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# ISDN Analysis

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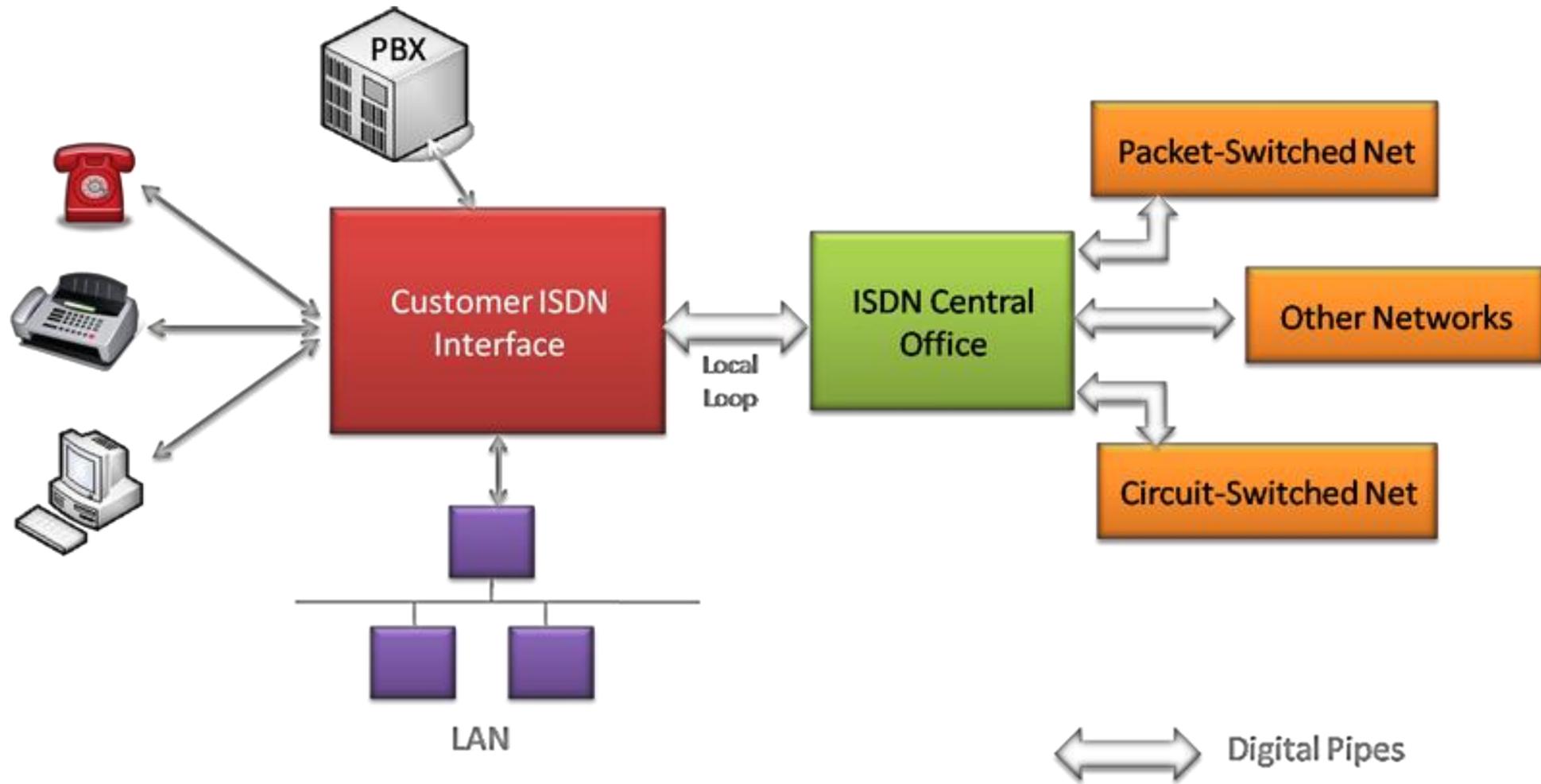


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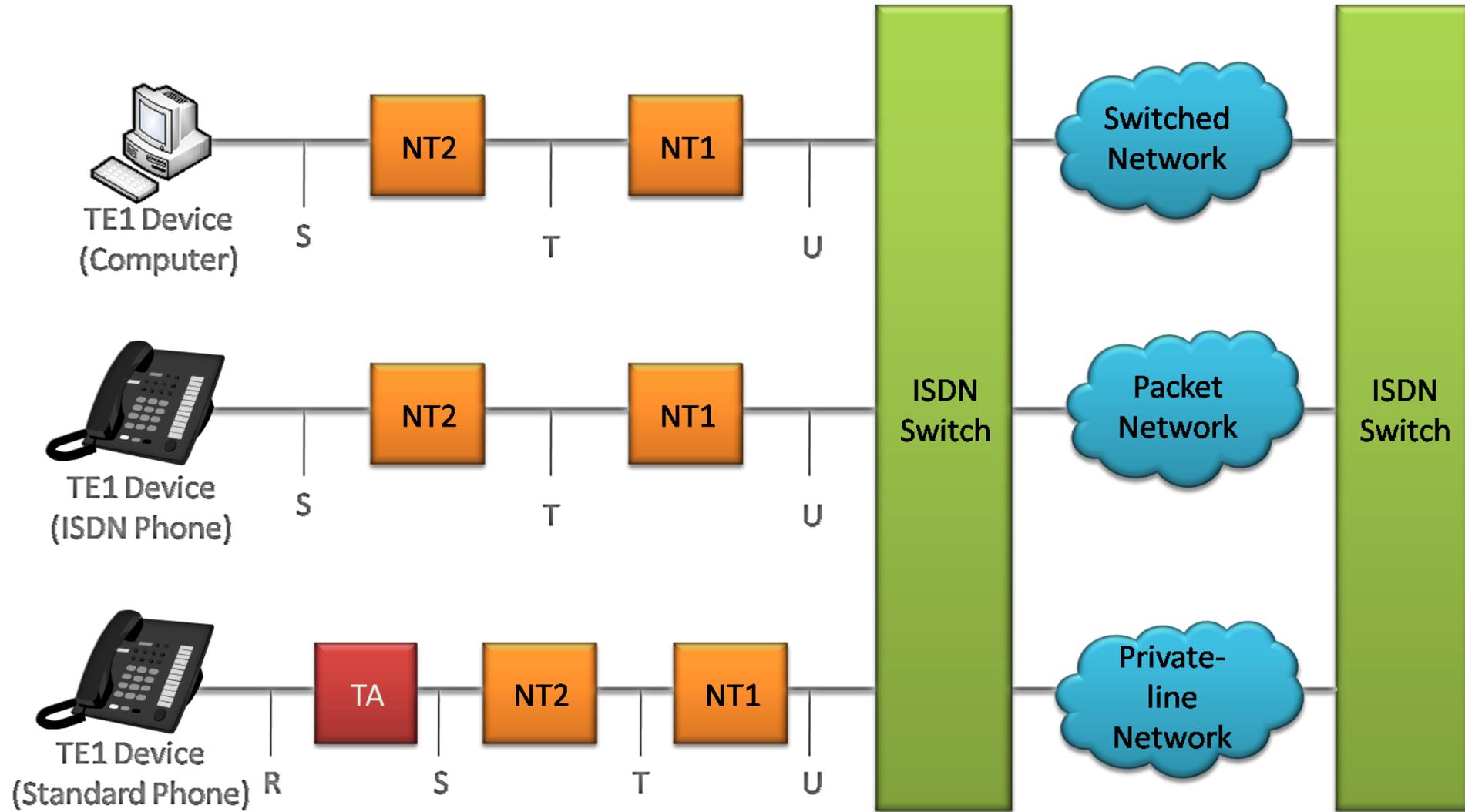
# ISDN – A Brief Overview

- Allows the transmission of voice, data, video and graphics, at very high speeds, over standard communication lines
- Operates at Layer 3 – Network Layer
- Used in Switched and non-switched circuit & packet networks
- ITU-T standard defines number of component parts & functions of ISDN
  - ISDN CHANNELS
  - ACCESS TYPES
  - DEVICES
  - PROTOCOLS

# ISDN Conceptual View



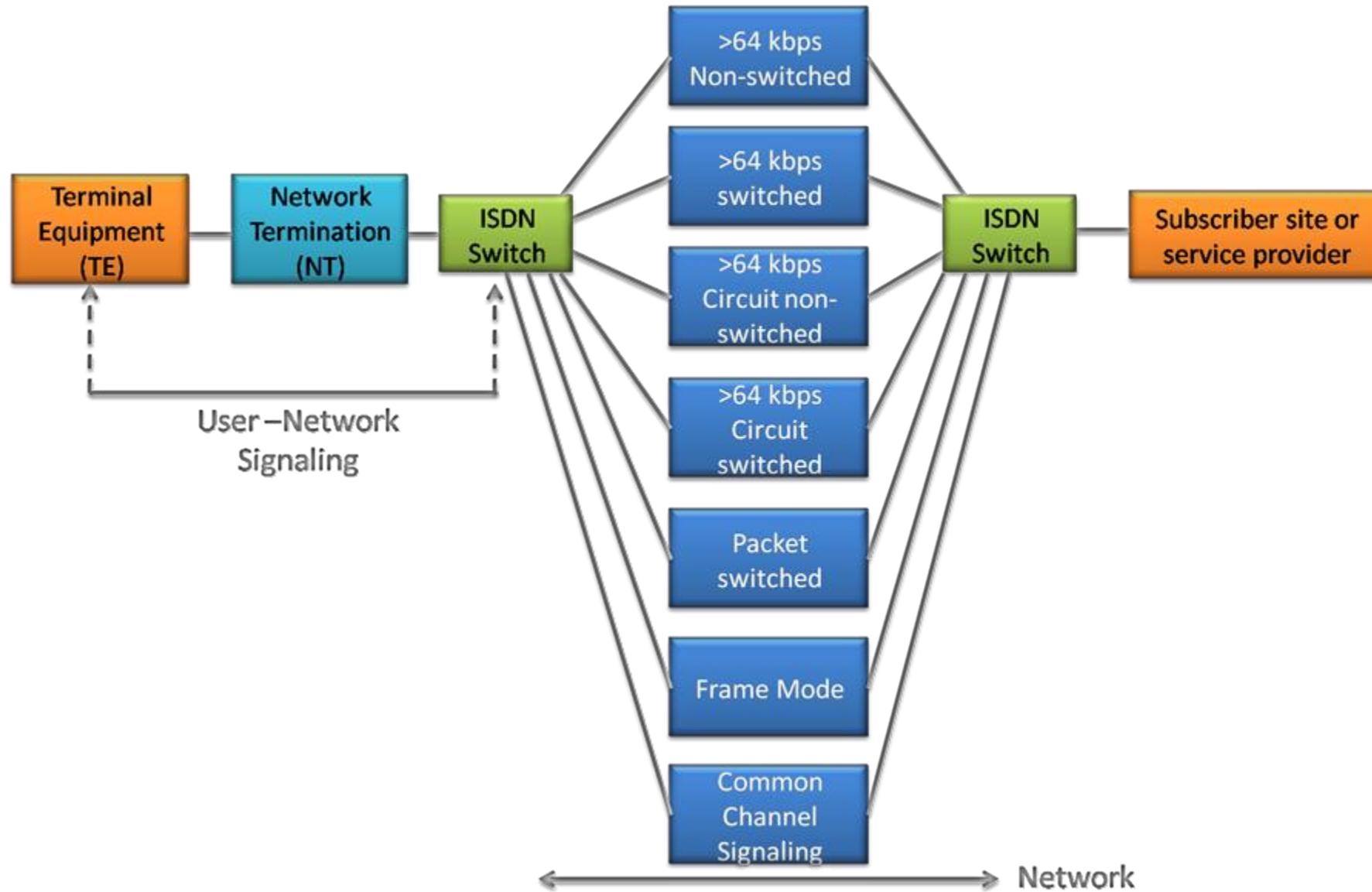
# ISDN Interface and Devices



# ISDN Basics

- ISDN Devices
  - Terminal Equipment (TE)
  - Terminal Adapter (TA)
  - Network Termination 1 (NT1)
  - Network Termination 2 (NT2)
  - Exchange Termination (ET)

# ISDN Architecture



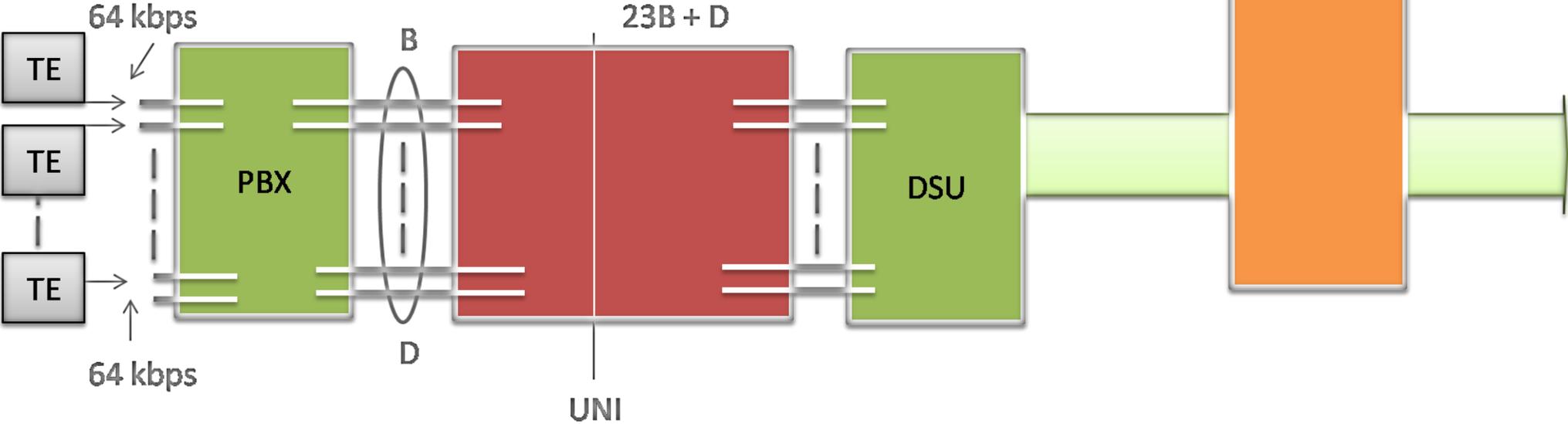
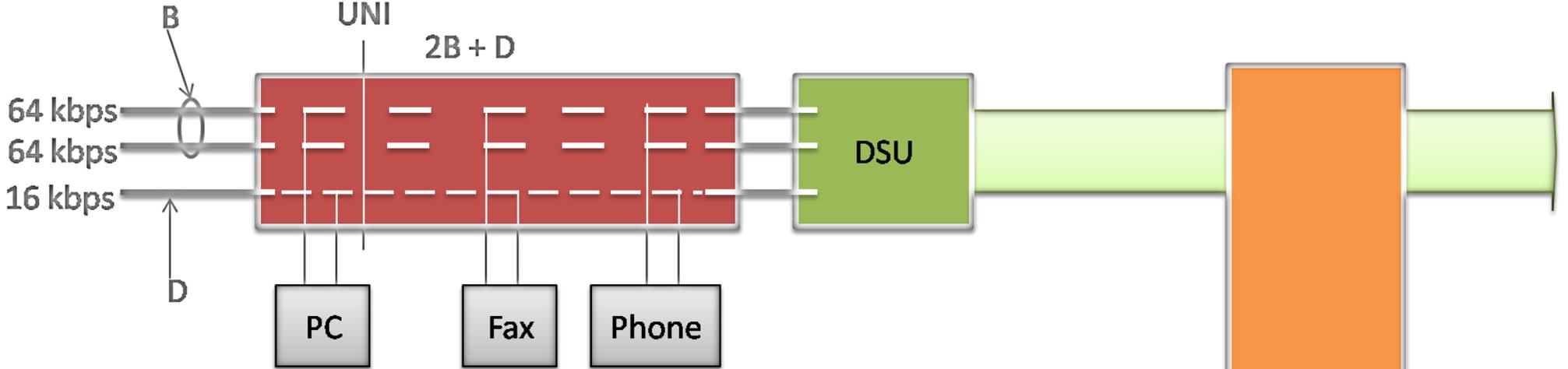
# ISDN Basics

- Types of channels
  - Bearer channel (B-channel=64 kb/s) clear pipe for data
  - Delta channel (D-channel, 16 kb/s or 64 kb/s) call signaling information:
    - who is calling
    - type of call
    - calling what number
  - High-capacity channels (H channels)
    - An H channel is a special, high-speed clear channel. H channels, designed primarily for full-motion color video, are not yet in common use

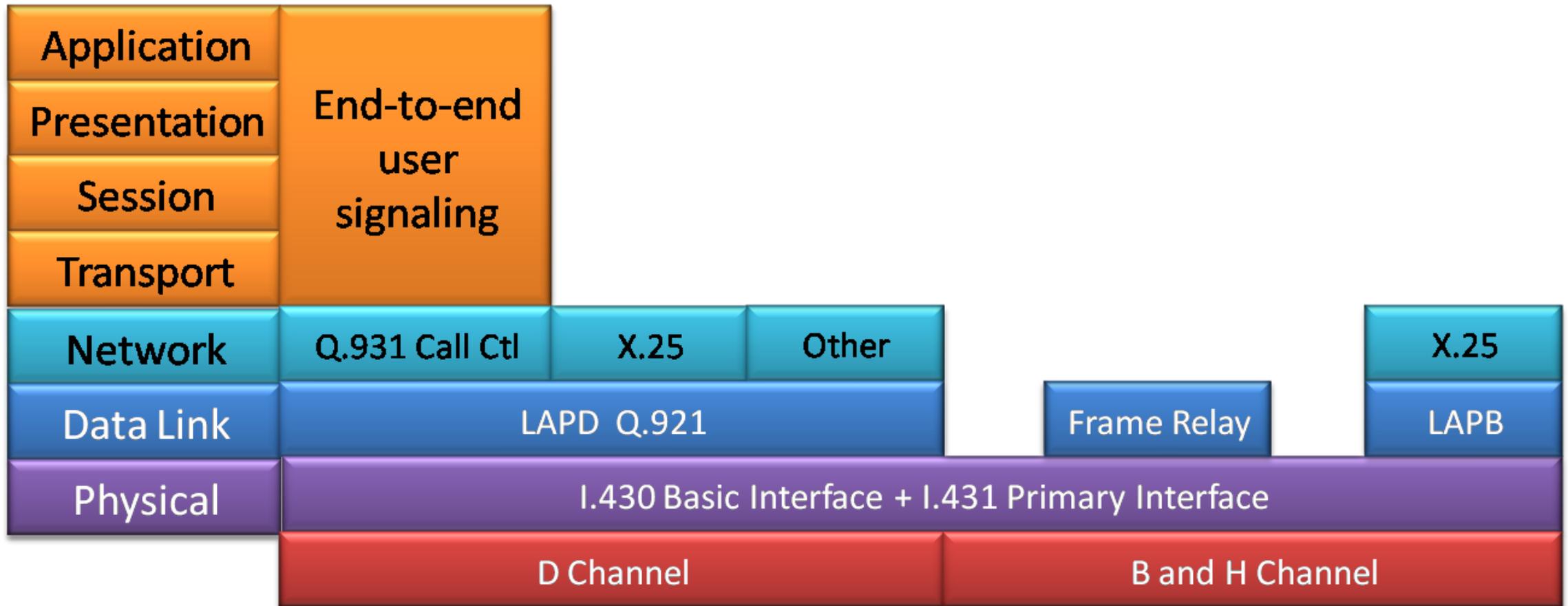
# General types of Services

- Basic Rate Interface (2 B channels + 1 D channel (16 kb/s))
  - Composition: 2B+D (16 kbps D-channel) + synchronization and framing = 192 kbps
  - Intended to meet the needs of individual users (residences, small offices)
  - Most existing two-wire local loops can support this interface
- Primary Rate Interface (30 B channels + 1 D channel (64 kb/s))
  - In U.S.: 23B+D (64 kbps D-channel) = 1.544 Mbps (T1)
  - In Europe: 30B+D (64 kbps D-channel) = 2.048 Mbps (E1)
  - Users w/ greater capacity requirements (offices w/ a PBX or LAN)
  - May also be used to support H-channels (e.g. 3H0+D supplies a 1.544 Mbps interface)

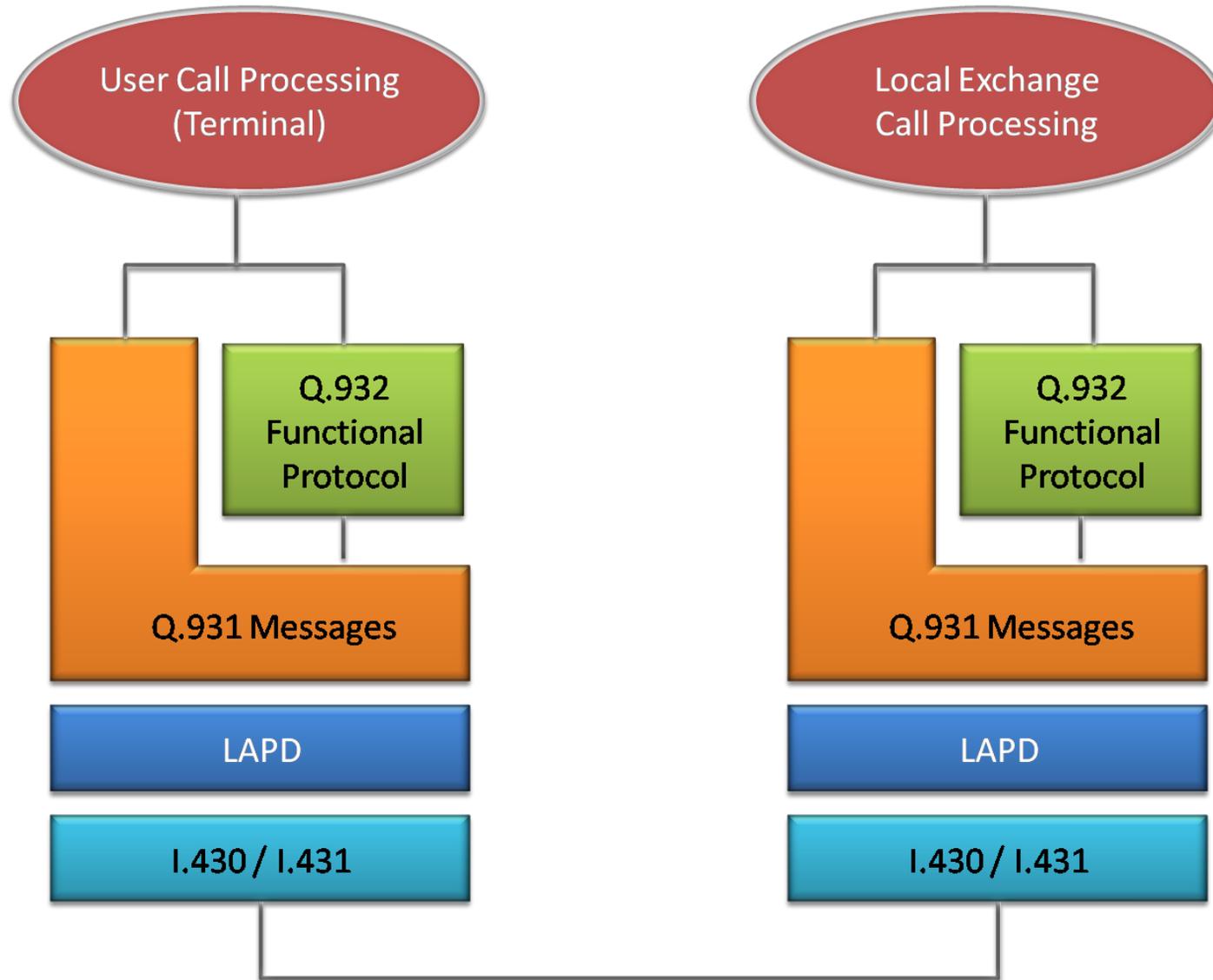
# ISDN Services : PRI & BRI



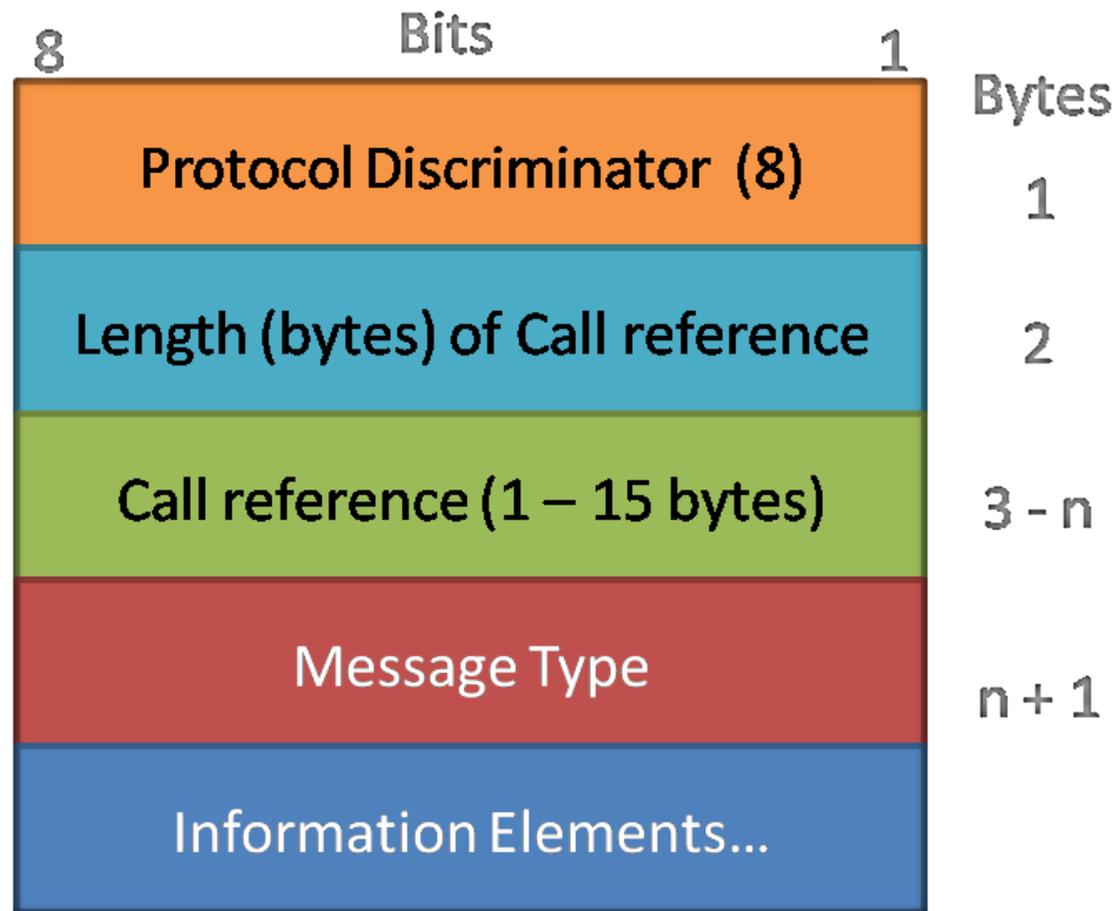
# ISDN Protocol Structure



# ISDN Layer 3 Protocol



# Q.931 Frame Format

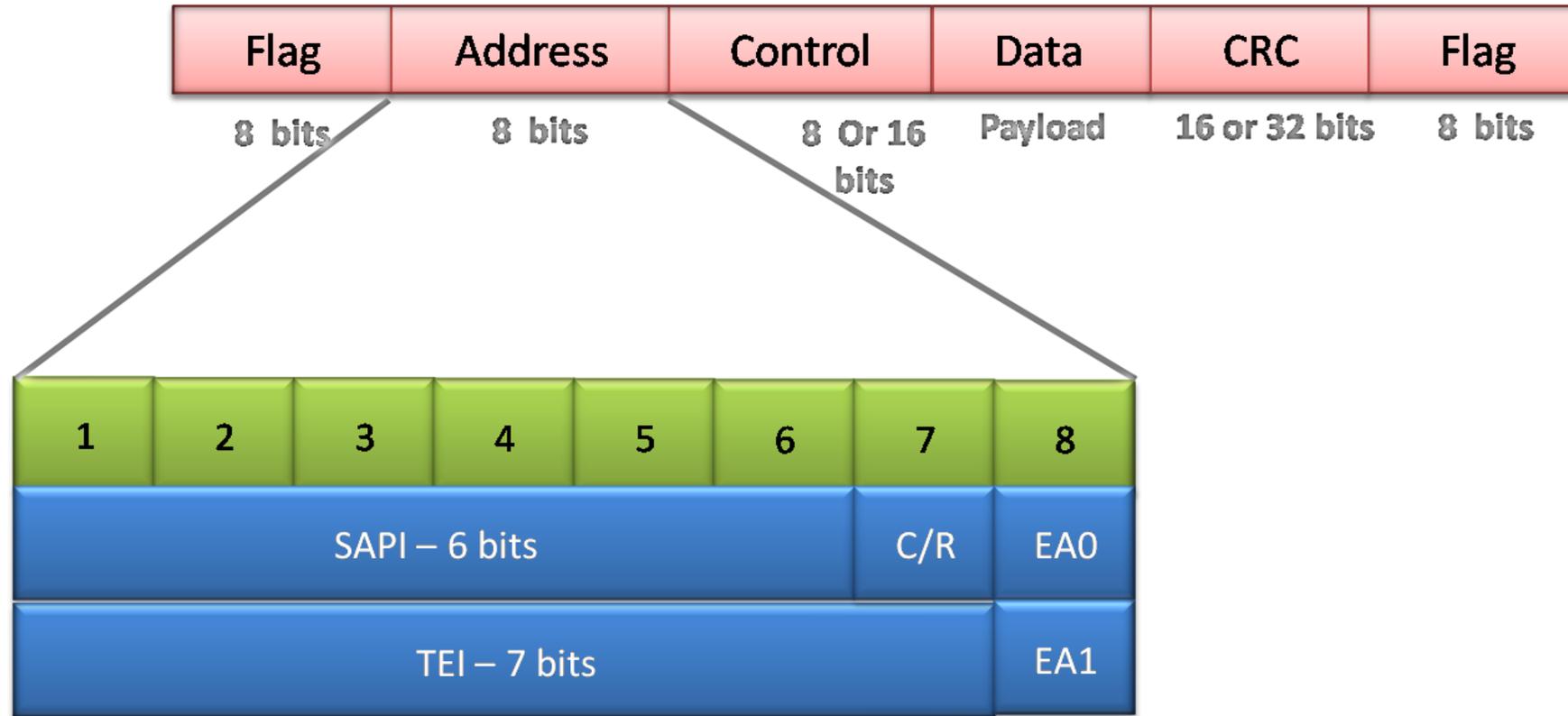


# ISDN Layer 2 Protocol

## Link Access Protocol – D Channel (LAPD)

- Layer 2 protocol
- Almost identical to LAP-B used w/ X.25 (based on HDLC)
- Provides unacknowledged information-transfer service (unnumbered frames, error detection to discard frame but no error control or flow control) and acknowledged information transfer

# LAPD Frame Format



**SAPI** – Service Access Point Identifier

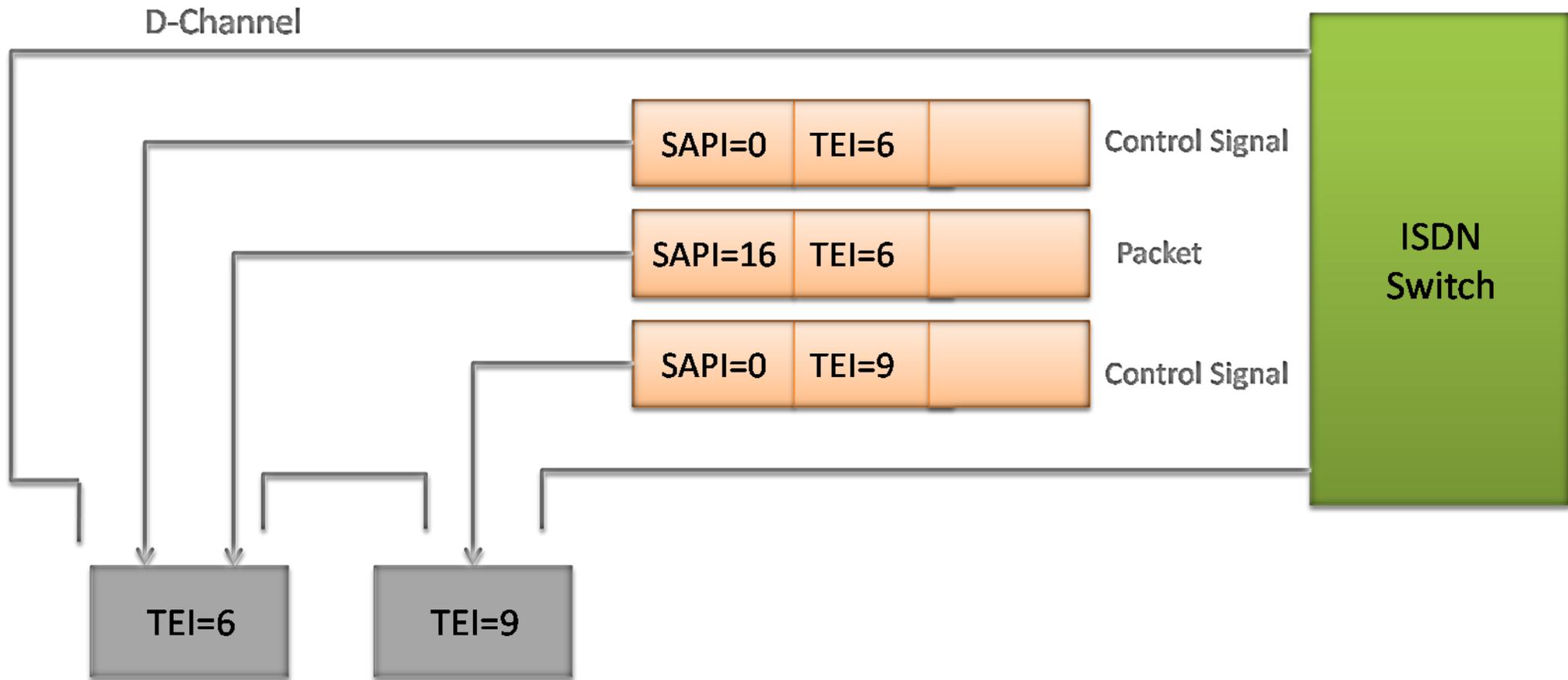
**C/R** – Command/Response

**EA** – Extended Address field

**TEI** – Terminal Endpoint Identifier

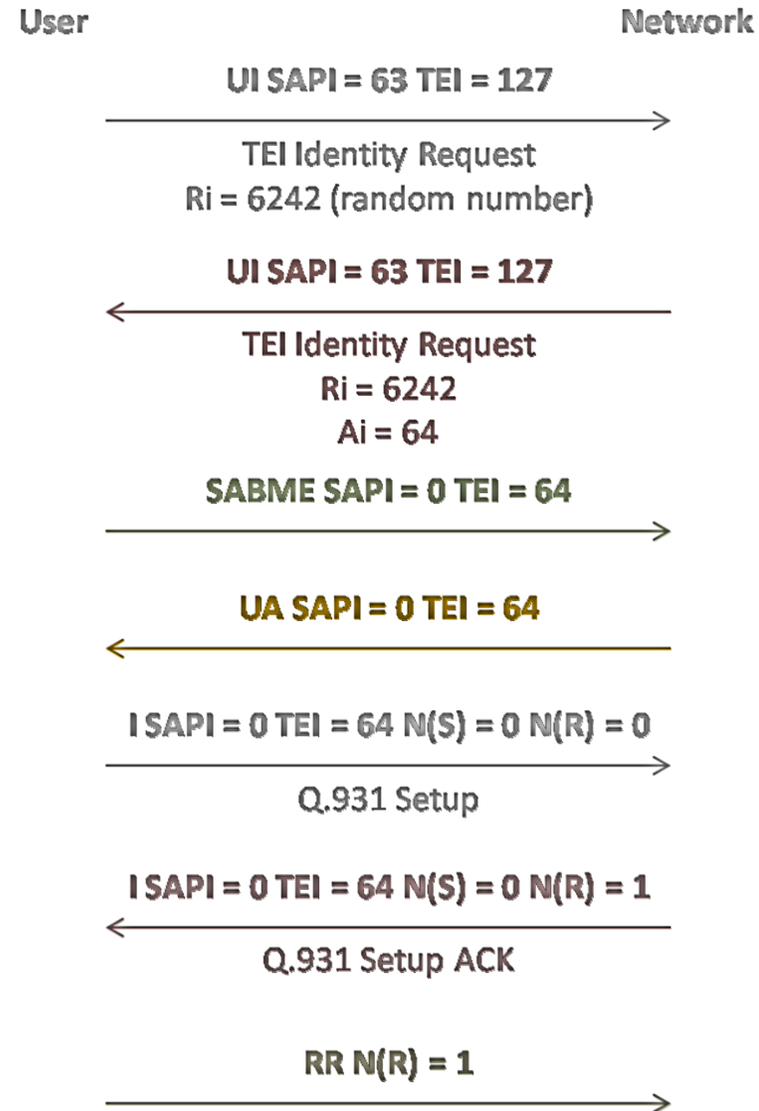
## Address Field of LAP-D Frame Format

# LAPD Channel

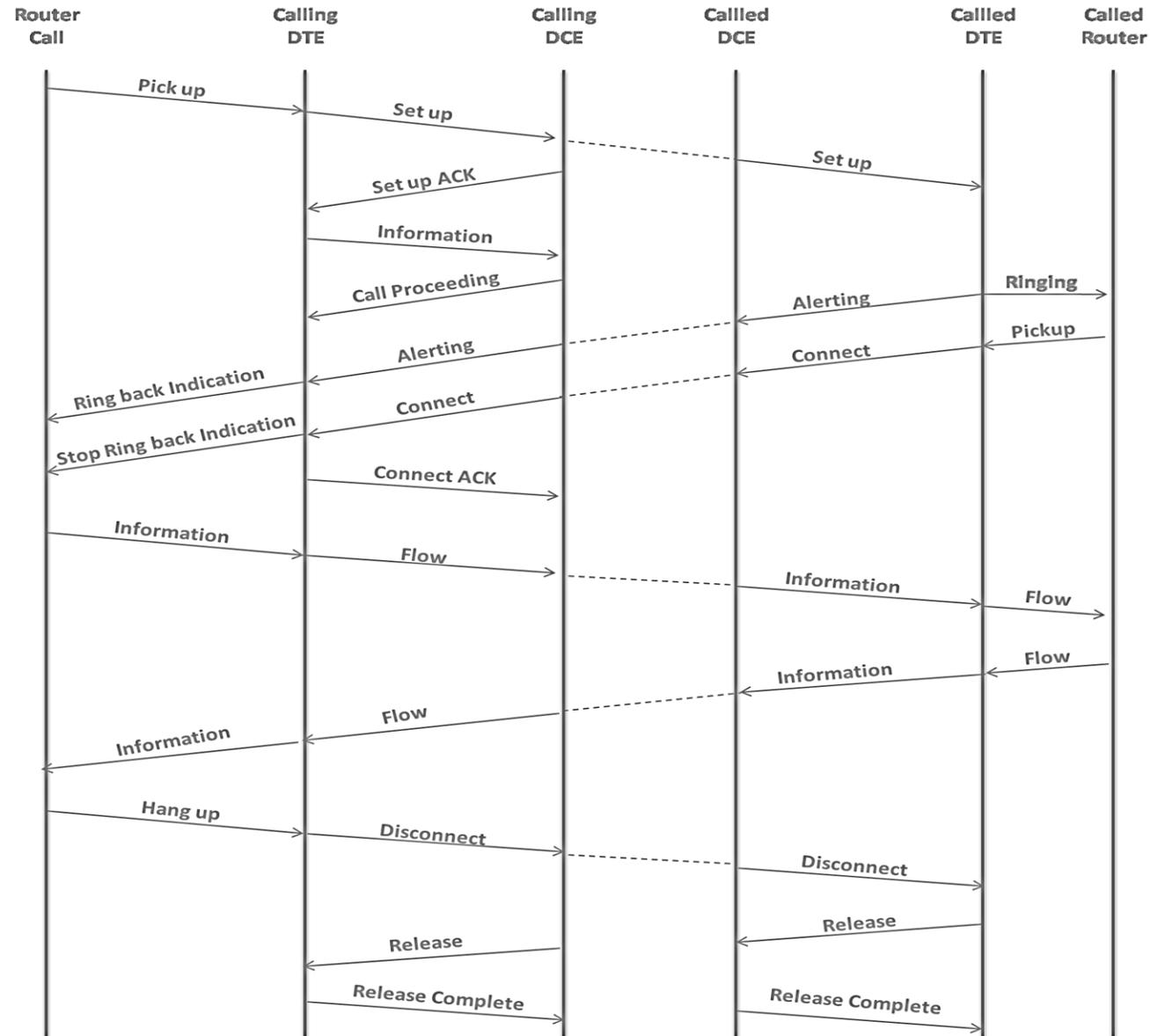


End-to-end Mode

# Sample Exchange b/w User & Network



# ISDN Call Flow



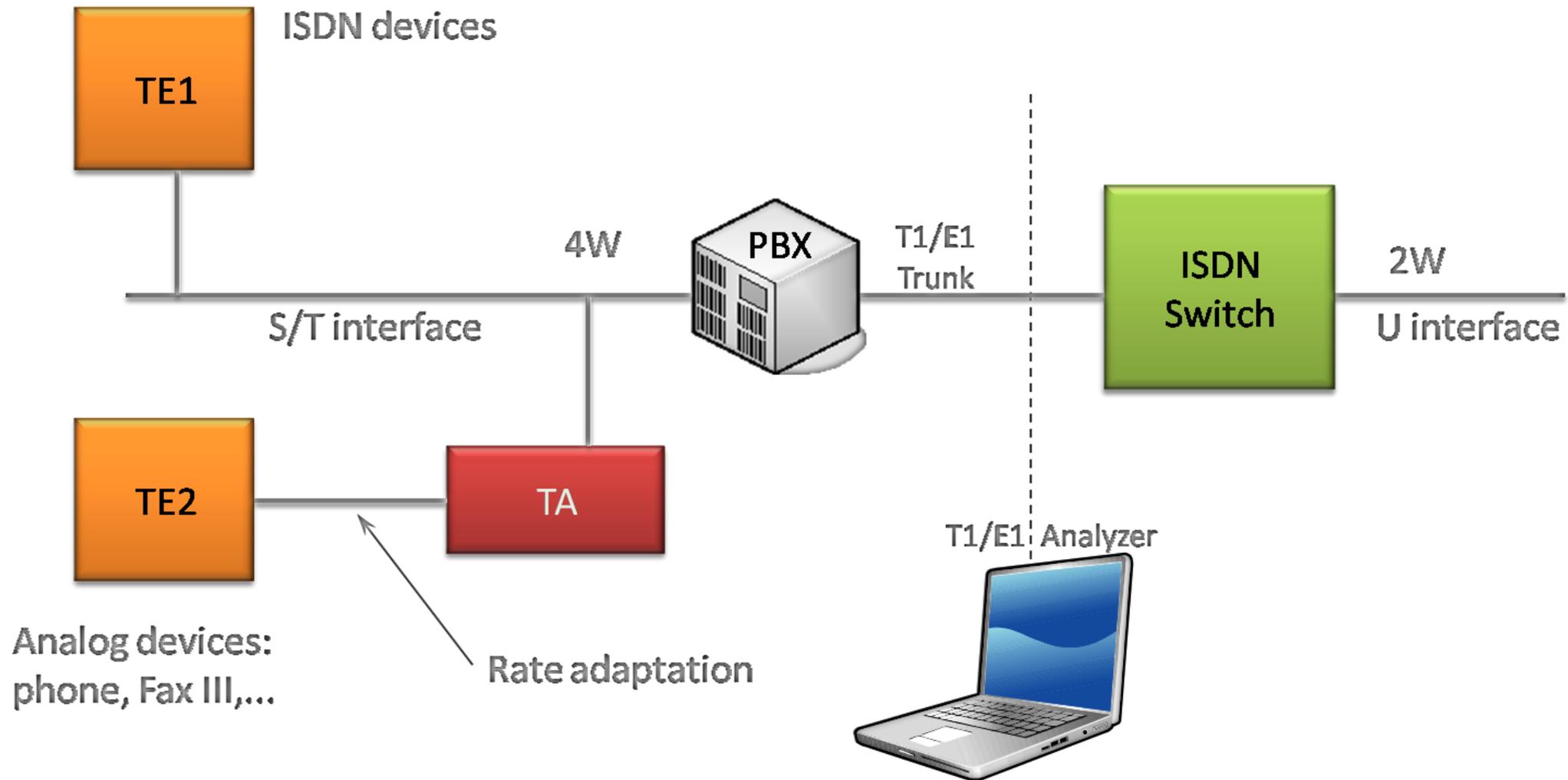
# Advantages of ISDN

- **Digital**
  - reliable connection
- **Speed**
  - faster (192 kbps in BRI, 1.5 Mbps to 2.048 Mbps in PRI)
- **Fast call setup**
  - 2 seconds
- **Bandwidth on Demand**
  - adding new channels to the bundle of channels
- **Multiple devices**
  - phone, fax, PC, videoconferencing system, router, terminal adapter, each with its own sub-address

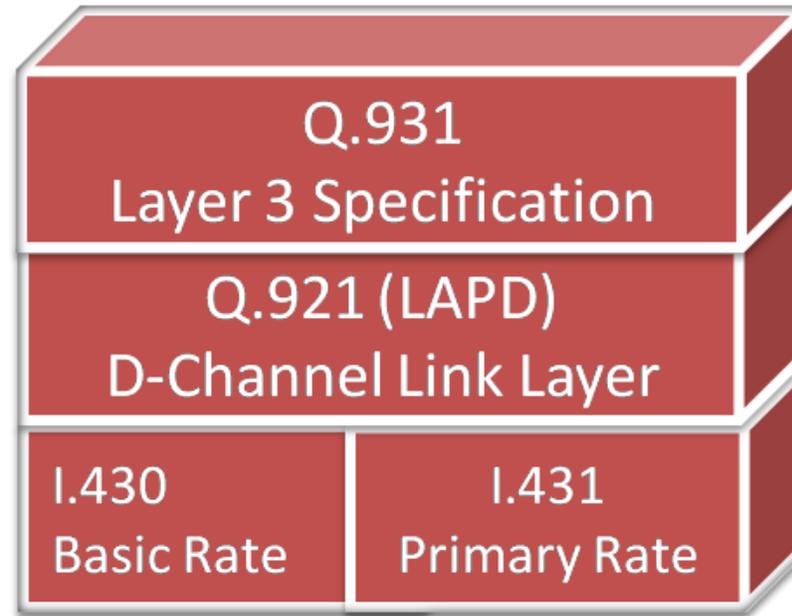
# Advantages of ISDN

- To network providers
  - standards support universality and larger potential market for services, drive down equipment costs
- To manufacturers
  - larger potential market, economies of scales
  - standards decrease risk of obsolescence
- To enhanced service providers
  - simplified user access

# GL's ISDN Analyzer



# Protocol Standards Supported by GL's ISDN Analyzer



- BELL NI2
- DMS -100, DMS -250
- ANSI – T1.607
- QSIG ETSI
- Q.93x
- 4ESS
- 5ESS
- ETSI 300- 102

# GL's ISDN Analyzer

**ISDN Protocol Analysis Q.93x**

File View Capture Statistics Database Call Detail Records Configure Help

0 GoTo

Dev	TS...	Su...	Fram...	TIME (Relative)	Len	Error	C/R	SAPI	TEI	CTL	P/F	N(S)	N(R)	CRV	Message Type
✓ 2	23		18	00:00:27.113625	38		Comman...	0	0	Inform...	0	39	70	161...	SETUP
✓ 2	23		19	00:00:27.119000	38		Comman...	0	0	Inform...	0	40	70	163...	SETUP
✓ 2	23		20	00:00:27.125750	38		Comman...	0	0	Inform...	0	41	70	166...	SETUP
✓ 2	23		21	00:00:27.131000	38		Comman...	0	0	Inform...	0	42	70	168...	SETUP
✓ 2	23		22	00:00:27.136250	38		Comman...	0	0	Inform...	0	43	70	171...	SETUP

Card2 TimeSlot=23 Frame=18 at 00:00:27.113625 OK Len=38

HDLCL Frame Data + FCS

```

===== LAPD Layer =====
C/R          = .....0. Command(User), Response(Network)
SAPI         = 000000.. (0)
TEI          = 0000000. (0)
Ctl          = .....0 Information
N(S)         = 0100111. (39)
    
```

Hex Dump of the Frame Data

```

+-----+-----+-----+-----+-----+-----+-----+-----+
00 01 4E 8C 08 02 3F 00 05 04 03 90 90 A2 18 03      N ?  |c
A9 83 90 70 0B A1 35 30 38 33 30 32 31 31 31 31      @| | p i5083021111
7D 02 91 84 D9 51                                     } ' | UQ
    
```

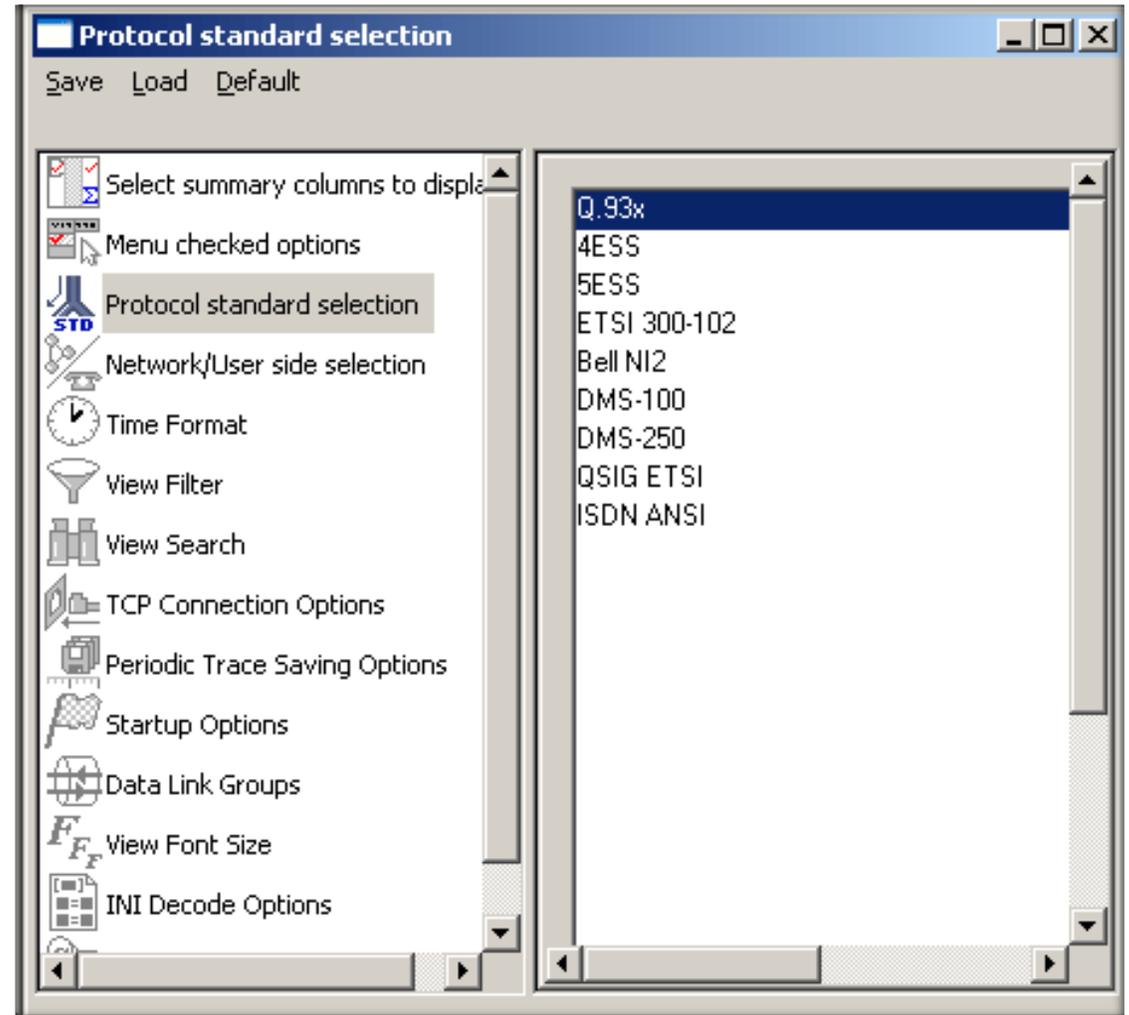
Device #	C/R	Frame Count(Device #)
2	Comman...	103
2	Respons...	92
total 2	Total	195

Call ID	Call Status	Calling Num	Called Num	Call Start Date & Time	Call Duration	Release Complete C
0	completed		5083021111	2001-05-16 17:08:11.445500	00:00:43.185625	Normal call clea
1	completed		5083021111	2001-05-16 17:08:11.450750	00:00:43.182750	Normal call clea
2	completed		5083021111	2001-05-16 17:08:11.457125	00:00:43.179375	Normal call clea
3	completed		5083021111	2001-05-16 17:08:11.462500	00:00:43.176375	Normal call clea
4	completed		5083021111	2001-05-16 17:08:11.468250	00:00:43.173625	Nnrml call clea

C:\Program Files\GL Communications Ir 195 Frames

# Protocol Standard

- Layer 2 Protocols - LAPD is parsed according to Q.921
- Layer 3 Protocols includes -
  - Bell NI2 (Bellcore National ISDN-2),
  - AT&T/Lucent switch 4ESS and 5ESS,
  - ETSI 300-102
  - QSIG (Q-reference point Signaling System) ETSI
  - Q.93x (ITU implementation of ISDN ) & ISDN ANSI decode
  - Nortel's switch DMS-100/250
- MLPP (Multi-Level Precedence. and Preemption) procedures for – (ISDN ANSI decode, ITU implementation - Q.955.3 & Facility Information Element - Q.932 )



# Call Detail Records

The screenshot displays the 'ISDN Protocol Analysis ISDN ANSI' application window. The main window is divided into several sections:

- Table 1: Call Detail Records** (Top section)
- Text View:** Shows HDLC Frame Data + FCS and LAPD Layer details for a specific frame.
- Hex Dump:** Displays the raw hexadecimal data of the frame.
- Table 2: Call Summary** (Bottom section)

**Table 1: Call Detail Records**

Dev	TS...	Su...	Frame#	TIME (Relative)	Len	Error	C/R	SAPI	TEI	CTL	P/F	N(S)	N(R)	FUN
✓ 2	0-23		0	00:00:00.000000	47		Res...	0	0	Inform...	0	16	26	
✓ 2	0-23		1	00:00:00.005458	6		Co...	0	0	Super...	0		27	RR
✓ 2	0-23		2	00:00:00.010703	11		Co...	0	0	Inform...	0	55	39	
✓ 2	0-23		3	00:00:00.015974	16		Co...	0	0	Inform...	0	56	41	

**Text View:**

```

Card2 TimeSlots=0-23 Frame=0 at 00:00:00.000000 OK Len=47
HDLC Frame Data + FCS
----- LAPD Layer -----
C/R          = .....1. Response(User), Command(Network)
SAPI         = 000000.. (0)
TEI          = 0000000. (0)
    
```

**Hex Dump of the Frame Data:**

```

+-----+-----+-----+-----+-----+-----+-----+-----+
02 01 20 34 08 02 00 ED 05 04 02 80 90 18 03 A9      4 i || ©
03 07 6C 0C 21 00 26 26 28 27 26 25 21 20 20 20    ...1 186697651000
    
```

**Table 2: Call Summary**

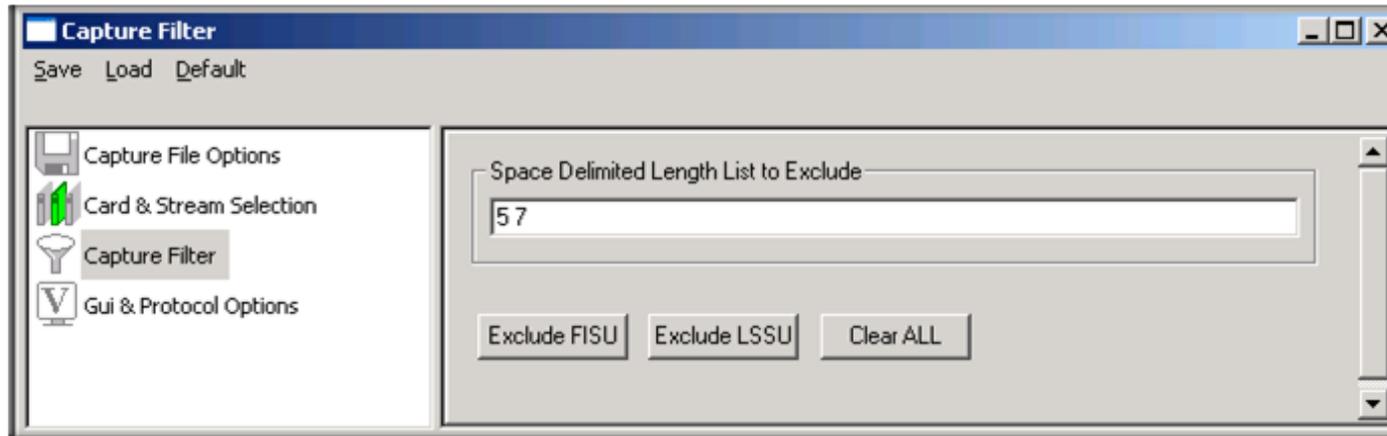
Call ID	Call Status	Calling Num	Called Num	Call Start Date & Time	Call Duration	Release Complete Cau...
2	completed	6697651000	3622251234	2002-04-08 14:53:24.142375	00:00:00.285750	Normal call clearing
3	completed	6697651000	3622251234	2002-04-08 14:53:24.242770	00:00:00.285744	Normal call clearing
4	completed	6697651000	3622251234	2002-04-08 14:53:24.295697	00:00:00.306890	Normal call clearing
5	active	6697651000	3622251234	2002-04-08 14:53:24.348645	00:00:03.469848	Normal call clearing
6	active	6697651000	3622251234	2002-04-08 14:53:24.401557	00:00:03.416937	x00
7	active	6697651000	3622251234	2002-04-08 14:53:24.491406	00:00:03.327088	x00

Off-line Viewing | C:\Program Files\GL Communications | 720 Frames

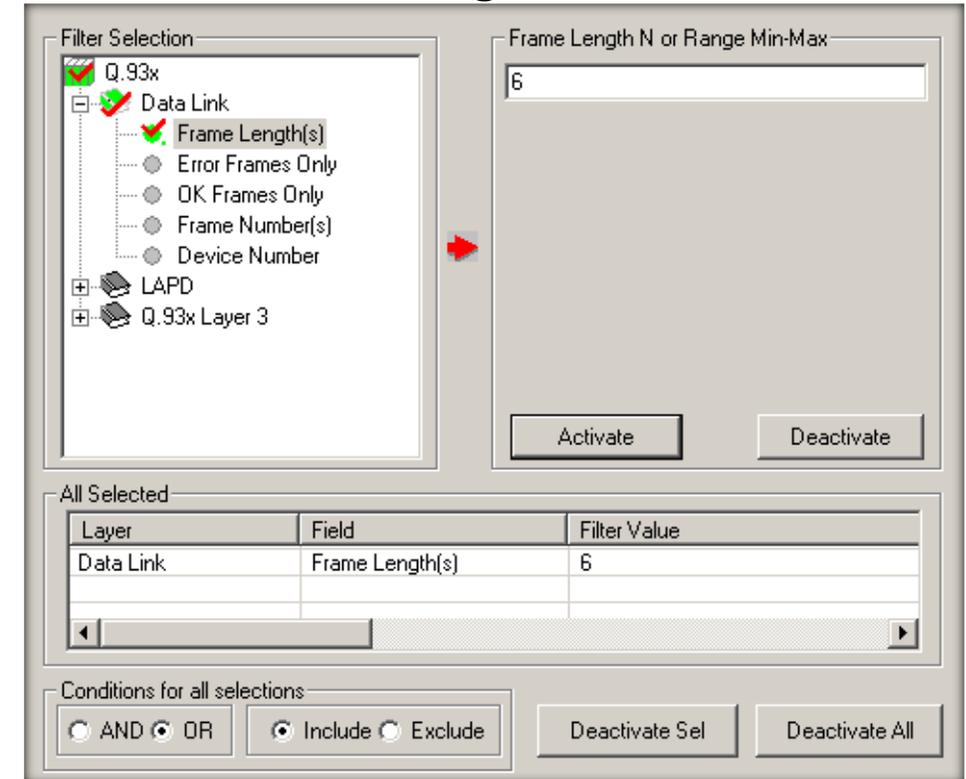
- Call trace defining important call specific parameters such as call ID, status (active or completed), duration, CRV, release complete cause etc are displayed

# Filter Frames

## Real-time Capture Filter



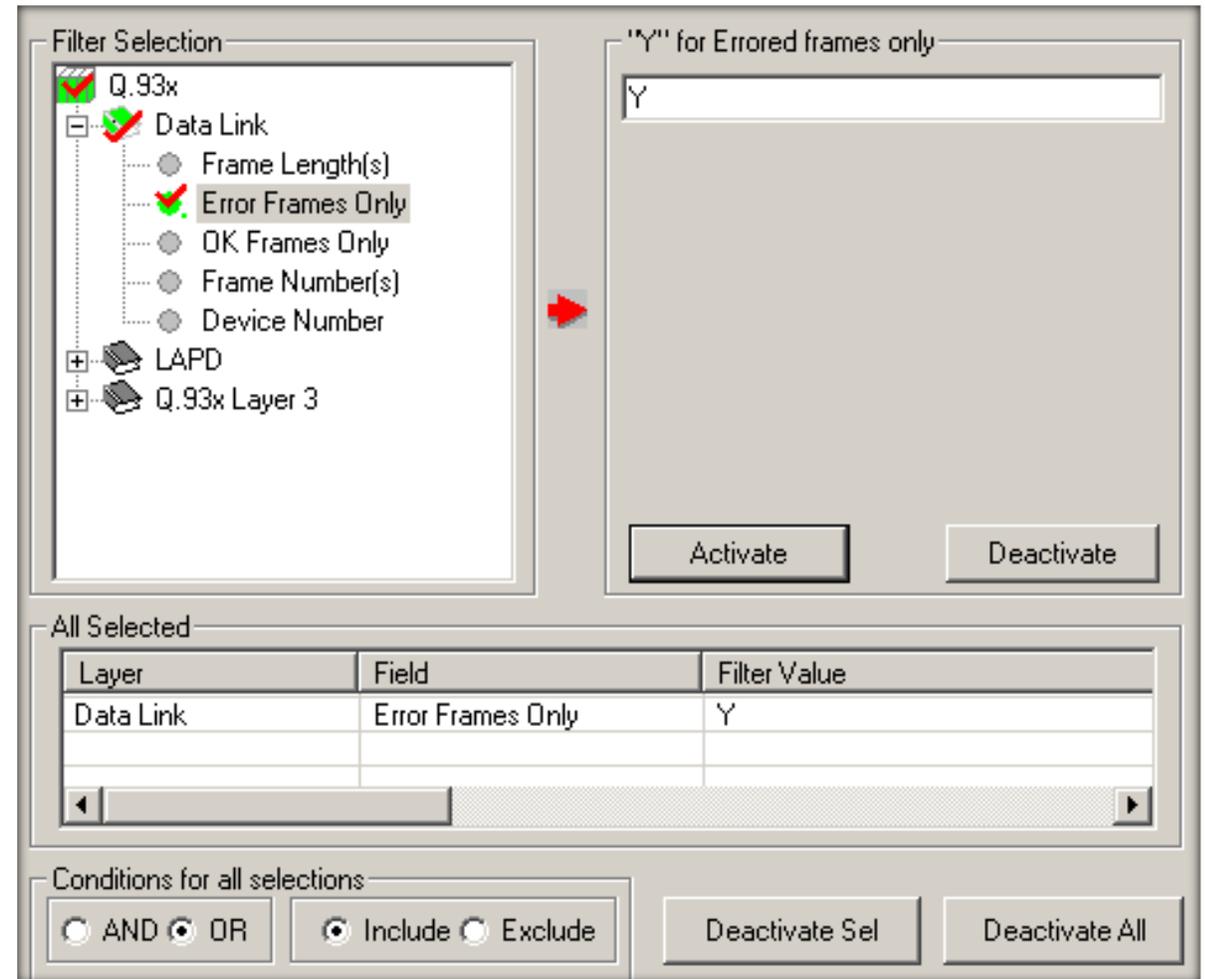
## Filtering Criteria



- Isolate certain specific frames from all frames in real-time as well as offline
- Real-time Filter applies to the frames being captured and is based on the Frame Length
- The frames can also be filtered after completion of capture according to SAPI, TEI, C/R, N (S), N(R), P/F, Supervisory Function and Type of ISDN Message

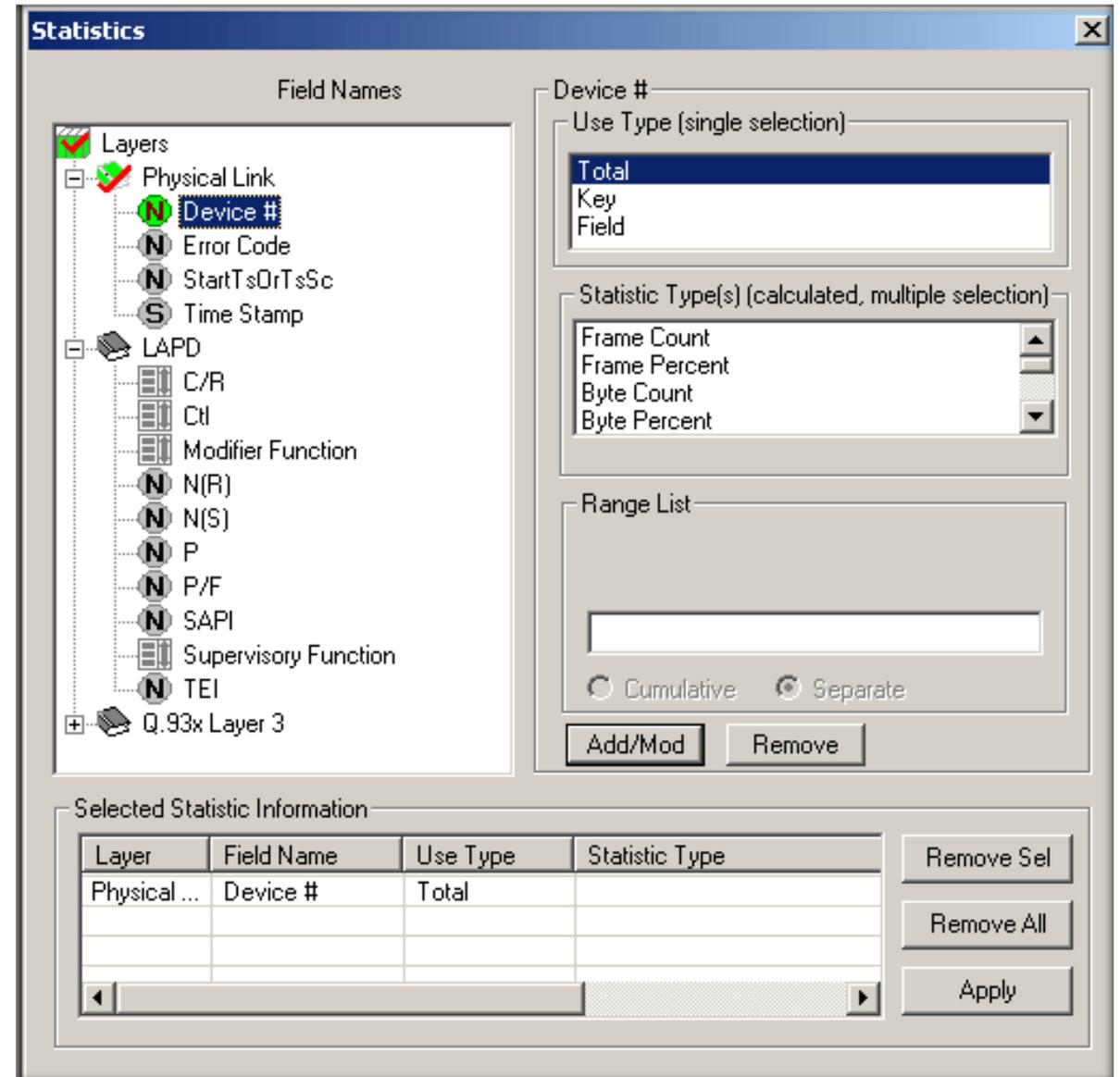
# Search Frames

- Search features helps users to search for a particular frame based on specific search criteria



# Statistics

- Statistics is an important feature available in protocol analyzer and can be obtained for all frames both in real-time as well as offline mode
- Numerous statistics can be obtained to study the performance of the network based on protocol fields and different parameters



# Applications

- Can be used as independent standalone units as "probes" integrated in a network surveillance systems
- Triggering, collecting, and filtering for unique subscriber information and relaying such information to a back end processor
- Collecting Call Detail Records (CDR) information for billing

**THANK YOU!**