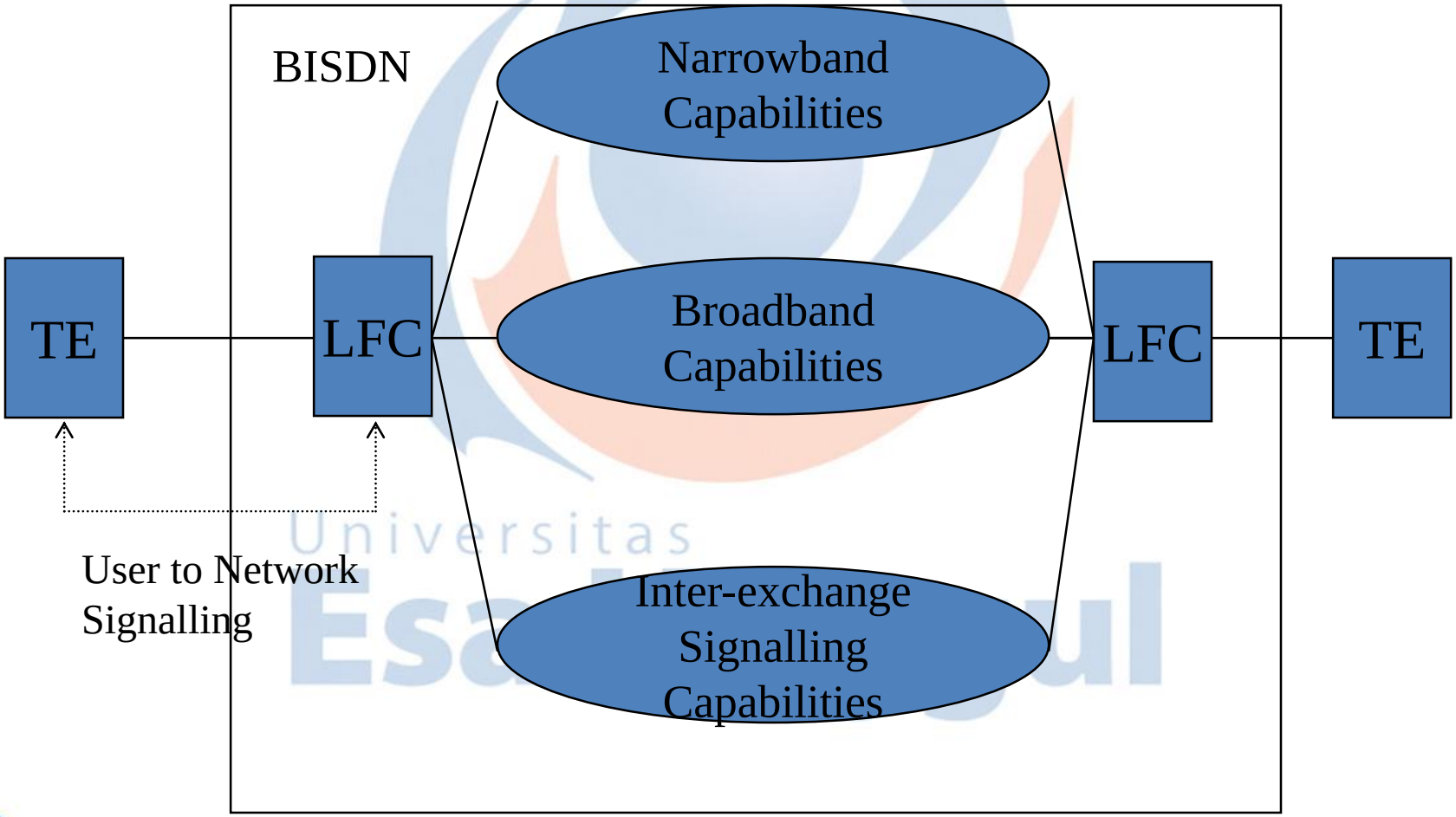
Provides user with additional data rates

- 155.52 Mbps full-duplex
- 155.52 Mbps / 622.08 Mbps
- 622.08 Mbps full-duplex

Exploits optical fibre transmission technology

Very high performance switches

B-ISDN Architecture



TE = Terminal equipment
LFC = Local function capabilities

B-ISDN

ATM is specified for Information transfer across the user-network interface

Fixed size 53 octet packet with a 5 octet header

Implies that internal switching will be packet-based

BISDN Protocol Structure