

# ***ANALOG DEVICES***

***Video-based***

***Distributor Training***

**“Signal Chain Selling:  
High Speed Solutions”**

***FOURTH DRAFT***

***Approved for Location Production  
(HI-SP4.SCR)***

***May 3, 1995***

*James A. Pfeiffer*  
*INTERSECT INCORPORATED*  
*15 Constitution Drive*  
*Bedford, NH 03110*

*603 472 6670*

Animated Title  
sequence 15  
seconds

Music:

1

Narrator on-  
camera walks into  
frame and stands  
in the hallway  
before the network  
operations center.  
Background  
suggests nothing  
more than office  
hallway.

**Narrator:**

Hello, and welcome to another in a  
series of programs on Analog  
Devices products and markets. I'm  
Suzanne Schemm.

2

Narrator begins to  
walk slowly.  
Camera tracks.

Today, we're coming to you from  
the New York and New England  
Telephone Network Operations  
Center in Framingham,  
Massachusetts

3

Fast dolly back to  
reveal the Network  
Operations Center  
and Narrator walks

into the  
environment

4

Narrator on-  
camera

This room monitors the operational  
status of all public and private  
telephone networks in five  
Northeast US states.

5

5

Narrator on-camera It provides network managers with a comprehensive, real-time, graphic view of voice and data traffic. It also shows transmission, switch, and facility status, and details on maintenance and repair activities.

6

Narrator on-camera This room is the central observation point in a huge, high speed voice and data network.

7

Narrator on-camera We're here because this room represents the subject of this program---high speed solutions.

8

Narrator on-camera We're also here because it's important to point out that, just a few years ago, much of the high speed technology in this room didn't exist.

9

**Narrator on-camera** High speed applications, like these, represent one of the fastest growth areas for Analog Devices.

**10**

- 10  
Narrator on-camera  
ADI offers the industry's largest portfolio of high speed products. These include Converters, Op Amps, Analog Signal Processors and DSPs.
- 11  
Narrator on-camera  
In this program we'll introduce you to four advanced applications that depend on ADI's high speed products.
- 12  
Narrator on-camera  
Before we get started, we'd like you to take a second look at the generic signal flow diagram we introduced in our last program.
- 13  
Dissolve to generic signal diagram from the previous program.  
Many of the building blocks present in this signal flow also apply to the high speed

Full Screen and applications we'll talk about here.  
Static.

14

Narrator on- If you keep this diagram in mind,  
camera it'll be easier to follow the new  
applications.

15

15

Narrator on-  
camera                      Let's get started.

16

Transition                      Music

17

Title Graphic                      **Cellular Basestation**

18

Narrator on-  
camera                      We'll begin with an application  
related to the networks that are  
monitored here.

19

Narrator on-  
camera                      Cellular telephones are part of a  
high speed radio system linked to  
the telephone network. We're  
Picks up cellular                      going to talk specifically about a  
telephone                      cellular system's digital  
basestation.

20

Narrator on-                      These basestations provide the

camera interface between cellular telephone radio waves and the wired public telephone network.

21

Narrator on-camera Within the cell, the basestation also performs system management and call routing.

22

- 22  
Narrator on-camera      The input to this system is a 900 megahertz signal.
- 23  
Basestation graphic      The "front-end" requires RF full screen. components. In this case, filters, low noise amplifiers, and mixers.  
Highlight bold as mentioned
- 24  
Graphic Full. Keep      These components "clean up" the the highlights. 900 megahertz signal and shift it down to a lower, intermediate frequency.
- 25  
Highlight all mixers      Down conversion usually occurs in several mixdown stages before the signal gets to the correct frequency.
- 26  
Graphic shows ADI      The opportunity to sell ADI products products at full starts at the frequency synthesizer level. Other parts and continues through the DSP.

are dim.

27

Enlarge section "A"  
Highlight frequency synthesizer.

The frequency synthesizer is a programmable signal generator that tunes the input section much like the tuner on your television or radio.

28

Same as previous graphic.

Frequency synthesizers use 12-bit high speed DACs, high-speed op amps, and references.

29

Change Frequency synthesizer label to DDS

You could also find a DDS or Direct Digital Synthesizer here. A DDS is a specialized frequency synthesizer.

30

Highlight Band Pass Filter (BPF)

Once the signal is tuned and mixed, it's filtered again. The output of the filter is a lower frequency signal that must be amplified by a VGA.

31

Reduce Section "A"

The VGA is a voltage controlled

and Enlarge Section amplifier. Its gain is set by the  
"B" Highlight VGA output of the DAC. VGAs are low  
noise analog signal processing  
devices. They let the DSP control  
the "gain" of the system.

32

Highlight DAC The digital to analog converter used  
to control the VGA is typically a  
twelve bit DAC operating at speeds  
of up to fifty kilohertz.

33

Highlight Mixer Next, the signal is again downshifted,  
or mixed. This mixing stage requires  
high speed, wide bandwidth op amps.

34

Highlight BPF The filtering that occurs after this  
mixing stage uses several discrete  
components.

35

Reduce Section "B" After the discrete filter, the signal is  
and Enlarge Section split in two. One path, the main

"C" Highlight main signal path, is split again, shifted in path. frequency one more time, and conditioned before analog to digital conversion.

36

Highlight mixers. Frequency shifting here is accomplished with low distortion, wide dynamic range mixers available from ADI.

37

Highlight amp. The buffer before the ADC requires a low power, rail to rail, dual op amp.

38

Highlight second path. The second signal path is called the Received Signal Strength Indication or RSSI path.

39

Same as previous graphic This path measures the amplitude of the input signal and controls the variable gain amplifier.

40

previous graphic continues      The RSSI path maximizes the input signal to the intermediate frequency or IF section

41

Highlight Log amp      This chain consists of a logarithmic amplifier. Log amps strengthen low level signals more than high level signals.

42

previous graphic continues      These are "Analog Signal Processors" or ASPs.

43

Highlight main ADC      There are actually three ADC's in this application. The ADC in the main signal path is a **dual** ADC operating with **fifteen** bits of resolution at speeds of up to ninety kilohertz

*(Need to check on the accuracy of the resolution)*

44

- 44  
Highlight ADC in RSSI      The ADC in the RSSI path usually requires twelve bits of resolution at about five hundred kilohertz.
- 45  
Highlight DSP      Finally, the DSP performs error correction, and decompresses the information before routing the data to the telephone network
- 46  
Narrator on-camera      In this example, we've concentrated on the receive side of the call. All cellular systems are duplex, meaning that they consist of a receive and transmit side. The transmit side performs all of these same operations in reverse
- 47  
Show full graphic with Part count      Now, we'll take a final look at the complete Cellular Basestation.

and dollar amount    This is the sales opportunity  
of sale                    presented by this application.

48

48  
Narrator on-camera                      This particular signal chain also creates a need for many standard linear support components. These might include Temperature Sensors, Trim DACS, and In Amps.

49  
Narrator on-camera                      Support components are sometimes overlooked because they serve purposes auxiliary to the functions of the main signal chain.

50  
Narrator on-camera                      Remember. . . Ask your customers about these support components.

51  
Transition                                  Music:

52  
Title Graphic:                              **Wireless Local Area Network**

Narrator on-camera  
Positioned so that  
network graphics  
are clear on the wall  
or at the  
workstations.

The wide area data networks  
monitored here use wire, fiber,  
satellite, and microwave  
technology to connect corporate  
and institutional networks.

54

Narrator on-  
camera

At individual business sites,  
smaller, local area networks used  
to be connected by wire alone.  
That's not true anymore.

55

Narrator on  
camera

In hospitals, factories, and many  
office buildings today, it can be  
difficult or impossible to hardwire  
computers and peripherals  
together.

56

Narrator on  
camera

Wireless local area network  
connections are becoming more  
and more popular as a way to

solve this problem.

57

Narrator on-  
camera

In this next example, wireless local area network terminals connect two computers together so they can communicate over short distances the same way they would if they were hardwired..

58

Narrator on-  
camera

A wireless LAN terminal must be installed at each end of the connection.

59

- 59  
Narrator on-camera                    The connection is made either by infra-red signals or radio frequency signals.
- 60  
Narrator on-camera                    Our example covers a radio frequency application
- 61  
Graphic full                            Like the basestation application, a wireless LAN includes both a transmit and receive section.
- 62  
graphic                                The input in this case is a two point five or five point eight gigahertz signal picked up by an antenna. In infrared systems, the signal is picked up by a photodiode.
- 63  
Enlarge Section                    Like the cellular basestation, the

"A" input here is an extremely high frequency signal..

64

Highlight the devices Because of this high frequency, the input filters and low noise amps are often "RF" devices

65

Highlight mixer The opportunity to sell ADI starts at the first mixer where the incoming signal is converted to a lower frequency.

66

same as previous graphic. This mixer requires low distortion and a wide dynamic range.

67

Reduce Section "A" and Enlarge Section "B" The IF frequency section requires analog signal processing components such as high speed amplifiers and demodulators.

68

Highlight  
Baseband  
Receiver Port

The "baseband receiver port" is a specialized highly integrated device consisting of an analog filter and analog to digital converters all on one chip.

69

Same as previous

Several different versions of this building block are available from ADI

70

Highlight DSP

The DSP performs echo cancellation, signal processing and formats the data.

71

71

Highlight PC

The information is then routed to its final destination. In this case, the information will go to a personal computer.

72

Back to Full  
Screen Graphic  
Highlight in  
reverse

The transmit channel essentially performs all of these functions in reverse..

73

The digital data from the DSP is coded and modulated, converted to analog by the baseband transmit port.

74

The signal is then shifted up to the carrier frequency by the mixer and boosted by a power amplifier.

75

It's then transmitted through the antenna

76

Highlight baseband transmit port (identical to receive port) The baseband transmit port is a combination filter, memory and dual ten bit DAC. Several versions of this type of device are available from ADI.

77

Narrator on-camera Once again, we'll take a final look at the entire system and identify the sales opportunity presented in wireless LAN applications.

78

graphic of part count and opportunity

79

Transition Music

80

Title Graphic

## **CCD Document Scanner**

81

Narrator on-camera

Each of these workstations gives the network manager access to a huge amount of information,---

Sitting at a workstation.

repair status, traffic reports, maintenance schedules, and electronic mail.

82

Narrator on-camera

In spite of this "paperless" design, some information still arrives on paper.

83

83

Narrator on-camera  Picks up a paper document.	As workstations become the primary tool for communication and information exchange, their will be an increasing interest in getting paper documents, like this one, off the desk, into a scanner, and on line.
--	--

84

Click on workstation to reveal a scanned document on-line.

85

Narrator on-camera	The need to deliver an image like this on line brings us to our next application, image processing.
--------------------	---

86

Narrator on-camera	Imaging applications use special optics to separate reflected light
--------------------	---

into red, blue and green components.

87

Narrator on-camera

CCD's or Charged Coupled Devices are then used to convert the three color components to digital information.

88

Narrator on-camera

Image processing applications require three identical signal channels, one for each of the color components.

89

Narrator on-camera

We're going to show you only one of these three identical channels.

90

Narrator on-camera

Image processing is the foundation for a variety of applications, including high speed commercial document scanning.

- 91  
Graphic full                      Each channel generates a voltage stream representing the image on the document.
- 92  
Enlarge Section "A"                      Before this signal can be converted to digital information, it must pass through several analog signal conditioning stages.
- 93  
Highlight coarse adjustment, amplifier, and fine adjustment as mentioned.                      The first stage makes coarse adjustments to the DC level of the signal. The second stage amplifies that signal, and the third stage finely adjusts the output of the amplifier so that the signal precisely matches the input requirements of the ADC.
- 94  
graphic                      Multiple medium to high speed, low

cost op amps perform these functions.

95  
Reduce Section "A" Enlarge Section "B" Highlight ADC  
The analog-to-digital converters in this application typically require ten to twelve bits of resolution, and a throughput rate of one to three megahertz.

96  
same as previous  
The actual speed and resolution are driven by the overall performance requirements of the scanner.

97  
Highlight reference and buffer  
As you know, many ADCs also require an external reference, and, in this case, the reference is buffered by an op amp before going to the ADC.

98  
INTERSECT INCORPORATED 15 Constitution Drive Bedford NH 03110 603 472 6670

98

**Highlight DSP**                      **After the signal is digitized by the ADC, the information is often sent to a DSP for further gain and offset error correction.**

99

**Reduce Section "B" and Enlarge Section "C"**                      **The signal is then processed and digitally enhanced by the image processor.**

100

**Back to the full screen Graphic and show opportunity**                      **Here's a look at the sales opportunity in this application.**

101

**Transition**                      **Music**

102

**Title Graphic**                      **Digital Camera**

103

**Camera pans**                      **Voice over pictures**

network operations

center

104

Pan continues

Our final example is a digital video  
camera.

105

105

Camera comes to  
rest on a quad  
video split of  
security camera  
images.

Narrator on-  
camera

Narrator walks into  
the frame of one of  
these security  
cameras

106

Narrator on-                    All video applications, including  
(security)- camera       this security camera scan images  
at very high speeds.

107

Narrator on-                    Video applications include  
camera.                        cameras that are typically found in

(Use mirror to broadcast, medical, and graphics  
show camera systems.  
recording picture)

108

Full Screen As you can see, the block diagram  
Graphic is similar to the document scanner.  
The sensor is a CCD.

109

Enlarge Section The output from the CCD is  
"A". Highlight adjusted to the proper dc level,  
parts then amplified by a programmable  
gain amplifier. The signal is fine  
tuned to match the input of the  
ADC.

110

Same as previous Several video speed, low cost op  
graphic amps perform these functions.

111

Reduce Section Once again we have a requirement  
"A" Enlarge for an ADC and reference.

Section "B"

Highlight both ADC  
and reference

112

Highlight ADC      The ADC requires a resolution of  
eight to twelve bits at video  
speeds of five megahertz or  
greater, depending on the exact  
application

113



one of multiple channels.

117

Narrator on-  
camera

For many applications, the total  
opportunity is much larger.

118

118

Narrator on-  
camera

By the way, don't forget that in all these applications you will find additional opportunities to sell interface and power management products as peripherals to microprocessor.

119

Turn, walk for  
close.

**Music Under**

120

Narrator on-  
camera  
Wide shot similar  
to open.

The examples in this program cover only a few of many emerging high speed applications.

121

Narrator on-  
camera

As this technology evolves, your opportunities will increase.

122

Narrator on-

If you carefully review these signal

camera

chains, you'll notice the similarities across all high speed applications, and you'll be better prepared to recommend Analog Devices products.

123

123

Narrator on-  
camera

That's all we have time for now.  
Thanks for joining us. Good luck,  
and good selling.

124

Analog logo.

Music fade to end

125

*Credit*

*Our special thanks to the managers and staff  
of the NYNEX Network Operations Center in  
Framingham, Massachusetts, USA for their  
cooperation and assistance in the production  
of this program.*

126