

# INTERNET AND PSTN ARCHITECTURES

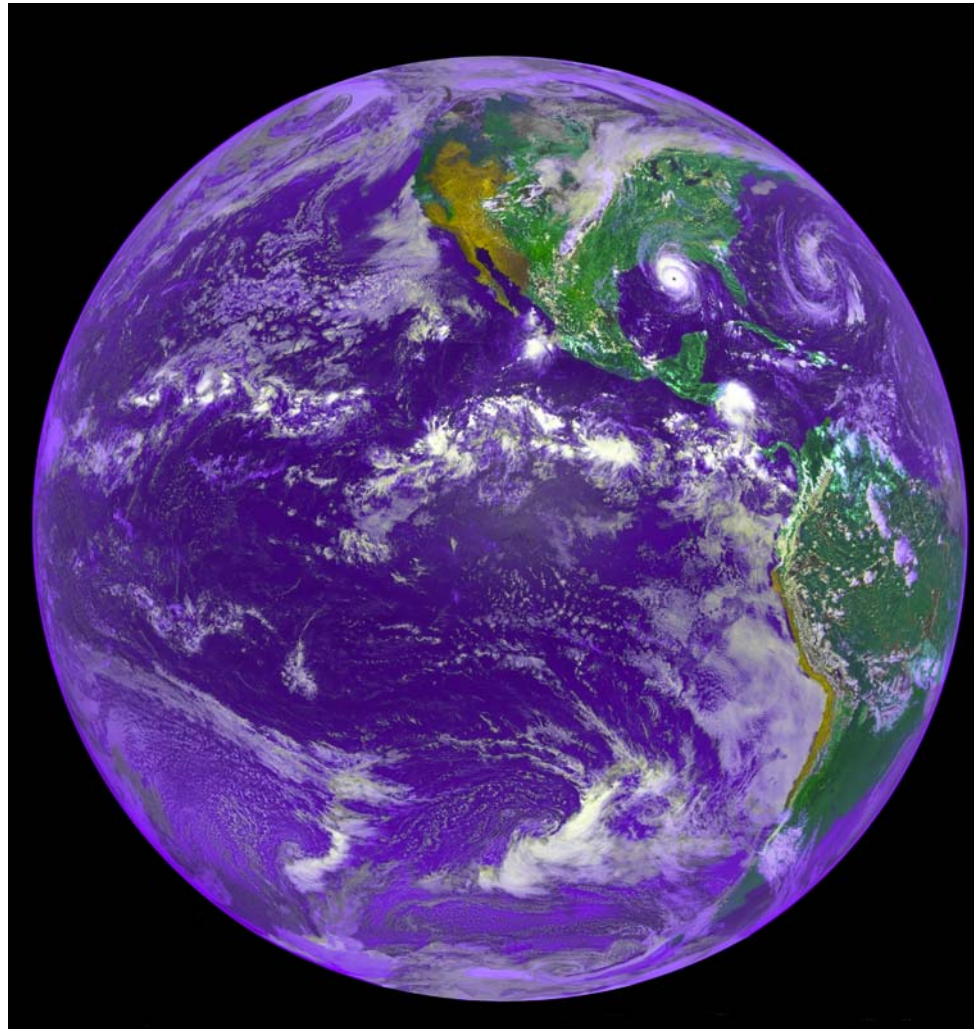
Notes prepared for EEDG/CE 6345

by

Professor Cyrus D. Cantrell, P.E.

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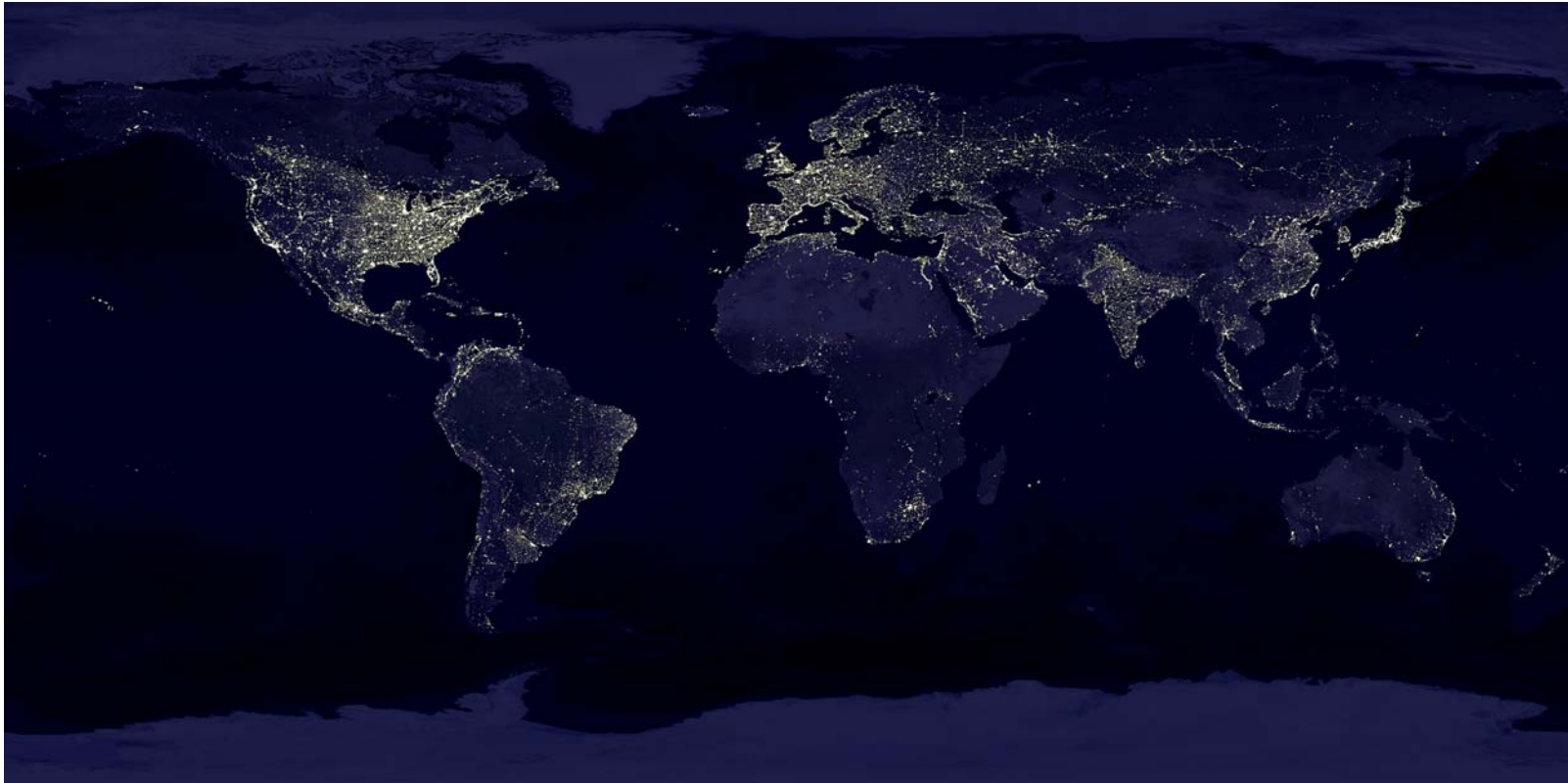
## A PLANETARY-SCALE DIGITAL SYSTEM



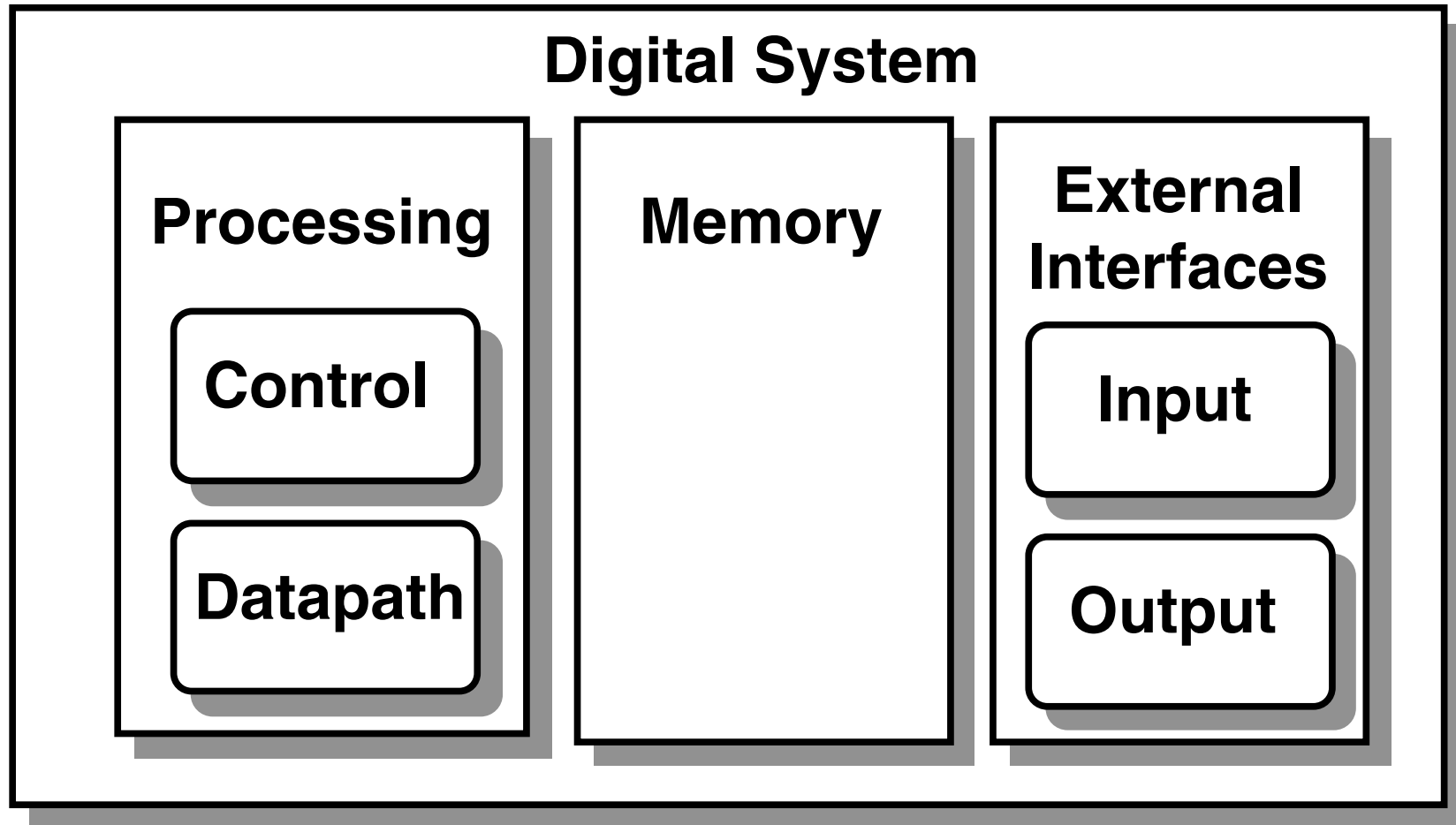
## A PLANETARY-SCALE DIGITAL SYSTEM

- A visitor from space would be able to conclude that a planetary-scale digital system exists on Earth without descending to the surface
  - ▷ Waveforms of satellite communications signals indicate digital modulation (mostly phase-shift keying (PSK) and quadrature amplitude modulation (QAM))
  - ▷ Wide geographical distribution of uplinks to satellites
- The major components of this planetary-scale digital system are the Internet and the public switched telephone network (PSTN)
  - ▷ EE 6345 surveys the digital architectures of the Internet and the PSTN
    - Functional units
    - How they talk to one another
    - Hardware/software interface

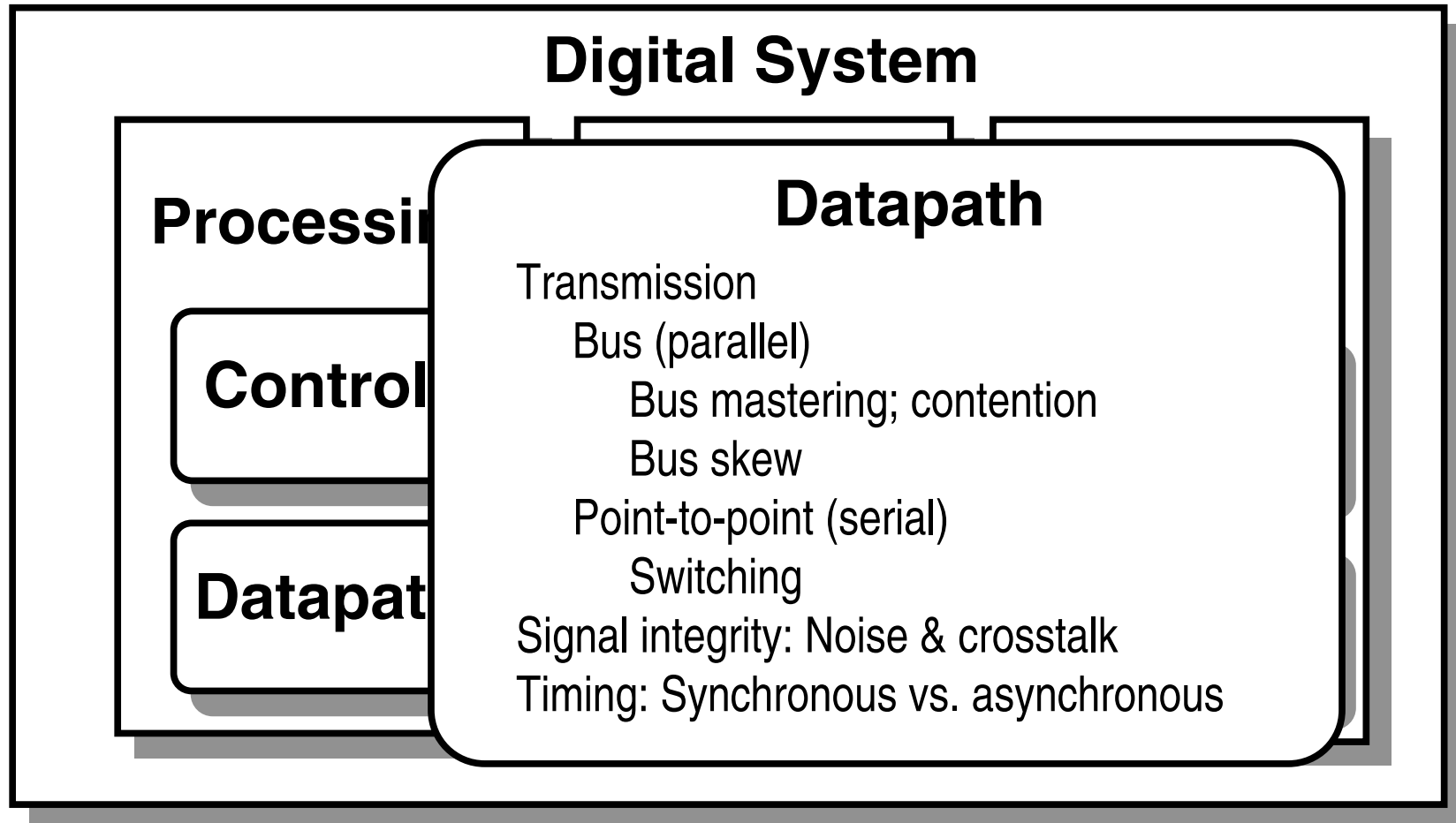
## INDICATORS OF THE POWER GRID



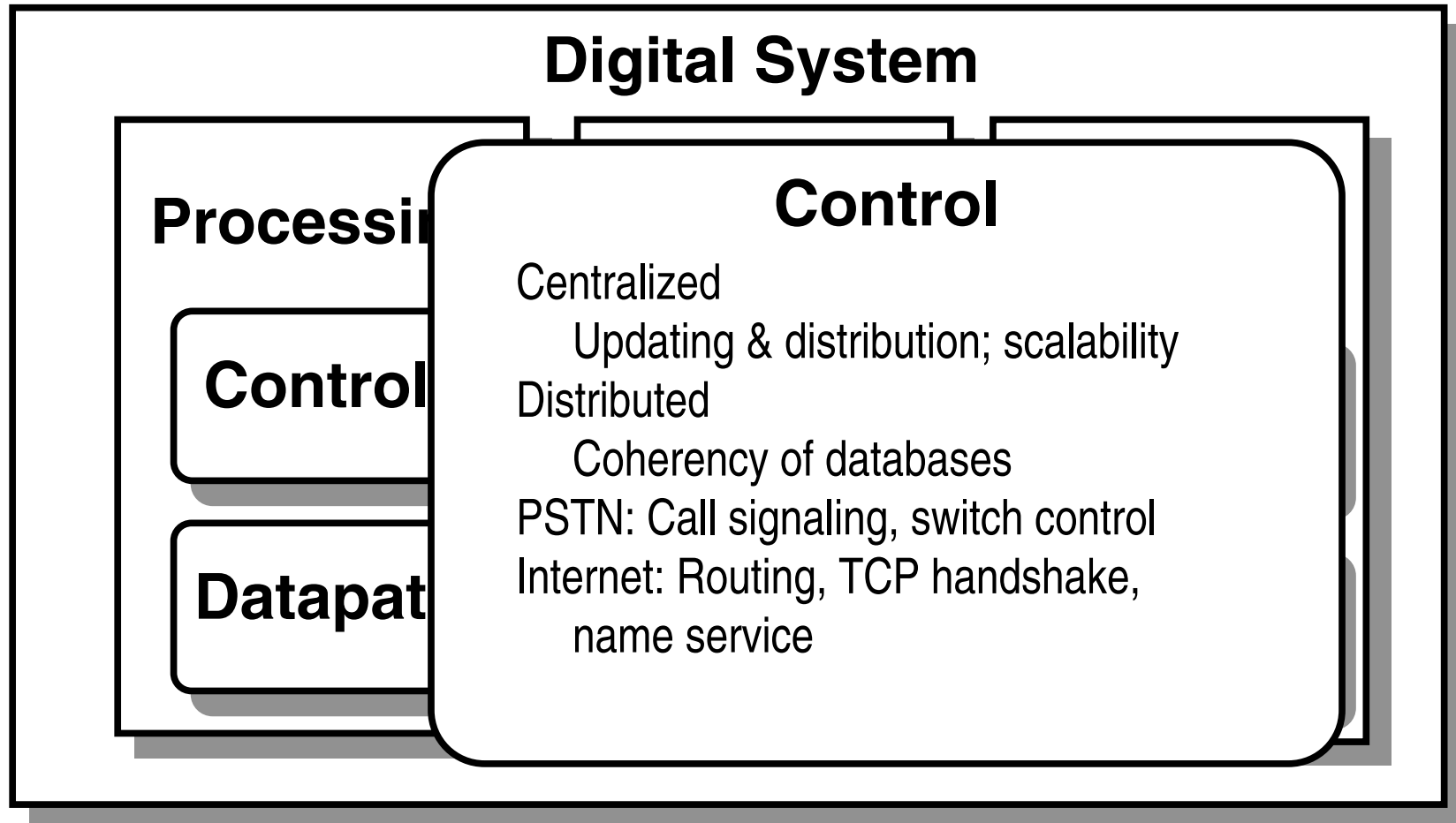
## ARCHITECTURAL COMPONENTS



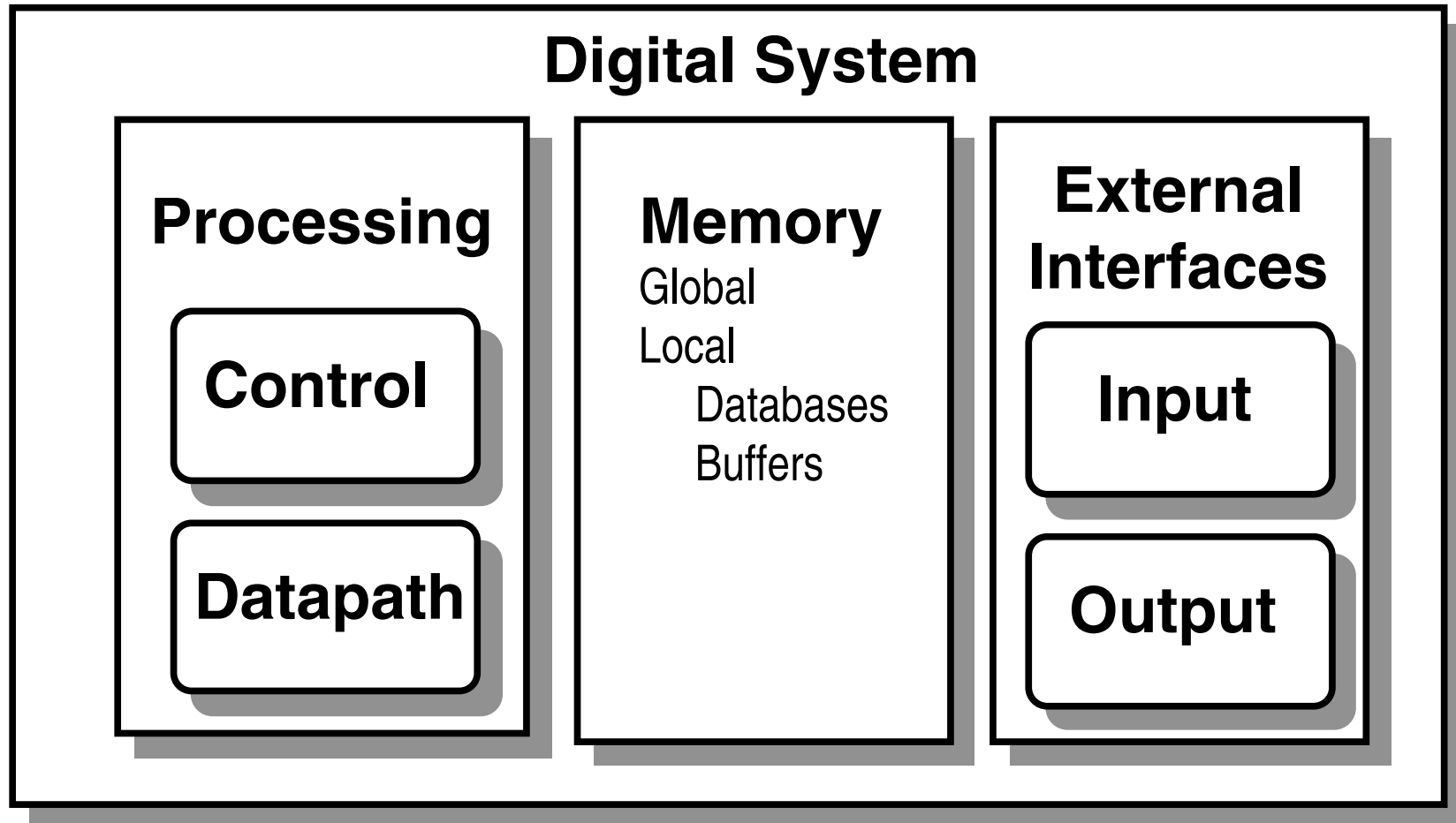
## ARCHITECTURAL COMPONENTS



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## THE ELECTRICAL TELEGRAPH SYSTEM

- The first planetary-scale digital system
  - ▷ First international telecommunications agreement: 1865
- Datapath:
  - ▷ Telegraph wires (unshielded pairs or twisted pairs)
  - ▷ Telegraph keys, batteries
  - ▷ Digital encoding: **Morse code**
  - ▷ Network topology: A mesh of point-to-point links
  - ▷ Access network: Handwritten notes (input); postal system (output)
- Control: Manual!
  - ▷ Messages stored (manually transcribed) and forwarded
  - ▷ Message routing: Outgoing line; postal addresses for final destinations
  - ▷ I/O: Human message submission from origin and human delivery to end destination

# Morse Code Alphabet

The International morse code characters are:

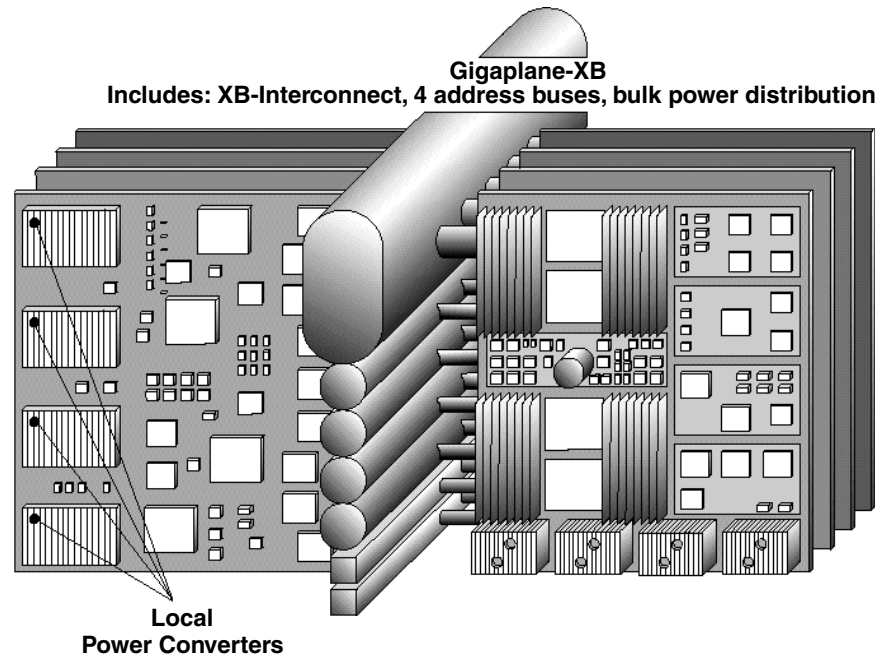
A	. -	N	- .	0	- - - - -
B	- . . .	O	- - -	1	. - - - -
C	- . - .	P	. - - .	2	. . - - -
D	- . .	Q	- - . -	3	. . . - -
E	.	R	. - .	4	. . . . -
F	. . - .	S	. . .	5	. . . . .
G	- - .	T	-	6	- . . . .
H	. . . .	U	. . -	7	- - . . .
I	. .	V	. . . -	8	- - - . .
J	. - - -	W	. - -	9	- - - - .
K	- . -	X	- . . -	Fullstop	. - . - . -
L	. - . .	Y	- . - -	Comma	- - . . - -
M	- -	Z	- - . .	Query	. . - - . .

## PACKET NETWORKS FOR DIGITAL-SYSTEMS MAJORS

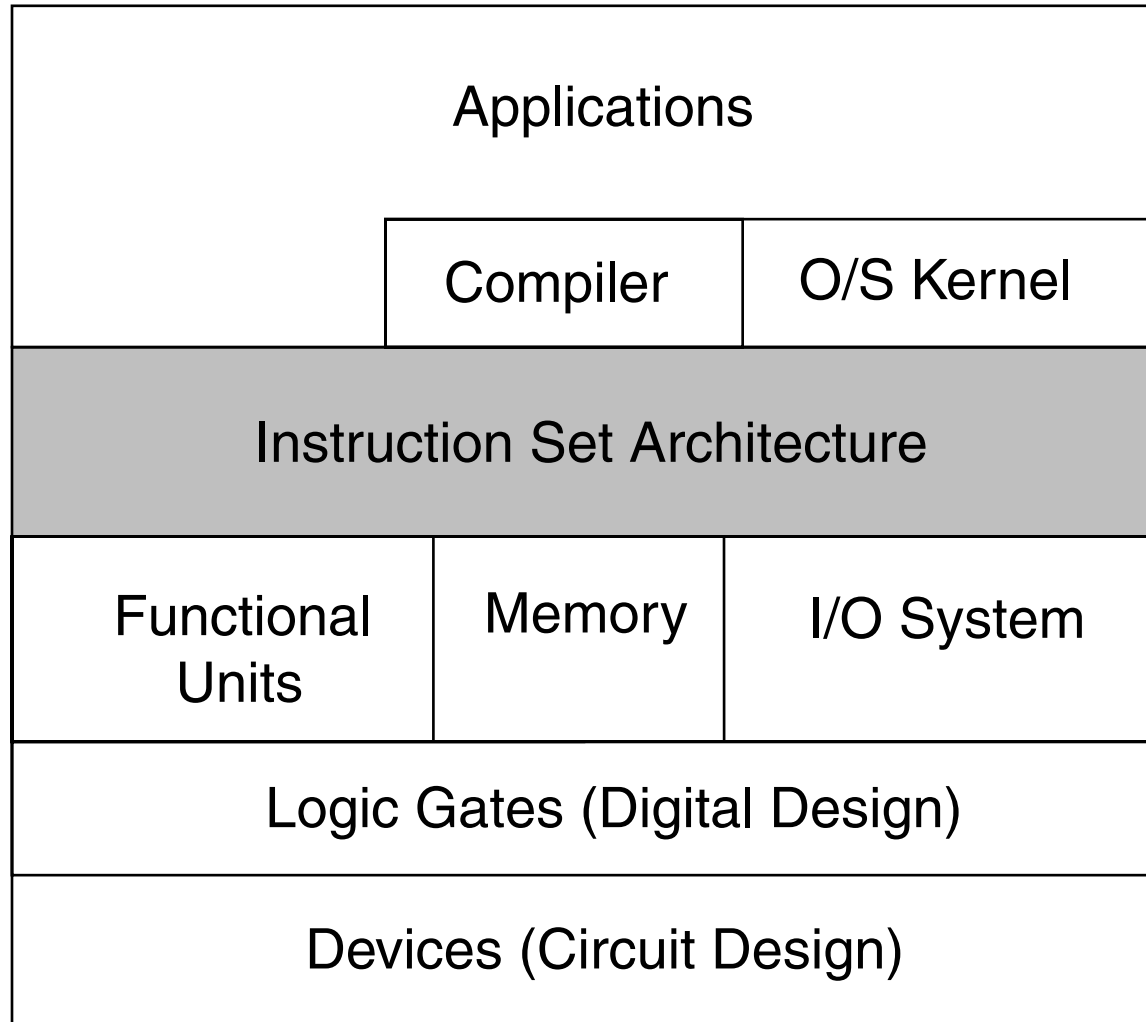
- Networks are a major application area for digital design and technology
  - ▷ Network processors
  - ▷ Communication controller ICs
  - ▷ Encryption/decryption
  - ▷ Data compression
  - ▷ DSP
- Multiprocessor computer systems use some networking technologies
  - ▷ Packet communication
  - ▷ Digital switching
- Consumer electronics makes heavy use of networks
  - ▷ VOIP, IEEE 1394, IEEE 802.x, ...

# EXAMPLE: NETWORK TECHNOLOGY IN A DIGITAL SYSTEM

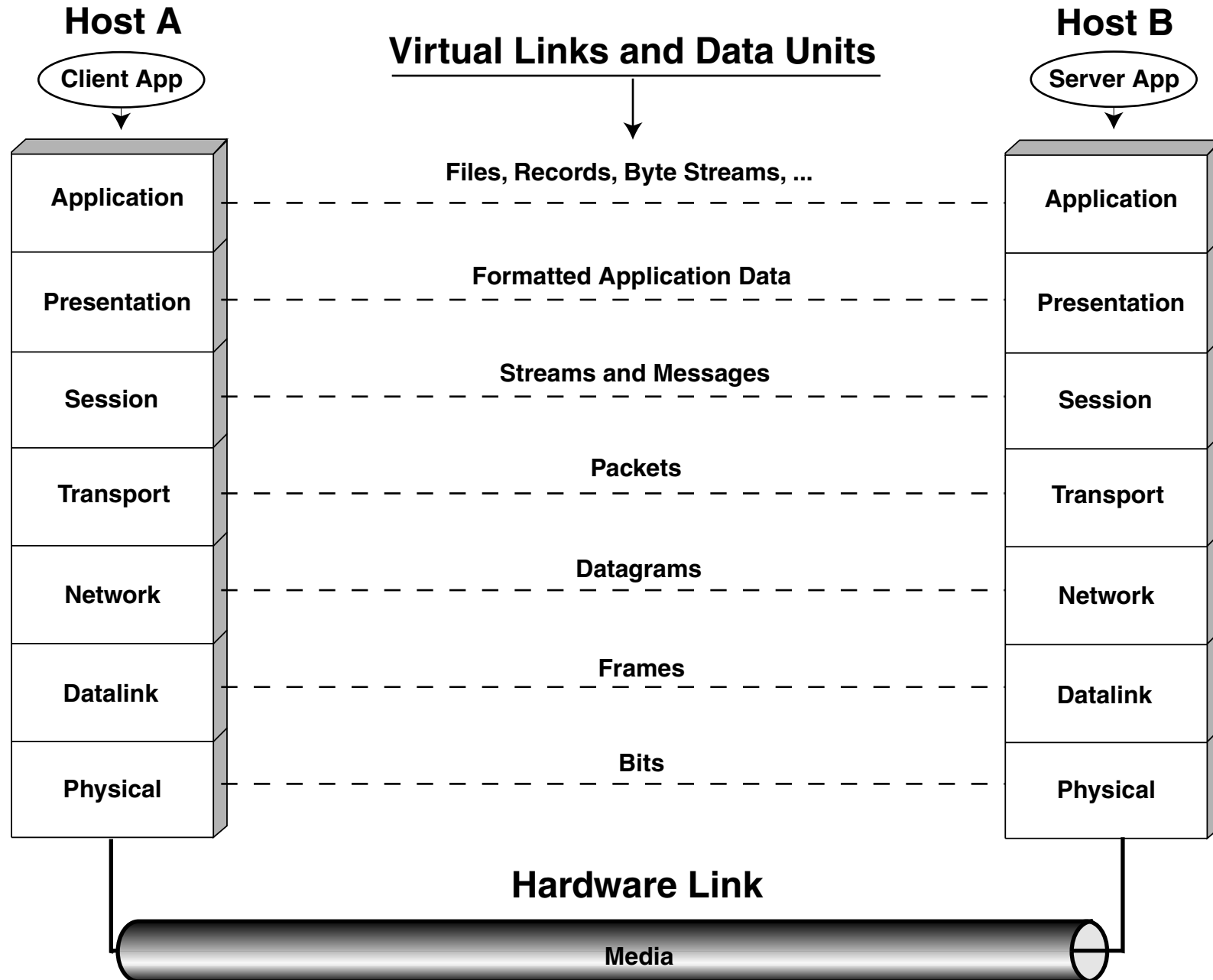
## Sun E10000 System Boards and 16x16 Crossbar Interconnect



## WHAT IS “COMPUTER ARCHITECTURE”?



# Peer-to-Peer Links in the OSI model



## REVIEW AND BACKGROUND

- Media layer: An overview of the physical basis of communications
- Physical layer: A review of digital communications

## THE PUBLIC SWITCHED TELEPHONE NETWORK

- The PSTN is the most widely-deployed digital network
  - ▷ Analog voice network (must understand for historical reasons)
  - ▷ The post-divestiture PSTN in the US
  - ▷ The circuit-switched digital network
    - Digital encoding of speech
    - North American Digital Hierarchy
    - SONET
    - The Synchronous Digital Hierarchy
    - Common channel signaling
    - ISDN
    - ATM
  - ▷ Standardization and regulation

## THE INTERNET

- The TCP/IP protocol stack
  - ▷ Media layer (0)
  - ▷ Physical layer (1)
    - Bit or symbol signaling
  - ▷ Datalink layer (2)
    - Framing
    - Media access control
  - ▷ Network layer (3)
  - ▷ Transport layer (4)
  - ▷ Application layer (5)

## OTHER NETWORKS

- Cable television
  - ▷ Current cable TV distribution is mostly analog
  - ▷ Other services offered in unused spectral regions
- Satellite television
  - ▷ Digital (MPEG-2 encoding)
  - ▷ Internet access in remote areas

## APPROACHES TO UNDERSTANDING NETWORKS

CS	SE	CE/TE	EE
Proof-based study of algorithms	Analysis and design of systems, components and devices		
Distributed computing systems	Software systems	Networks & telecom systems	Electrical & optical systems, components & devices
Protocols	Network programming	Network architecture	Network hardware