

# Data Communications and Networks

ITS323: Introduction to Data Communications  
CSS331: Fundamentals of Data Communications

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# What Is Data Communications?

- ▶ When we communicate we are sharing information
  - ▶ Local sharing, e.g. face-to-face
  - ▶ Remote sharing, e.g. over some distance
- ▶ Data: information being shared, e.g. text, numbers, images, audio, video
- ▶ Data Communications: exchange of data between two (or more) devices via some transmission medium

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## Analog and Digital Data

## Communication Systems

## Information and Applications

# Analog and Digital Data

**Data:** Entities that convey meaning or information

## Analog Data

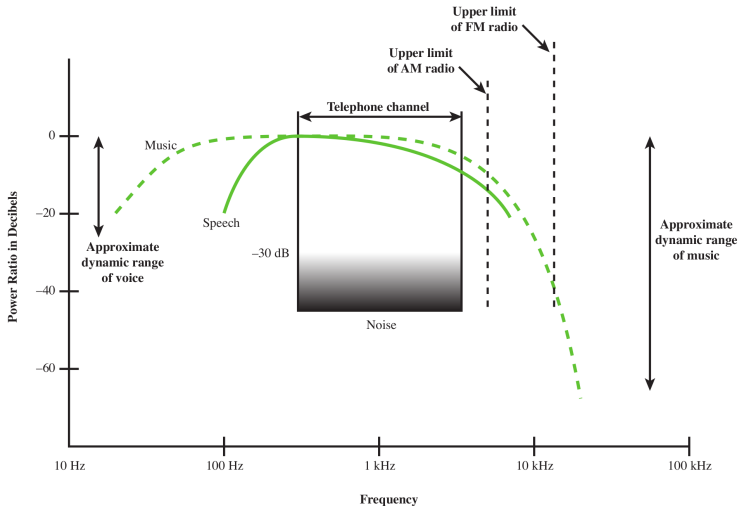
- ▶ Continuous varying over time
- ▶ voice, music, video, sensor data, photos . . .

## Digital Data

- ▶ Discrete values over time
- ▶ text, integers, digitized analog data
- ▶ Digitizing involves taking samples of analog data (discretization) and mapping those samples to numbers (quantization)

# Example of Analog Data: Audio

## Acoustic Spectrum of Speech and Music



# Example of Digital Data: Text

	First 3 bits							
	000	001	010	011	100	101	110	111
0000	NUL	DLE	SP	0	@	P	,	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EOT	DC4	\$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	,	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	-	o	DEL

Last 4 bits

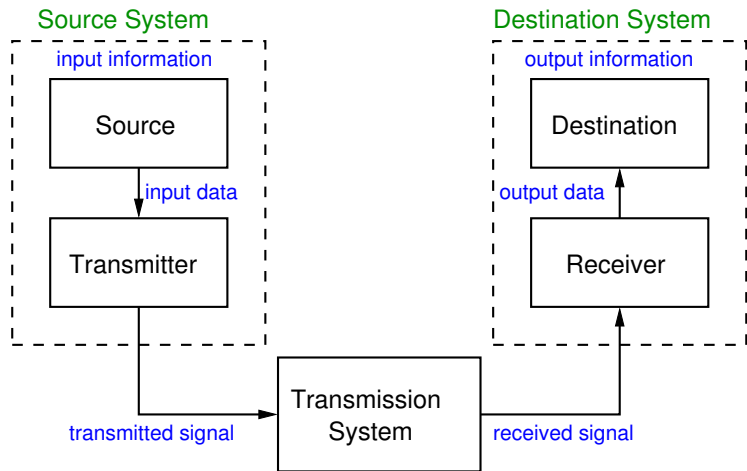
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# A Model of Communication Systems





# A Model of Communication Systems

**Aim:** transfer information from source to destination

**Source:** Device that generates data to be transmitted

**Transmitter:** Converts data from source into transmittable signals

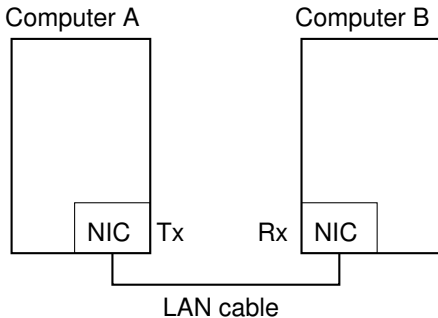
**Transmission system:** Carries data from source to destination

- ▶ Maybe simple as a single link/cable
- ▶ Or a complex network, e.g. the Internet

**Receiver:** Converts received signal into data

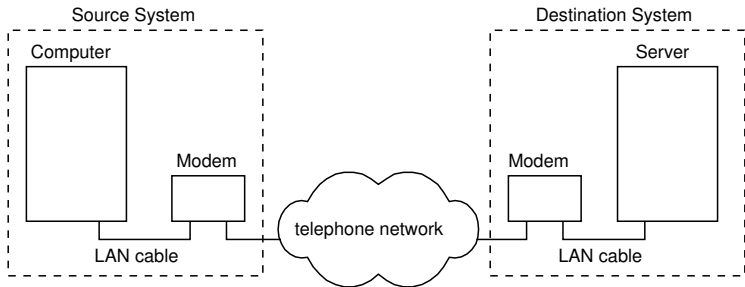
**Destination:** Takes and uses incoming data

# Example: Computer to Computer



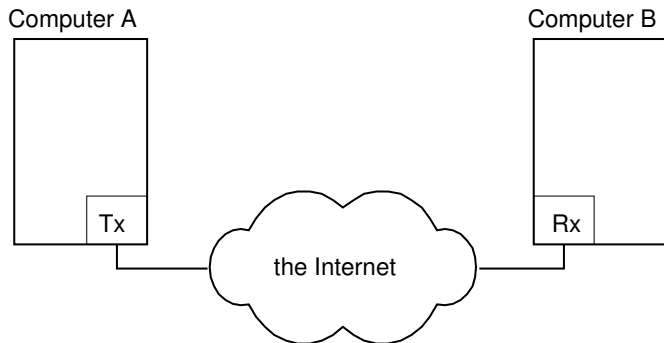
- ▶ Transmitter (Tx) is built into source computer (Network Interface Card)
- ▶ Receiver (Rx) is built into destination computer
- ▶ Transmission system is single link between two computers

# Example: Old Dialup Connection



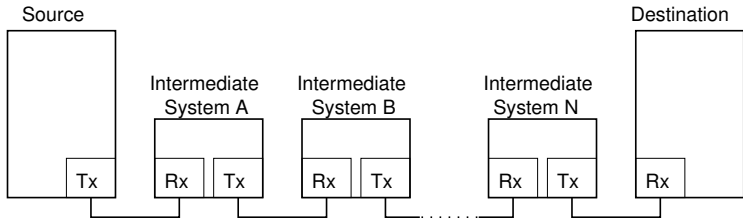
- ▶ Source and transmitter are separate devices (similar at destination)
- ▶ Transmission system is telephone network

## Example: Communications via the Internet



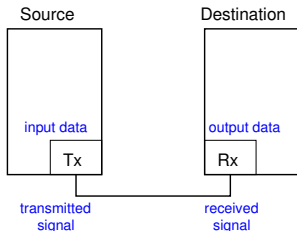
- ▶ Source and transmitter may support different technologies
- ▶ Transmission system is the Internet

# General Model for Communications via a Network



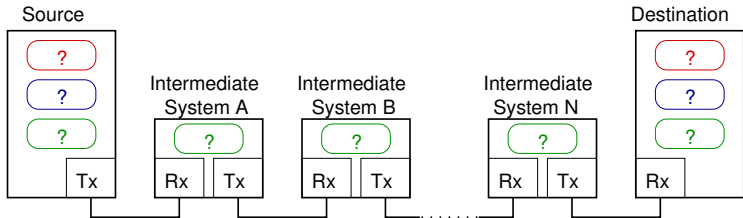
- ▶ Source system generates data
- ▶ Intermediate systems receive signal from previous system and then transmit to next system
- ▶ Destination system receives and processes the data
- ▶ Source and destination are connected via multiple transmission systems (or links) to form a network

# Challenges with Link Communications



- ▶ How to convert information into transmittable signals?
- ▶ What are the characteristics of signals?
- ▶ What transmission media to use?
- ▶ How to efficiently encode data as signals?
- ▶ How to know who is at other end?
- ▶ How to deal with errors?
- ▶ How to share media amongst two or more transmitters?

# Challenges with Networked Communications



- ▶ How do intermediate systems receive/send data?
- ▶ How to select which intermediate systems to send via?
- ▶ What happens if failures within intermediate systems?
- ▶ How to create applications without knowing the details of underlying network and technologies?

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## How big is a ...

- ▶ Web page?
- ▶ Email?
- ▶ Photo?
- ▶ Song?
- ▶ Audio CD?
- ▶ TV show?
- ▶ Movie?

# Classify Types of Information

Information may be in analog or (more commonly) digital form

- ▶ Audio: voice calls, radio, music
- ▶ Video: video conference, video streams
- ▶ Data:
  - ▶ Early: signalling, fax, SMS, ...
  - ▶ Internet: messaging (email, instant), web browsing, remote login, database, business-specific apps, monitoring and control systems, ...

# Effective Data Communications

**Delivery:** the data must be delivered to the correct destination

**Accuracy:** the data received must be accurate representation of the data sent

**Timeliness:** the data should be delivered within a reasonable time

# Types of Internet Applications

## Traditional Internet-Based Applications

- ▶ File transfer, email, web browsing, remote login, database
- ▶ Accuracy is most important

## Multimedia or Real-time Applications

- ▶ Audio/video streaming, voice/video calls, gaming, collaborations
- ▶ Timeliness is most important