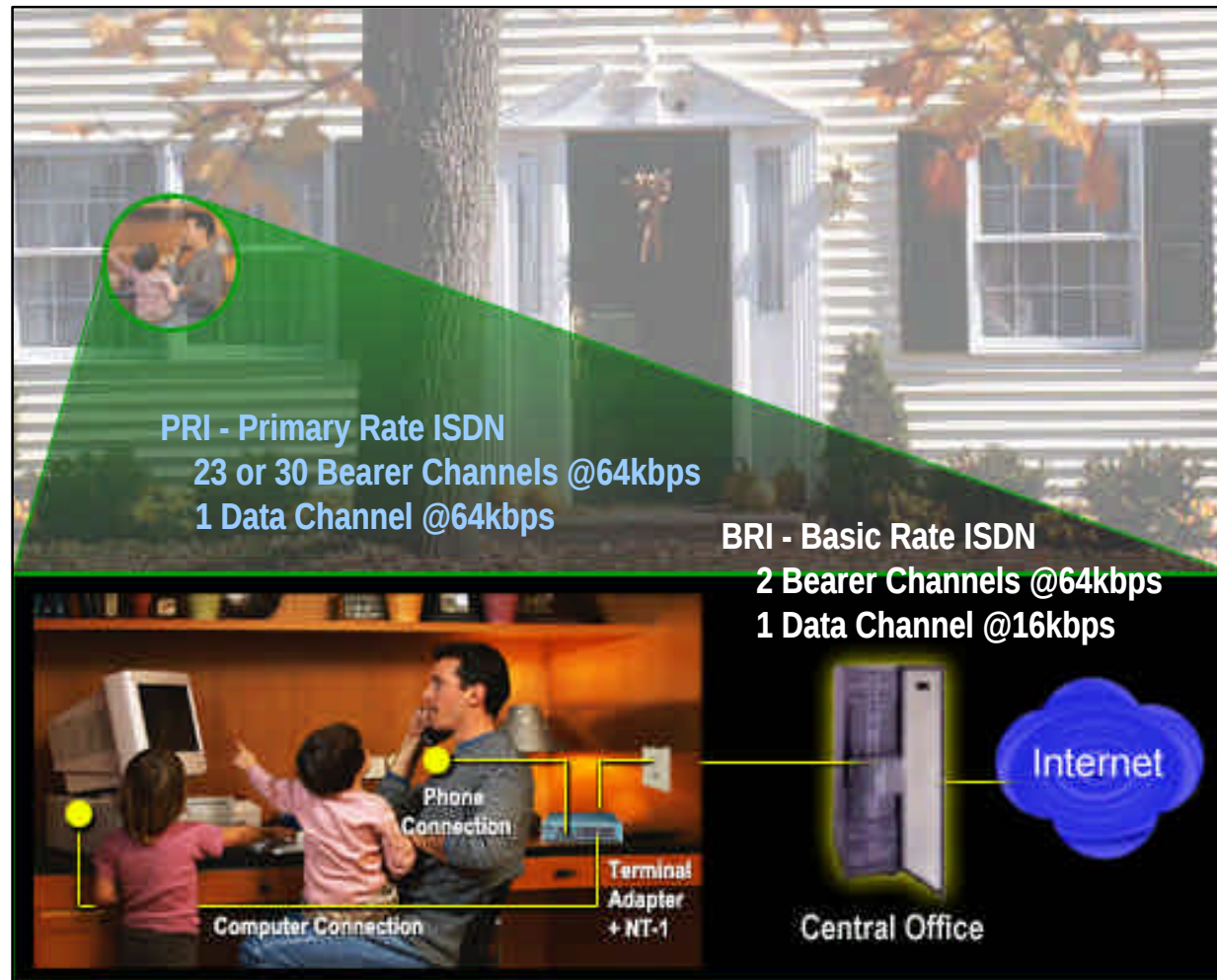


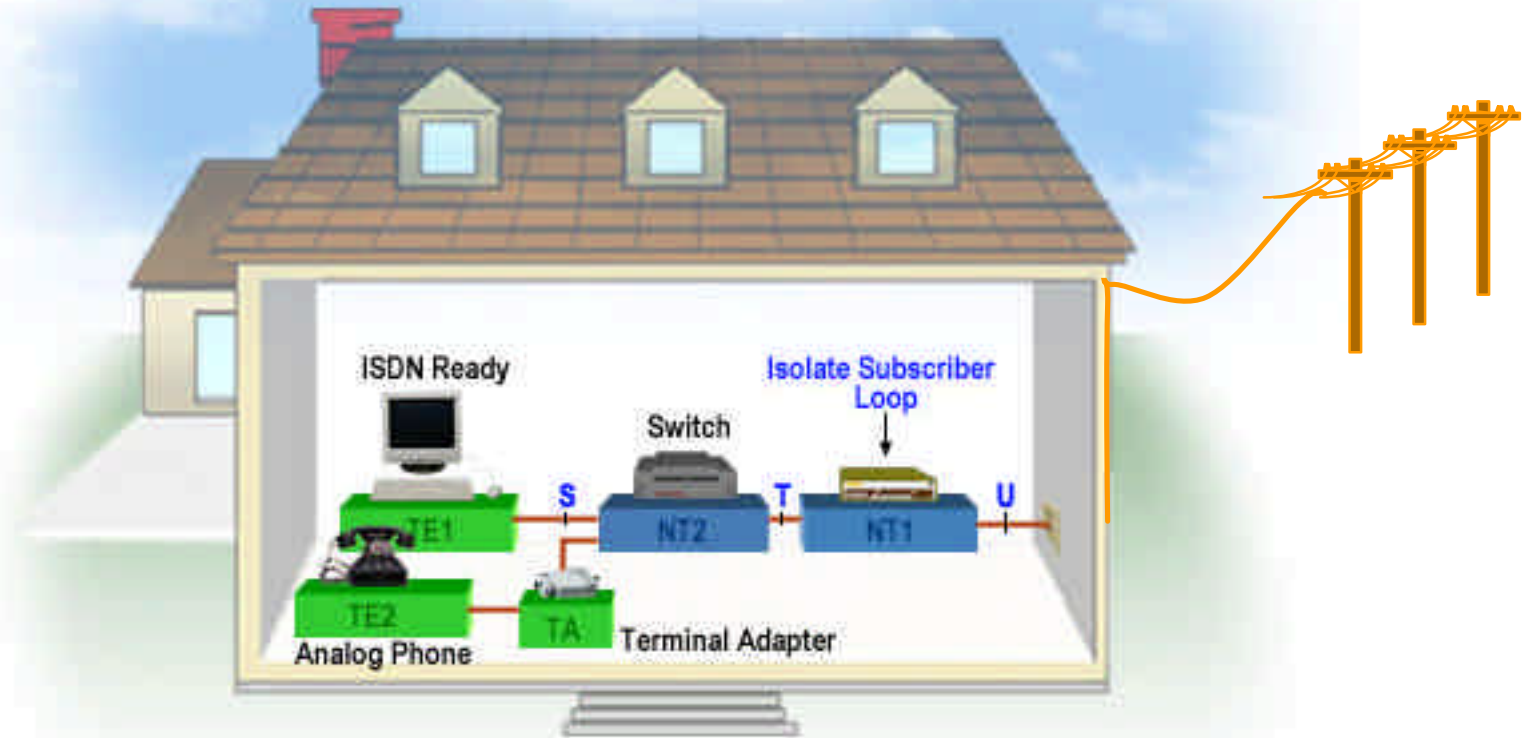


ISDN Modems

ISDN Overview



Understanding ISDN Equipment



Terminal Equipment (TE1) - ISDN ready
Terminal Equipment (TE2) - Non ISDN
Terminal Adapter (TA) - Analog to ISDN

Network Terminator (NT1) - Subscriber Line Isolation
Network Terminator (NT2) - Network Switch (PBX)

ISDN

Integrated Digital Services Network

- ◆ High-speed, fully digital telephone service
 - Upgrades today's analog telephone network to a digital system
- ◆ Can operate at speeds up to 144Kbps
 - 5 or more times faster than today's analog modems
 - Dramatic speed up of information transfer over the Internet or over a remote LAN connection
 - Rich media like graphics, audio, video or other applications
- ◆ Widely available

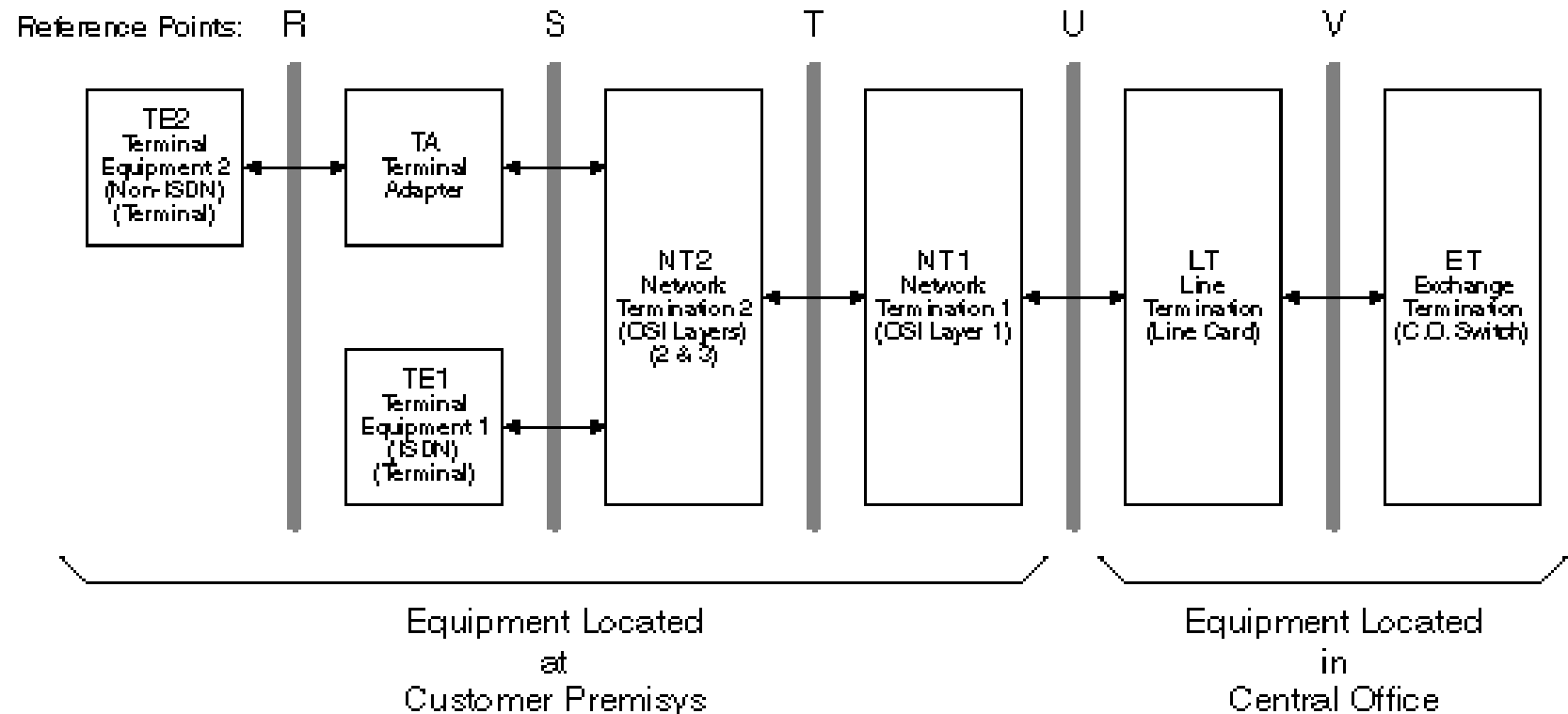
ISDN

- ◆ The Original Digital Service
 - Technology was defined in the mid-80s
- ◆ Uses circuit switched technology to support
 - D (Delta) channels are used for signaling
 - Data is transported over 64 Kbps B (Bearer) channels
 - Channels may carry voice, packet data, video

Two Major Variants

- ◆ BRI (Basic Rate Interface)
 - Targeted at home and small business users
 - Provides 2 B channels over a single twisted pair
- ◆ PRI (Primary Rate Interface)
 - Targeted at larger corporate customers
 - Provides 23 B channels over T1 in North America
 - Provides 30 B channels over E1 in Europe

ISDN Model



isdwhb1

Functional Groupings

- ◆ TE2 (Terminal Equipment 2)
 - Non-ISDN equipment such as personal computers
- ◆ TA (Terminal Adapter)
 - Interfaces non-ISDN equipment to the ISDN
- ◆ TE1 (Terminal Equipment 1)
 - ISDN terminal equipment such as ISDN phones
- ◆ NT1 (Network Termination Equipment, Layer 1)
 - Terminates the ISDN network connection at the physical layer
- ◆ NT2 (Network Termination Equipment, Layer 2)
 - Terminates the ISDN network connection at the data link layer

Reference Points

- ◆ R (Rate) Reference Point
 - Non-ISDN interface between non-ISDN user equipment and terminal adapter
- ◆ S (System) Reference Point
 - Interface between Terminal Adapters (TA) or terminal and Network termination
- ◆ T (Terminal) Reference Point
 - Interface between Network Termination (NT) equipment
- ◆ U (User) Reference Point
 - Interface between customer and central office

U Reference Point

- ◆ Connects subscriber to Central Office (CO)
- ◆ Point to point connection with a 5.5 km maximum distance
- ◆ 2 wire interface
- ◆ 2B1Q line coding
 - 2B1Q in North America
 - 4B3T in Europe
- ◆ Adaptive equalization, echo cancellation
- ◆ Data is scrambled
 - Improve clock recovery & spectral characteristics

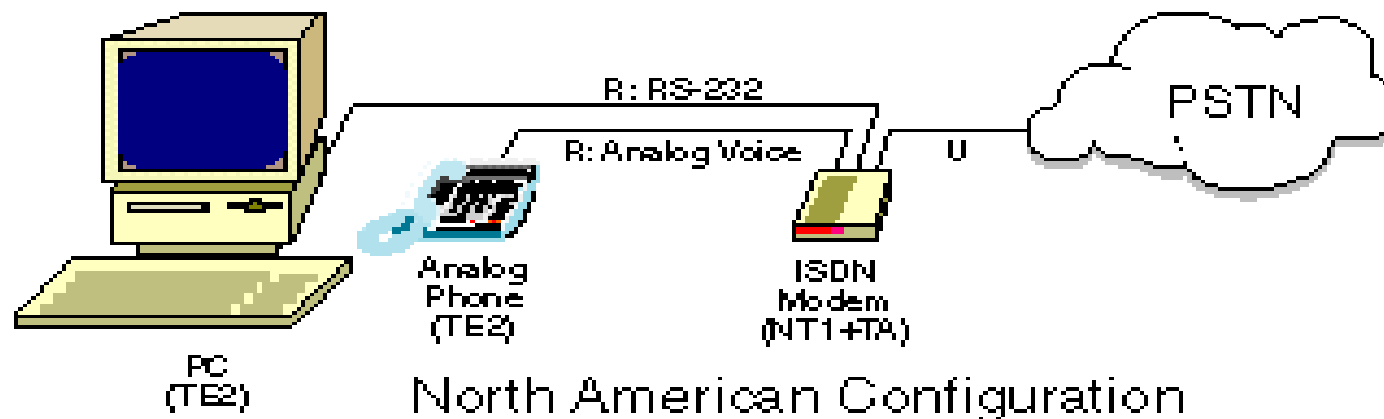
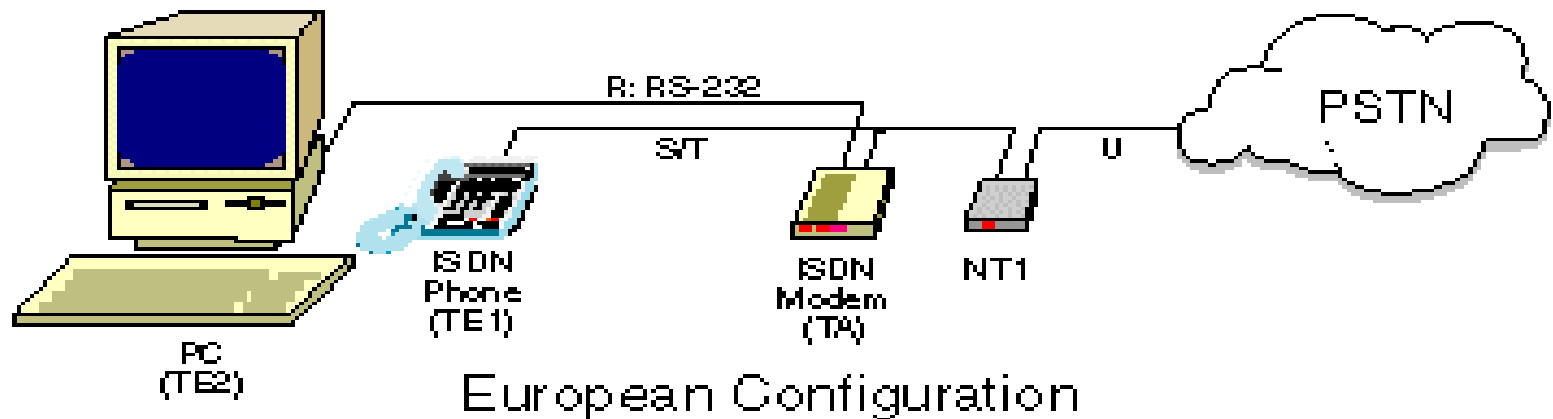
S/T Interface

- ◆ Interconnects customer premises equipment (CPE)
- ◆ Bus topology
- ◆ 4 wire interface
- ◆ 1 km maximum distance
- ◆ Alternate Space Inversion (ASI) line coding

Proprietary TDM interfaces

- ◆ Used to connect ISDN devices inside equipment
- ◆ 4 to 7 wire interfaces
 - Clock
 - Data In
 - Data Out
 - Start of frame indicator
- ◆ Several versions defined by ASSP vendors
 - CHI (Concentration Highway Interface): Lucent
 - IOM-2 (ISDN Oriented Modular Interface): Infineon, AMD
 - IDL (Inter-chip Digital Link): Motorola

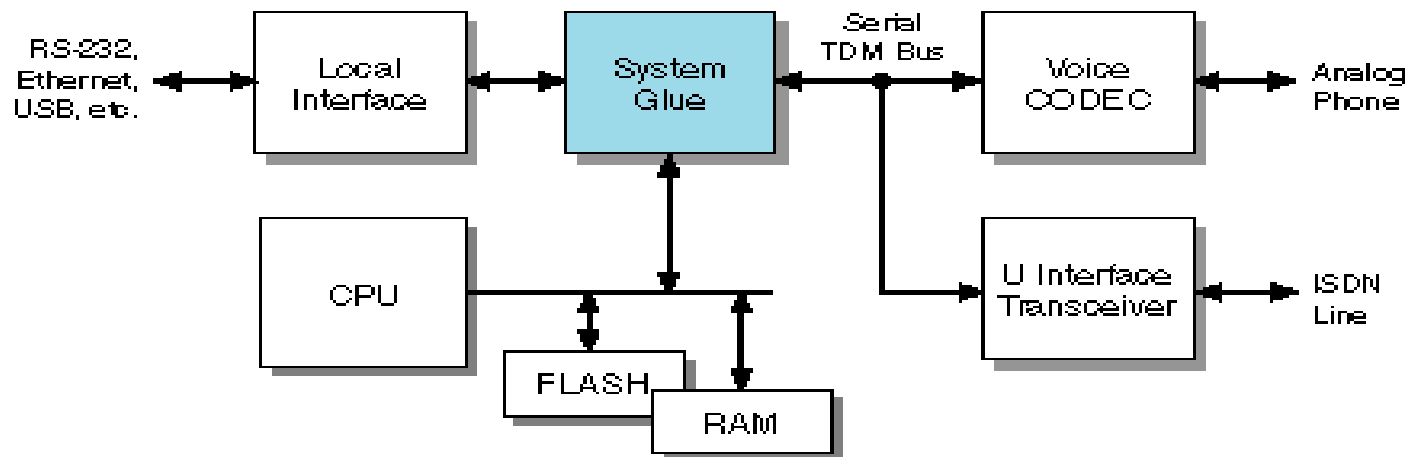
ISDN In the Real World



isdnwhb2

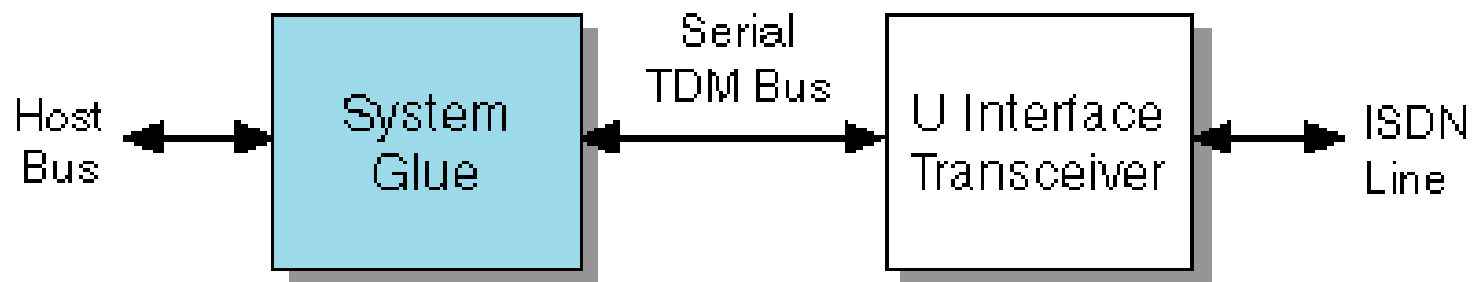
External ISDN Modem

- ◆ Includes processor for protocol processing
- ◆ Optional POTS interface
- ◆ System glue
 - Interface glue for ASSPs
 - ISDN TA functions



Internal ISDN Modem

- ◆ Uses host for protocol processing
- ◆ Voice features use host's sound card
- ◆ System glue
 - Host bus interface
 - ISDN TA functions



isdnwht4

Always On ISDN

- ◆ Provides continuous Internet connectivity
- ◆ Forwards IP traffic over the D channel
 - 16 kbps bandwidth
 - X.25 encapsulation
- ◆ Requires support from
 - ISP
 - Phone company
 - Hardware (modem/router)

IDSL

- ◆ IDSL = ISDN Digital Subscriber Loop
- ◆ Developed by Ascend
- ◆ Uses ISDN transport
 - 2B+D - 144 kbps
 - Static connections, no signaling
- ◆ Does not support ISDN voice calls
 - Requires VoIP instead

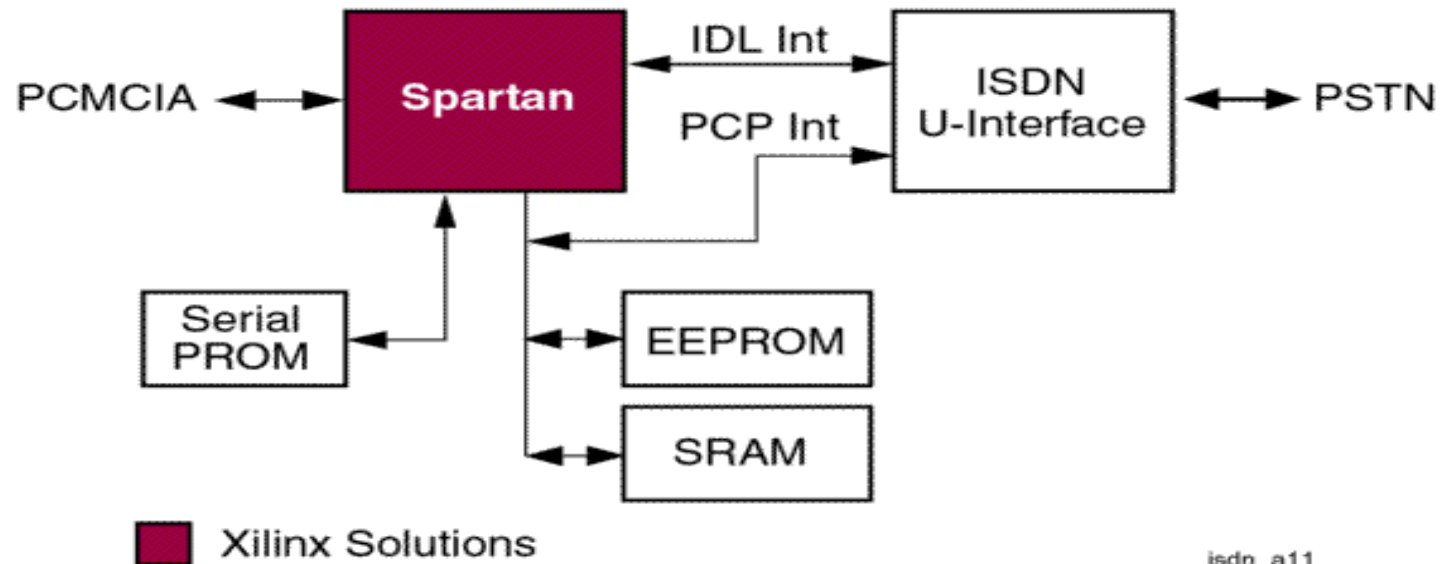
ASSP Providers

Supplier	Device	Function
Motorola	MC145572	U-Interface Transceiver
	MC145574	S/T-Interface Transceiver
	MC145575	Passive ISDN Terminal Adapter
	MC145576	Single-Chip NT1
AMD	Am79C30A/32A	Digital Subscriber Controller
Lucent	T7234	Single-Chip NT1
	T7256	Single-Chip NT1 with Microprocessor and TDM Interface
	T7237	U-Interface 2B1Q Transceiver
	T9000/T9001	ISDN Network Termination Node (NTN) Devices
	T7250	S/T-Interface with HDLC
National	TP3410	U-Interface Transceiver
	TP3420A	S/T Interface Device
Infineon	PEB 2091	U-Interface Transceiver
	PEB 2086	S/T Interface Device
	PEB 8090	Single-Chip NT1
	PEB 8191	Single-Chip NT1 with Microprocessor and TDM Interface
Yamaha	YTD423	HDLC with Microprocessor Interface
	YTD421	S/T Interface Device
Asahi Kasei	AK520S	Single-Chip NT1

Design Example: ISDN PCMCIA Modem

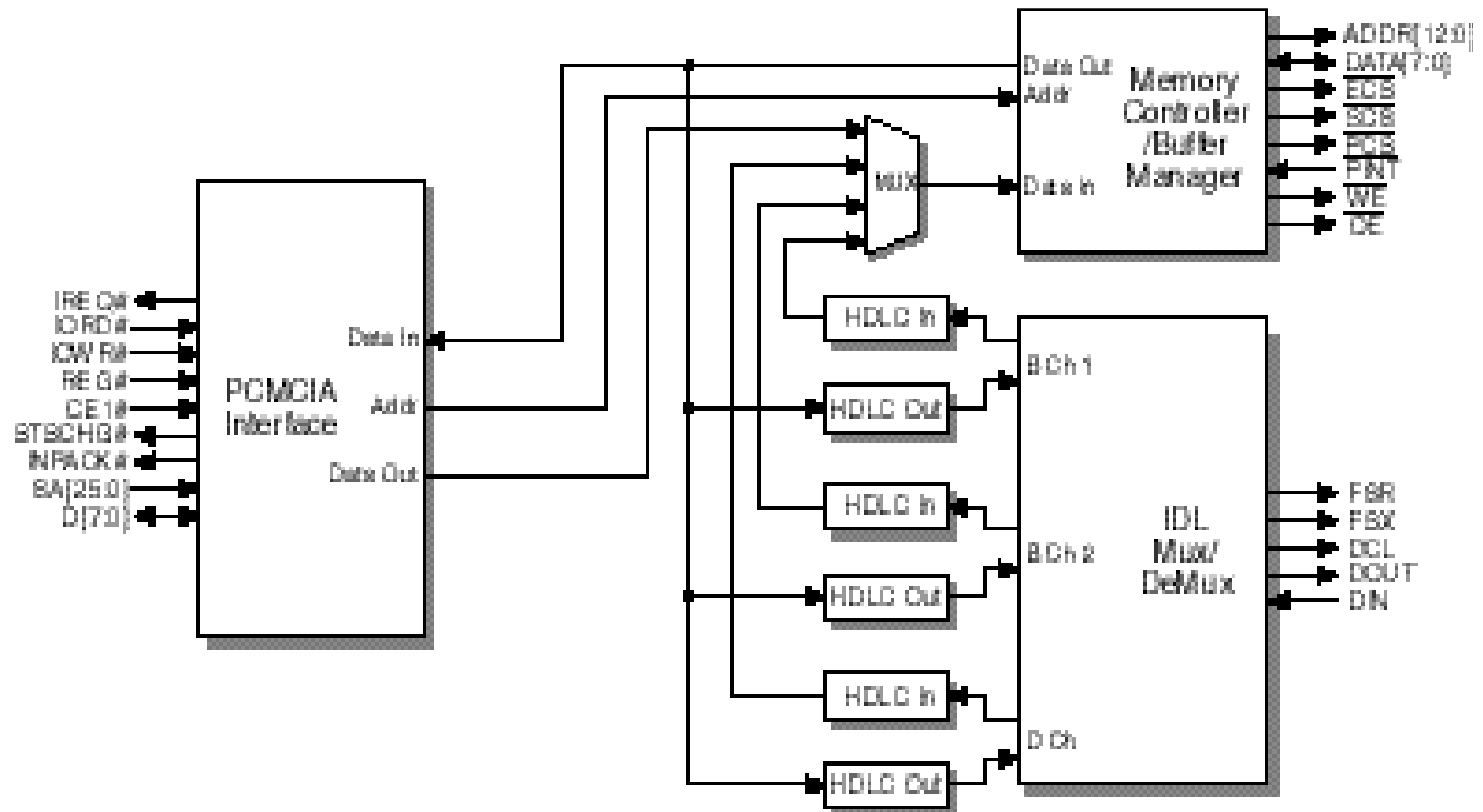
- ◆ Design objectives
 - Lowest possible total product cost
 - Target < \$30 for complete solution
 - Fastest time-to-market solution
 - Use available intellectual property as possible
 - PCMCIA core - Mobile Media Research, Xilinx Alliance Partner
- ◆ Spartan/XC9500 support solution
 - Spartan FPGAs implement system glue functions & PCMCIA interface
 - XC9500 manages memory interface
 - Spartan/XC9500 very cost effective

ISDN PCMCIA Modem

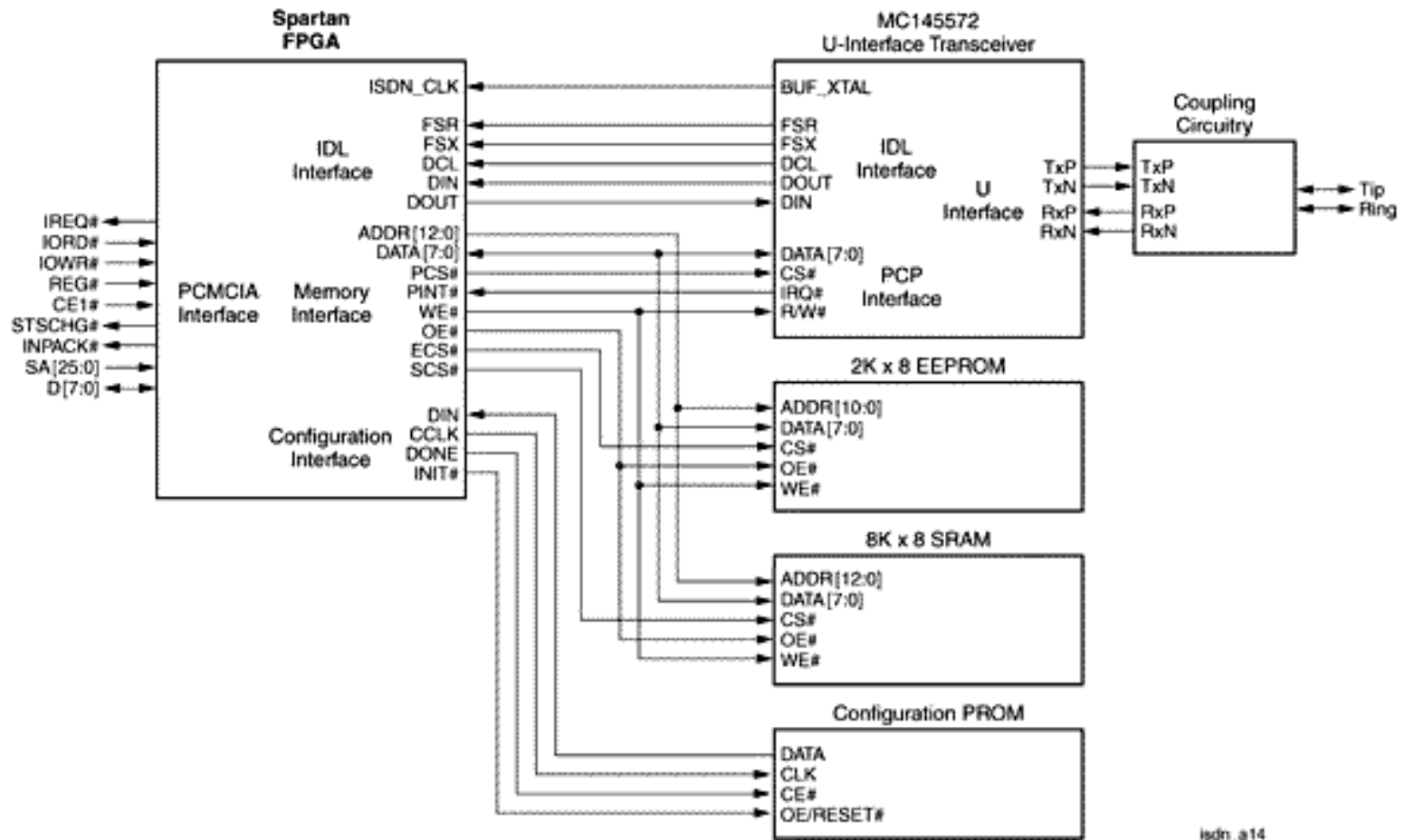


- ◆ PCMCIA - standard PC laptop interface
 - Implemented using IP core
- ◆ Requires system glue
 - Motorola MC145572 U transceiver to PCMCIA interface
- ◆ Memory control in CPLD

ISDN PCMCIA FPGA



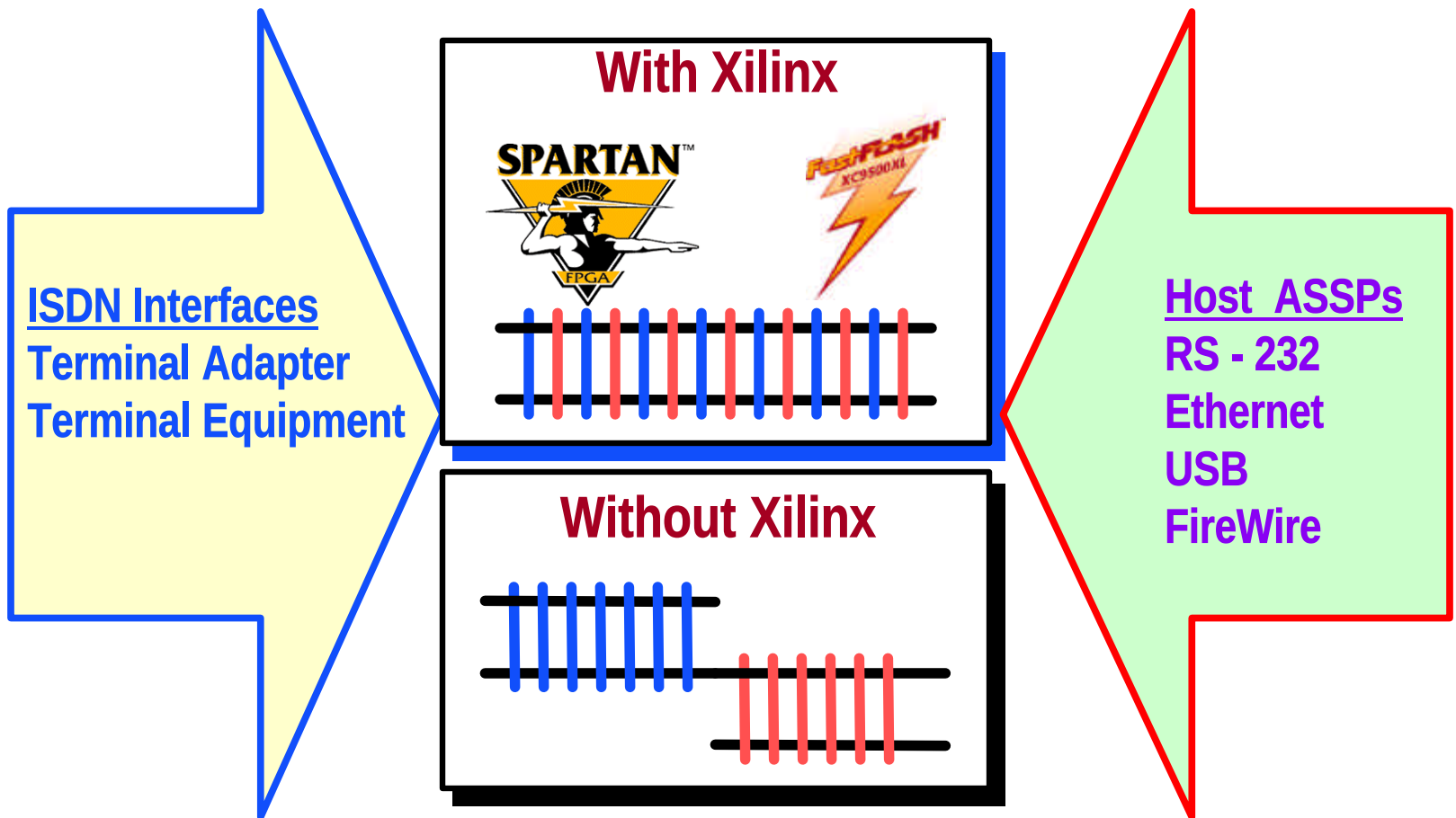
ISDN PCMCIA FPGA Block Diagram



Spartan Functionality

ASSP	Manufacturer / Part Number	Spartan System Glue - Functions
ISDN U-Interface Transceiver	Motorola MC145572	Handshaking ASSP Interface IDL Data Multiplexing IDL Data Demultiplexing
Host: PCMCIA	Xilinx XCS40XL-4VQ100C & Mobile Media Research (PCMCIA IP Core)	PCMCIA Interface Functions Function Control Register Files
CPU	Philips 8051 Microcontroller	System Initialization Functions

Xilinx - The Super Glue of System Logic



ISDN Summary

- ◆ Perfect match for use in ISDN modems
 - Faster Time-To-Market with programmable logic
 - Easily integrates system logic functions
 - Interface, control, decode, state machines, etc.
 - Extremely cost effective
- ◆ Customer benefits using Xilinx in ISDN modems
 - Most efficient way to integrate standard ASSPs
 - Hits both price & performance targets
 - Speeds Time-To-Market (TTM)
 - Maximizes new product revenue
 - “Off-the-shelf” IP further accelerates TTM
 - Provides total IC / Software / IP solution