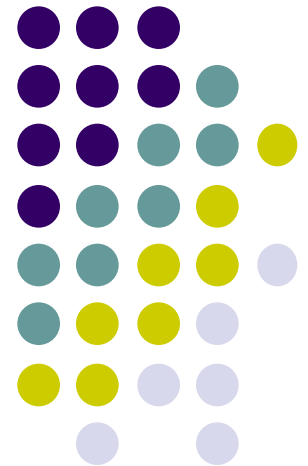


Digital Signal Processing (DSP)

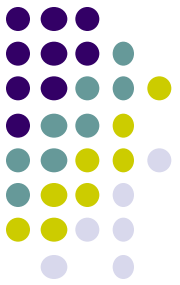




About me

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- Office: Room 618 E

Textbook



- Mitra S K, Digital Signal Processing: A Computer-Based Approach (Fourth Edition). McGraw-Hill, 2011.
- Teaching materials download:
dsp_dzm@163.com
password: 123456dsp



References

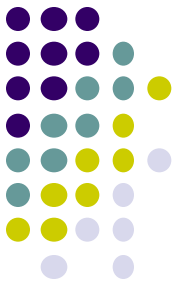
- Smith S W, Digital Signal Processing: A Practical Guide for Engineers and Scientists. Newnes, 2002.
- Vegte J V, Fundamentals of Digital Signal Processing. Prentice Hall, 2001.
- Proakis J G and Manolakis D G, Digital Signal Processing: Principles, Algorithms, and Applications (Third Edition). Prentice Hall, 1995.
- 程佩青,数字信号处理教程(第三版).清华大学出版社, 2007.
- 张德丰,详解MATLAB数字信号处理.电子工业出版社, 2010.

The Goals of this course



- Understanding of **basic concepts** of DSP
- Mastery of the **key terminologies**
- Ability of **simulating** digital signals and systems
- Matlab software, downloaded from:
<https://software.sysu.edu.cn/matlabhome>

Grade



- Attendance 10%
- Exercise 30%
- Project 60%



Introduction

Why signals should be processed?



- Signals are carriers of information
 - Useful and unwanted
 - Extracting, enhancing, storing and transmitting the useful information
- How signals are being processed?---
 - Analog Signal Processing vs.
 - Digital Signal Processing

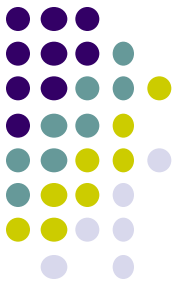


Digital Signal Processing

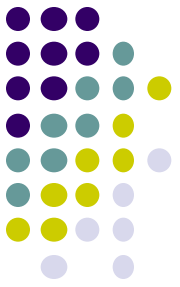
Theory, method, algorithm

Digital Signal Processor

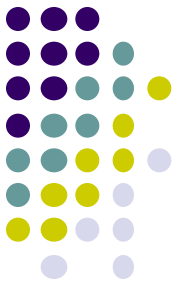
**A kind of microprocessor used to
implement digital signal
processing algorithm**



- ❖ **The foundation of information technology is digitalization.**
- ❖ **The kernel of digitalization is digital signal processing**
- ❖ **Most of digital signal processing, especially real-time processing are implemented by DSP processor or ASIC based on DSP core**
- ❖ **DSP technology becomes hot front edge and is growing up rapidly.**



About DSP



History of DSP

- The roots of DSP are in the 1960s and 1970s when digital computers first became available
- DSP was limited to only a few critical applications at first
- The personal computer revolution of the 1980s and 1990s caused DSP to explode with new applications



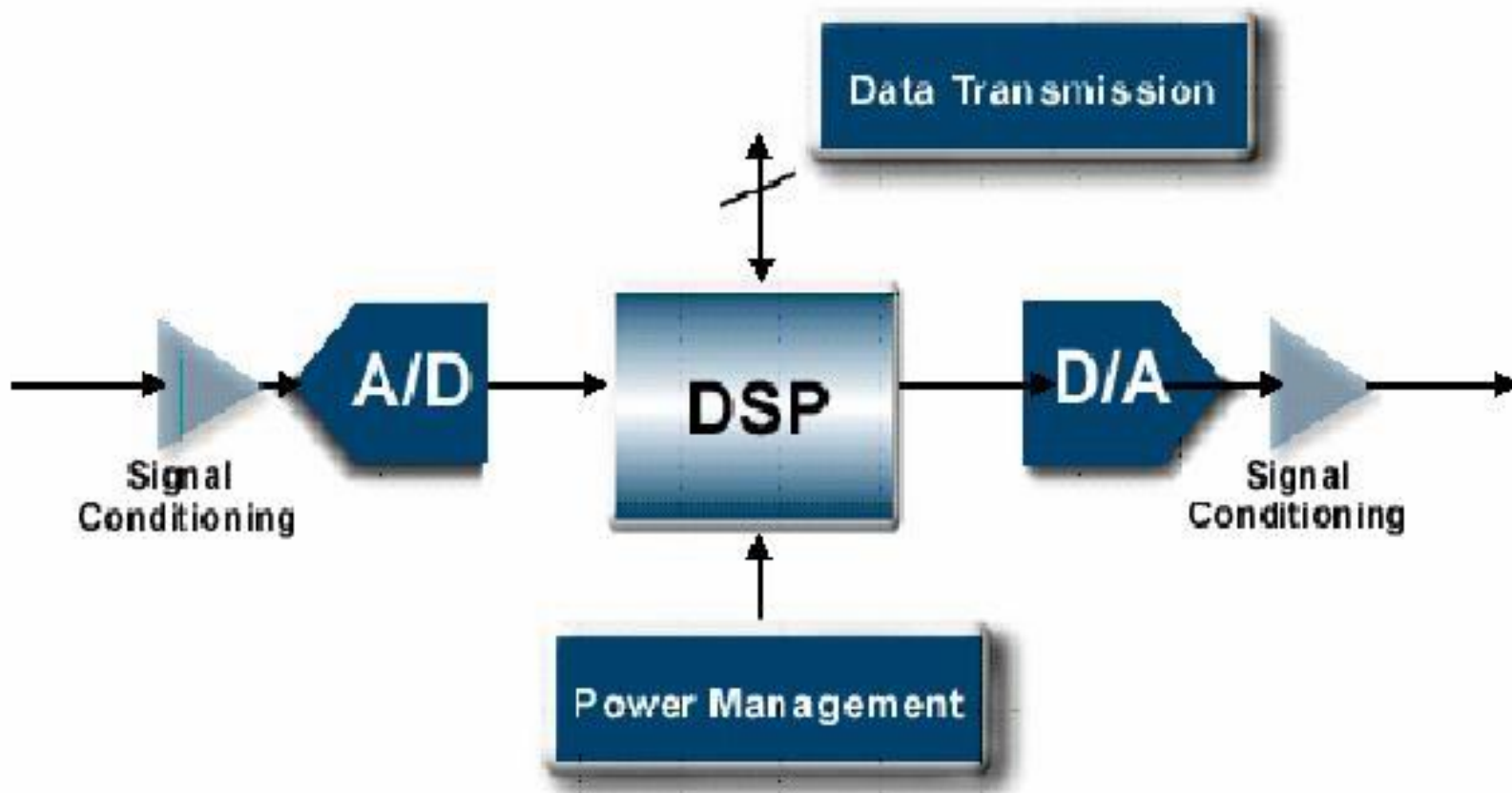
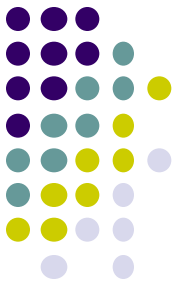
History of DSP (cont.)

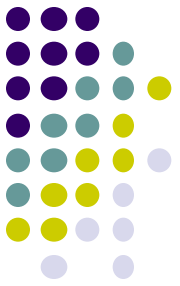
- In the early 1980s, DSP was taught as a graduate level course in electrical engineering
- A decade later, DSP had become a standard part of the undergraduate curriculum
- Today, DSP is a basic skill needed by scientists and engineers in many fields



Applications of DSP

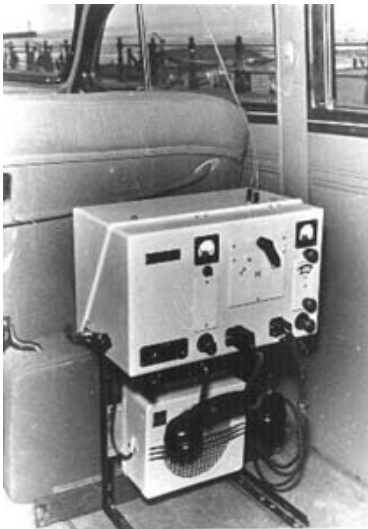
DSP Solution





Communication

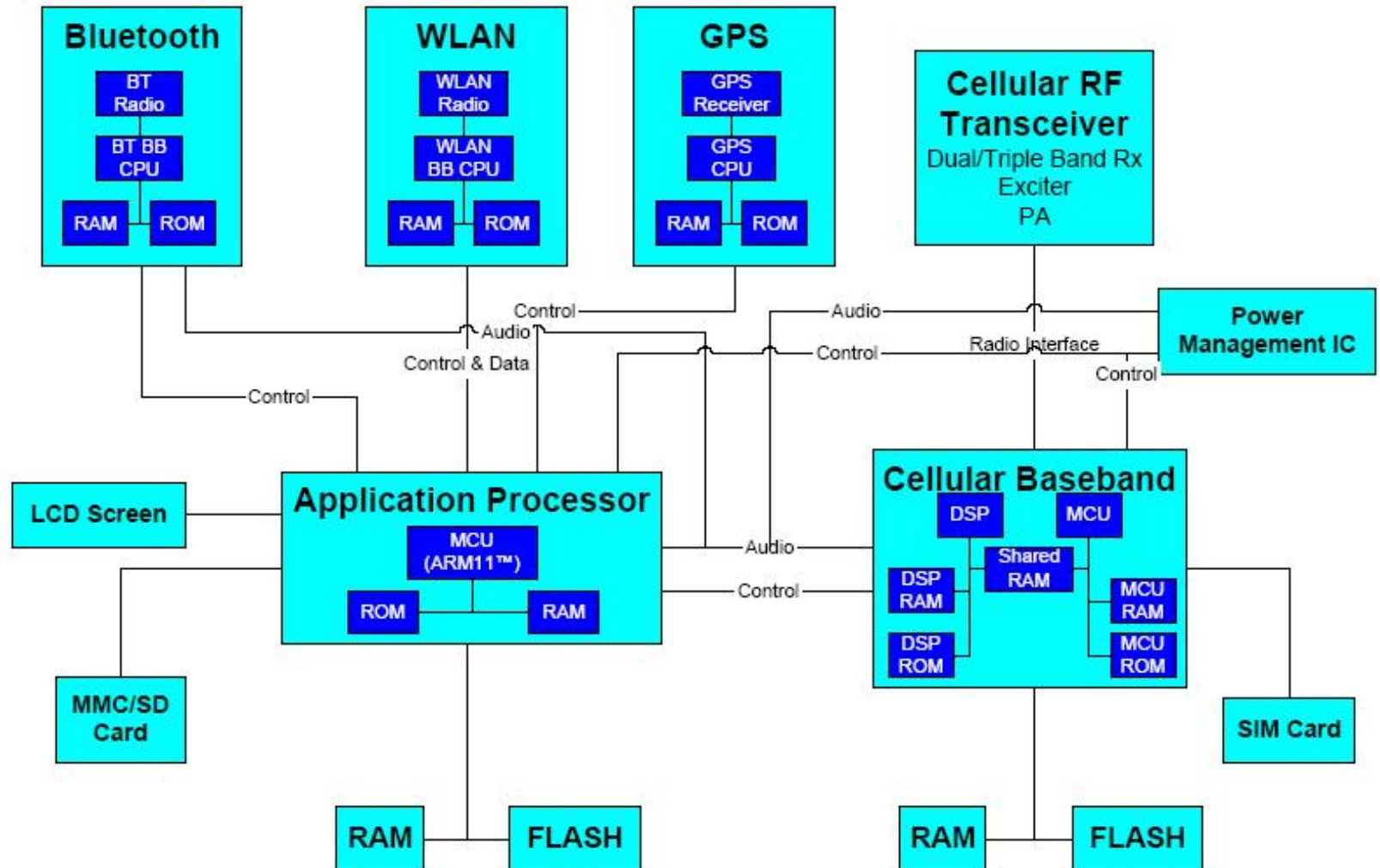
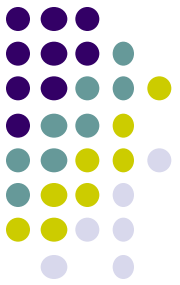
Analog Mobile Phones



Mobile phone



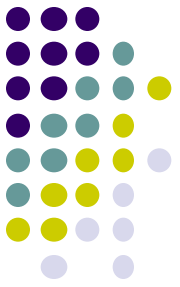
Current-Generation Smartphone Using Baseband IC with Application Processors



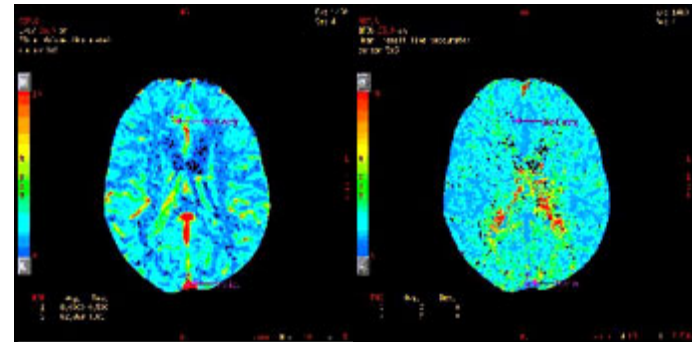
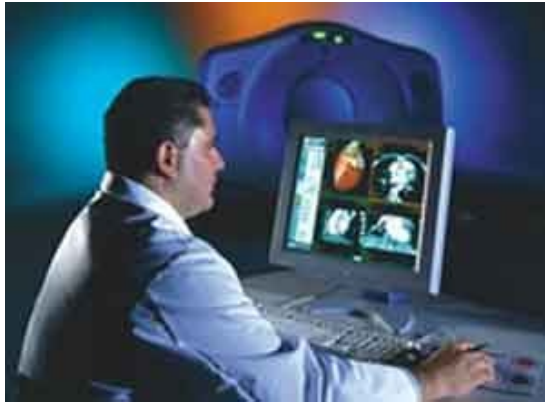
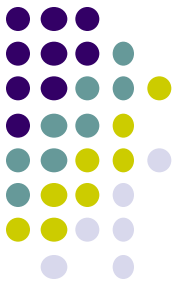


Medical

Ultrasound



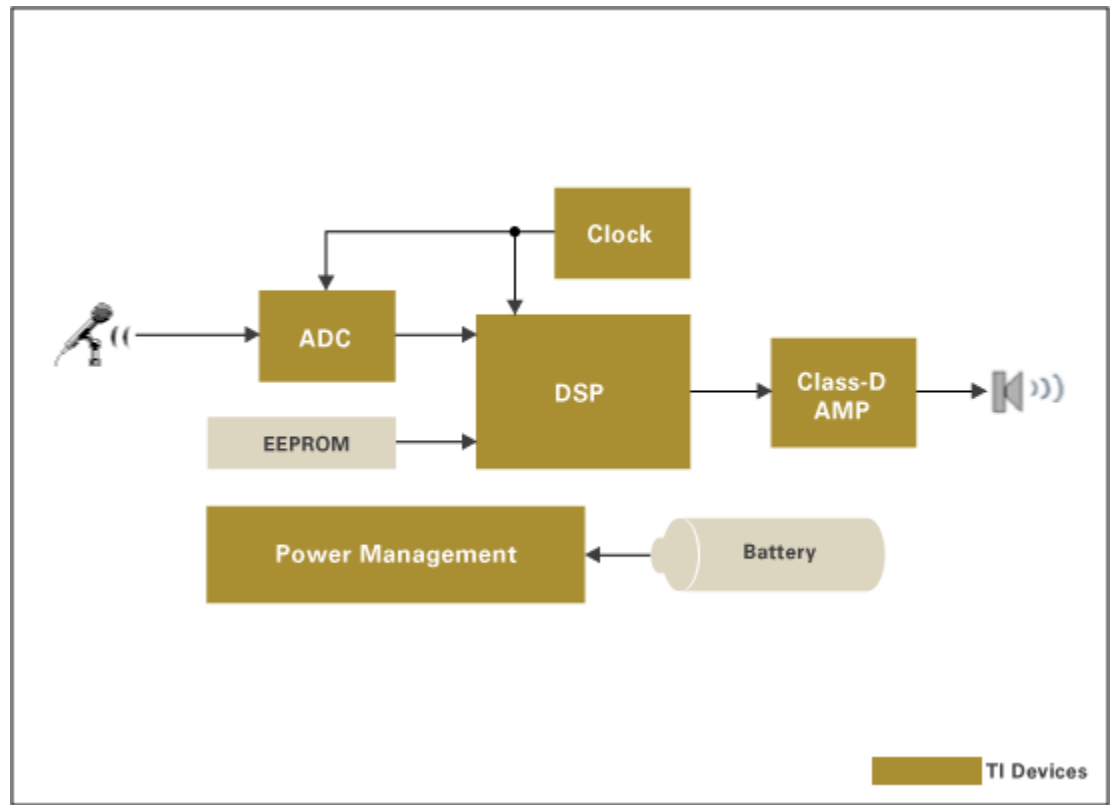
CT (Computed Tomography)

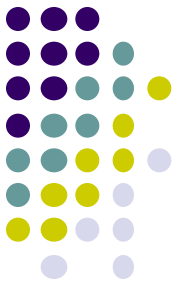


Hearing Aid



耳道式





Why digital?

(1) Programmability

Analog system: Modify hardware design.

Digital system: Modify software.

Example: Analog filter, digital filter, adaptive filter

Why digital?



(2) Precision

Analog system: component specification: resistors have a tolerance 5%; capacitors 20% or worse

Digital system: ADC bits, CPU word width and algorithm

Why digital?



(3) Stability

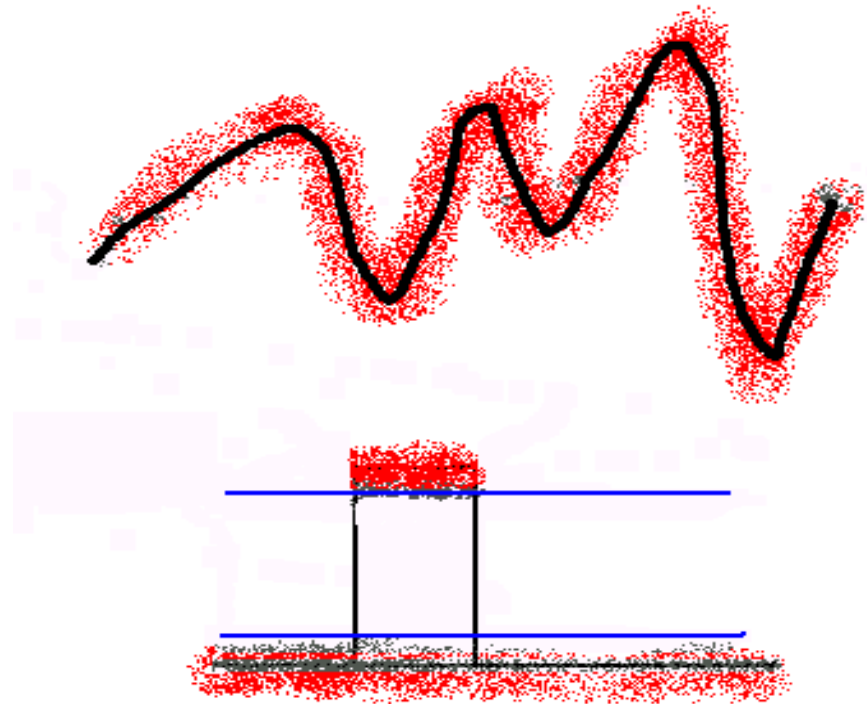
Analog system: the characteristics of analog system components, resistors, capacitors and operational amplifiers will change along with temperature, humidity

Digital system: will show no variation with temperature throughout their guaranteed operation range.

Why digital?



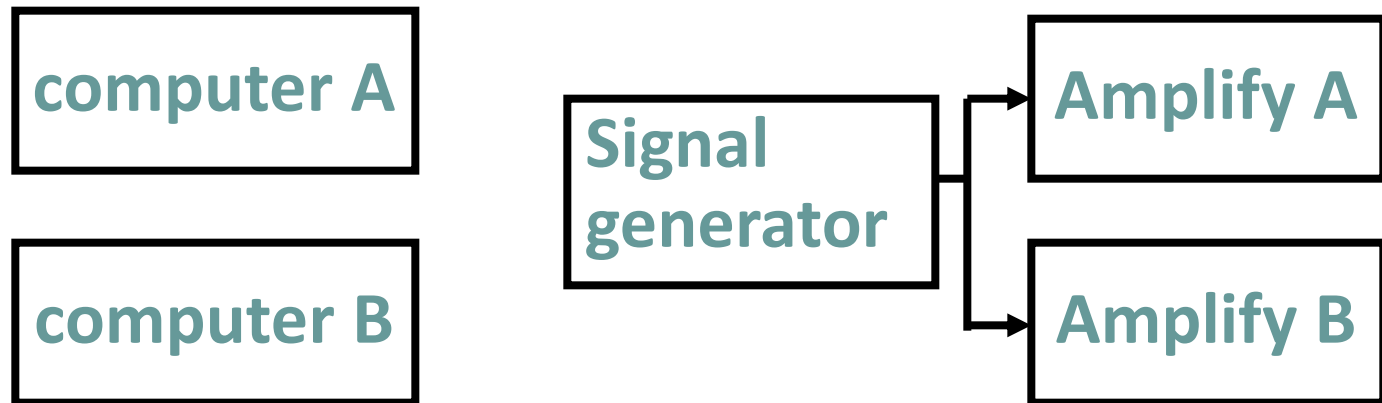
(4) Anti-noise



Why digital?



(5) Repeatability





Why digital?

(6) VLSI (Very Large Scale Integrated circuit)



Why digital?



(7) Error Correcting Codes

Data retrieval and transmission systems suffer from a number of potential forms of error.

With information in a digital or binary form, we may easily build into the data stream additional “redundant” bits that are used to detect when an error has occurred.

Why digital?



(8) Data Transmission and Storage

The Internet, Compact Disc (CD) and Digital Video Disc (DVD) brought information based on trouble-free high-quality text, audio and video into the office and home.

The fidelity of the digital medium is greater than that of the analog one.



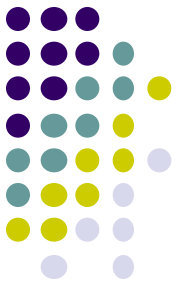
Why digital?

(9) Data Compression

The information channels cost and transmission bottlenecks make compression necessary for real-time processing.

With analog compression some information is lost. A typical example is the bandwidth limiting applied to analog telephone lines in order to multiplex calls, which limits the frequency response to 3kHz.

We still need analog processing



(1) Real-Time Processing

Analog system: Besides the delay introduced by the circuit, the processing is in real-time.

Digital system: Decided by the processor speed.



We still need analog processing

(2) Processing very high frequency signals

Analog system: may process microwave, mini-meter-wave, even light wave signals.

Digital system: By the Nyquist Rule, the processing speed is limited by the S/H, A/D and processor speed.

We still need analog processing



(3)The most signals in real world are analog.

If we want to process these analog signals with digital signal processing system, must change them into digital form first by mixed signal processing.



Thank you!