Video Conferencing: Silicon Valley's 50-Year History

Dave House, Eric Dorsey & Bryan Martin; Moderator: Ken Pyle

Organized by IEEE Silicon Valley Technology History Committee

Co-Sponsored by IEEE Consultants' Network of Silicon Valley (IEEE-CNSV)

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www.SiliconValleyHistory.com

22 July 2020

Today's Agenda

- IEEE Silicon Valley Technology History Committee Info:
  - Tom Coughlin, IEEE-USA Immediate Past President
- Recent IEEE historical Milestones
  - Brian A. Berg, IEEE Volunteer
- Main Event
  - Dave House, ex-Intel
  - Eric Dorsey, ex-Compression Labs, Inc.
  - Bryan Martin, 8x8, Inc. CTO and Chairman
  - Ken Pyle, Viodi (Moderator)

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IEEE Silicon Valley Technology History Committee

- Committee members:
  - Tom Coughlin, Chair
  - Brian A. Berg, Vice Chair
  - Tom Gardner, Treasurer
  - Ken Pyle, Videographer
  - Francine Bellson
  - Paul Wesling
  - Ted Hoff
  - Alan Weissberger

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IEEE Silicon Valley Technology History Committee

- Founded in 2013
- Our purpose: to hold meetings on the history of a broad range of technologies that were conceived, developed, or progressed in greater Silicon Valley
- If you are interested in offering your help, contact
  - Tom Coughlin: tomcoughlin@ieee.org
  - Brian Berg: b.berg@ieee.org

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Some Recent SV Tech History Events

- October 10, 2019
  - A Partial History of Makers in Silicon Valley
- June 13, 2019
  - Challenger Shuttle Disaster: Recovery of data from damaged tapes
- October 11, 2018
  - Gravitational Waves and LIGO – A Technical History
- September 14, 2017
  - DIALOG: The Beginning of Online Search
- March 20, 2017
  - The Other Women of ENIAC – Rethinking IT Innovation

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Out Next SV Tech History Event

- October 8, 2020
  - Lockheed's Agena: America's First Spy Satellite – Looking from Above the Iron Curtain
- Find out about our past and upcoming events:
  - SiliconValleyHistory.com

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Transition to Brian Berg

- IEEE Involvement includes:
  - Region 6 History Chair
  - Region 6 Milestone Coordinator
  - Consultants' Network of Silicon Valley Director and Past Chair
  - Silicon Valley Technology History Committee Vice Chair
  - Santa Clara Valley Section Past Chair

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IEEE Milestone Dedication (23 May 2019)

- "DIALOG Online Search System, 1966"
- The inspiration for proposing this Milestone was a Tech History Committee event on Sept. 14, 2017

- Dr. Roger Summit in 1970s with DIALOG's "data farm

Brian Berg (left) and Roger Summit (middle) with Silicon Valley USPTO Director John Cabeca (2nd from left)

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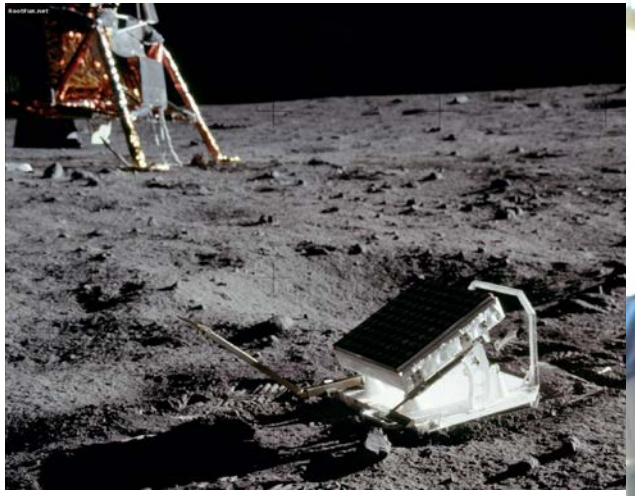
IEEE Milestone Dedication (1 August 2019)

- "Lunar Laser Ranging Experiment, 1969"
- Apollo 11 crew left a retro-reflector on the moon to allow measurement of the distance to the moon with 1.2 GW laser
- Crews worked at observatories at Haleakala, Lick and McDonald
- First success: Aug. 1, 1969 at Lick Observatory above San Jose
- Dedication held at Lick (mid-day), followed by an evening event



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Some Upcoming IEEE Milestones

- Silicon Valley:
  - Apple I, Apple II, Macintosh (delayed from May 2020)
  - Xerox ALTO Computer
  - Intel 4004 Microprocessor (in Nov. 2021, for 50th anniversary)
- Wash. State; Louisiana; Pisa, Italy
  - Gravitational-Wave Antenna (delayed from June/July 2020)
- Oregon
  - Universal Serial Bus (USB)

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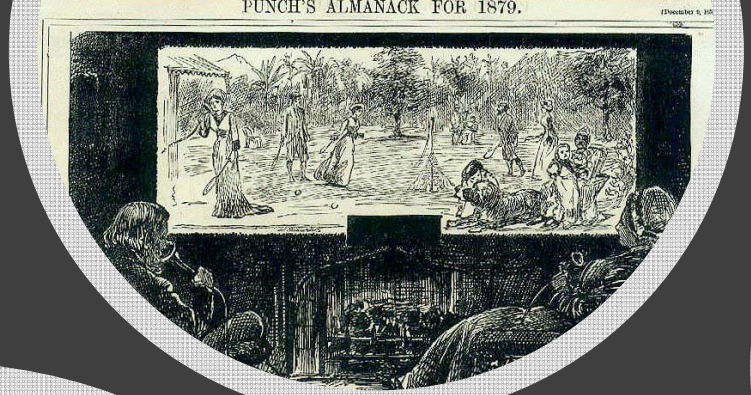
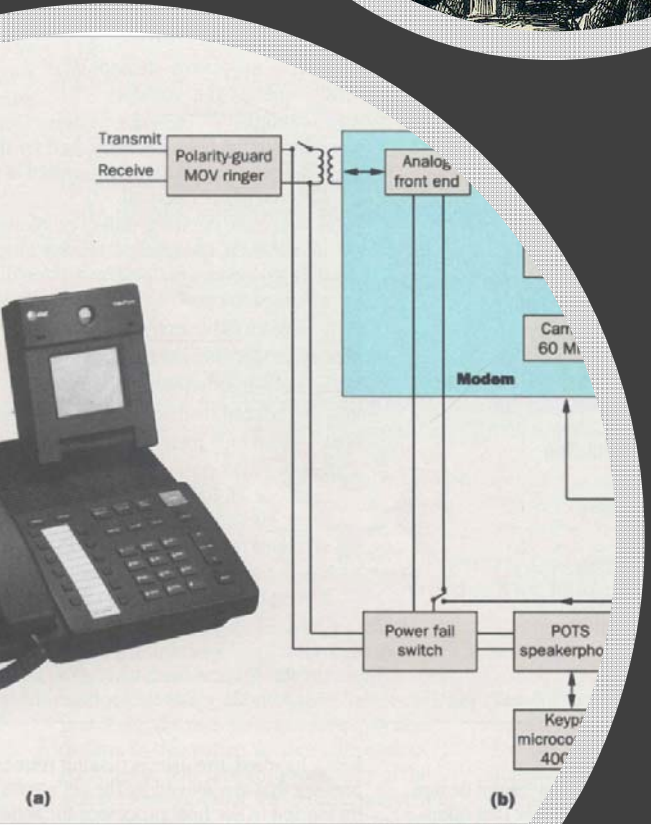




Video Conferencing: Silicon Valley's 50+ Year History

An IEEE Silicon Valley Technology History Committee Event
July 22nd, 2020, 1:30 to 2:30 PM PDT
via video conference, of course

Agenda

System diagram

A brief history from the 1870s to the 1970s

Silicon Valley’s Influence

Intel

Compression Labs

8x8

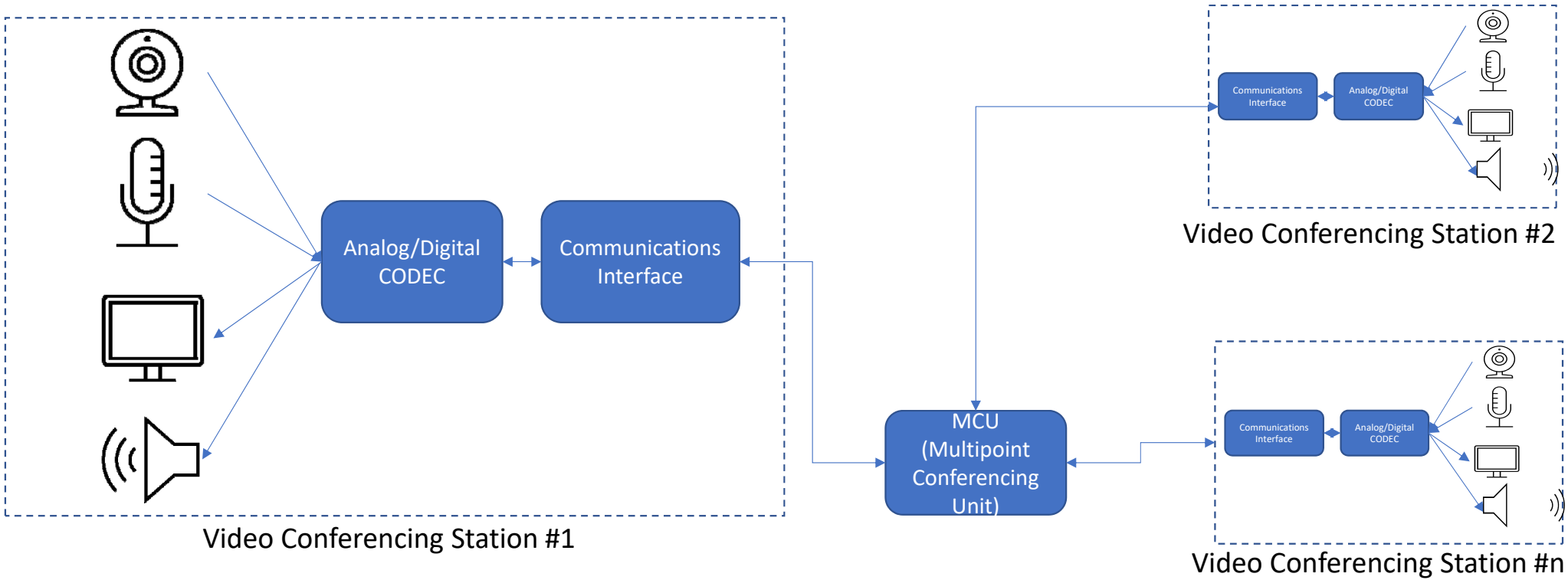
High-Level Video Conferencing Block Diagram

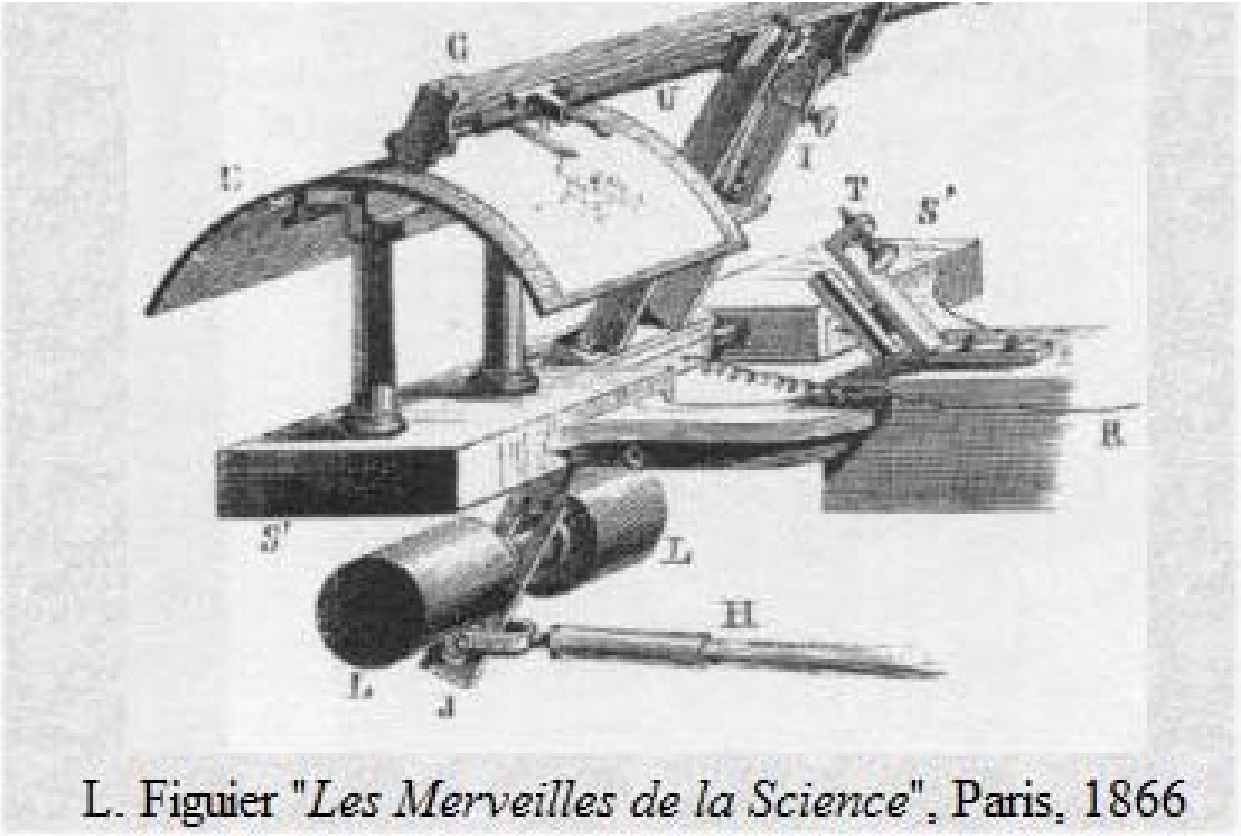
Video/Audio Capture & Display

Compression Decompression

Network Interface

Communications Network(s)

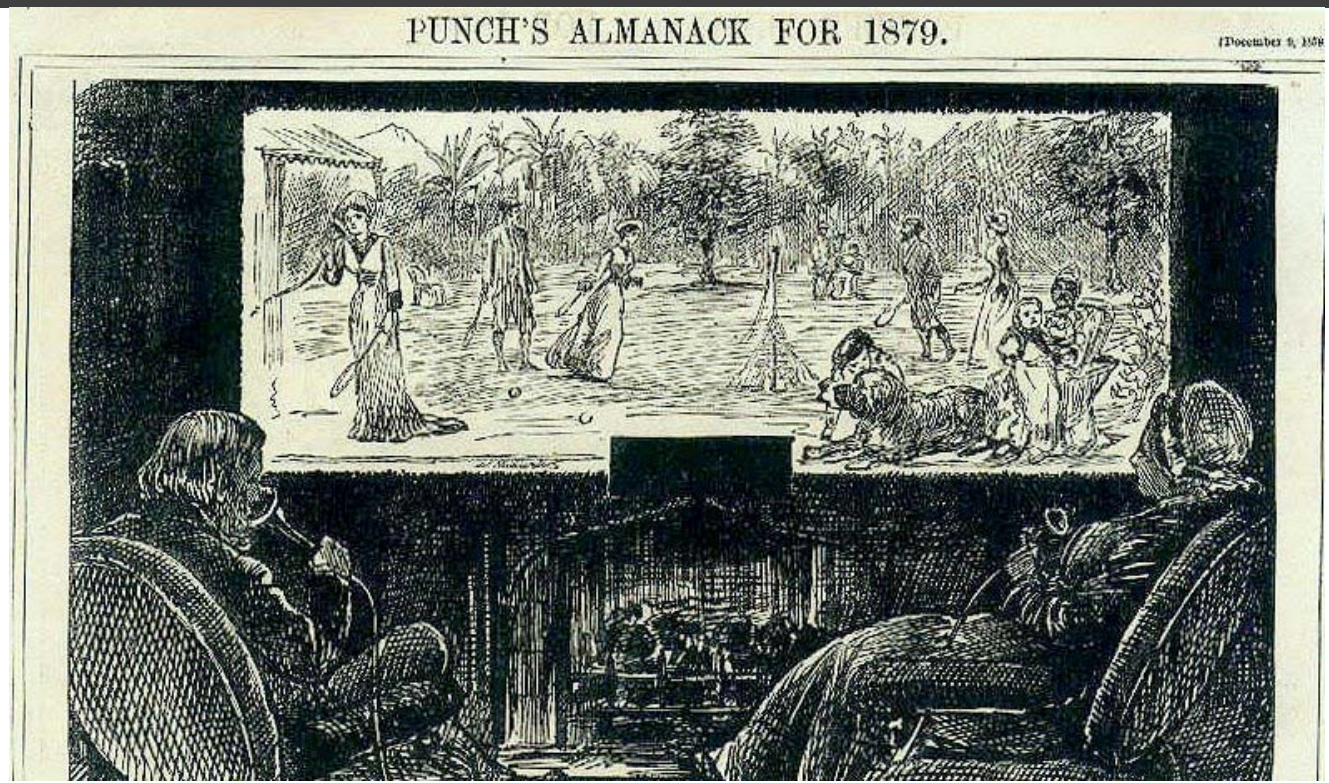




L. Figuier "*Les Merveilles de la Science*", Paris, 1866

1860s Pantelegraph The First Fax Machine

Telephonoscope Concept - 1879



Block Diagram of 1927 Bell 1-Way Video, 2-Way Audio

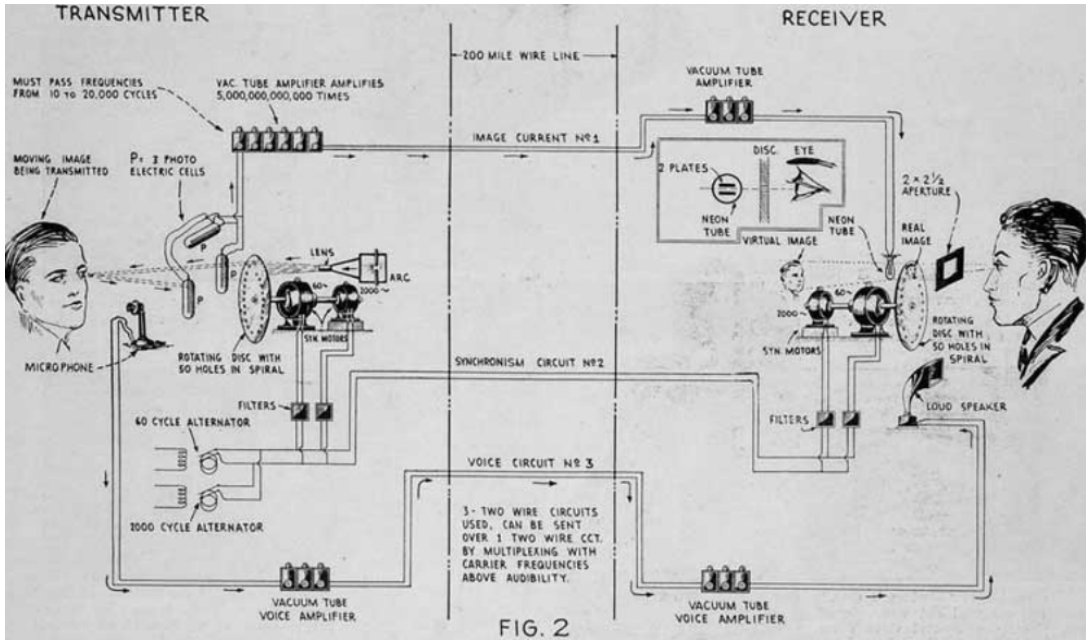


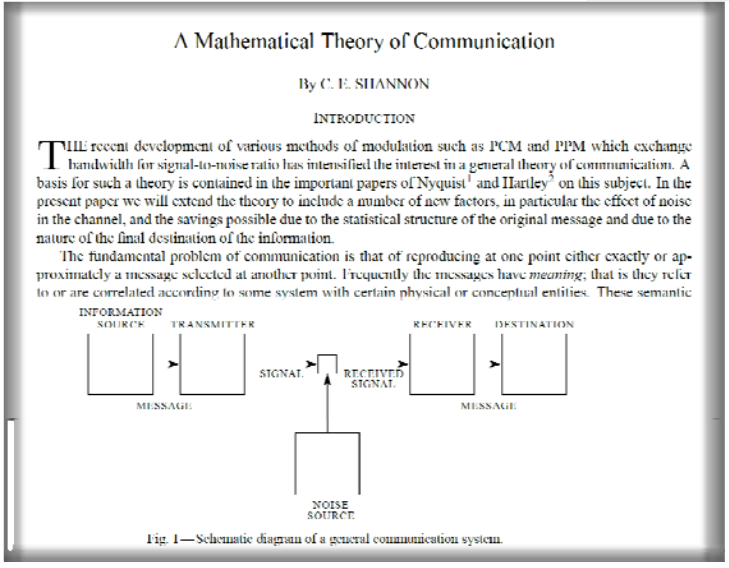
FIG. 2

AT&T's Post-War Efforts to 1978

After the transistor was invented at Bell Labs in 1948, an AT&T electrical engineer predicted:

> ...whenever a baby is born anywhere in the world, he is given at birth a... telephone number for life [and]... a watch-like device with ten little buttons on one side and a screen on the other.... when he wishes to talk with anyone in the world, he will pull out the device and [call] his friend. Then turning the device over, he will hear the voice of his friend and see his face on the screen, in color and in three dimensions. If he does not see and hear him he will know that the friend is dead.

—Harold Osborne, 1948.[33]



A Mathematical Theory of Communication

By C. E. SHANNON

INTRODUCTION

THE recent development of various methods of modulation such as PCM and PPM which exchange bandwidth for signal-to-noise ratio has intensified the interest in a general theory of communication. A basis for such a theory is contained in the important papers of Nyquist[1] and Hartley[2] on this subject. In the present paper we will extend the theory to include a number of new factors, in particular the effect of noise in the channel, and the savings possible due to the statistical structure of the original message and due to the nature of the final destination of the information.

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic

Fig. 1—Schematic diagram of a general communication system.

Enter the 1970s and Silicon Valley…..Some of the Silicon Valley Ties to Video Conferencing

1970s – 1990s (today's discussion)

2000s (future discussion)

Ataritel

Mitsubishi

CLI

AT&T 2500

CLI

8x8

Sarnoff

Intel

C-Cube Microsystems

LSI

Divicom

Harmonic

CATEL

PictureTel

Polycom

WebEx

Cisco

Zoom

Apple

BlueJeans

Verizon

WebRTC

Google

8x8

jitsi

Note: Company names depicted above intended to show relationships.

- Some were customer-supplier
- Some were acquisition paths
- Some were technology
- Some represent where the founder(s) worked prior to starting a particular company

INSIDE TRACK

Shocker at the CD-ROM Conference; DVI blows CD-I away. Phillips loses out; Microsoft cashes in.

Date: March 2–6. Place: Seattle. Event: CD-ROM Conference. Sponsor: Microsoft. Theme: Confusion, part II.

It was the same as last year: confusion, head scratching, shoulder shrugging, handwringing, and itchy knees. It seems that the entire CD-ROM scene is turning into a soap opera. It's now obvious (after this year's affair) that **breakthrough technologies** that "make it a whole new ball game" will be released cause the whole town was aware of the RCA stuff. I guess the Frenchmen were too busy checking the stock price of another fine Thompson investment—Fortune Systems.

Facts: The two-chip RCA video display processors can turn a plain-vanilla compact disk into a device that pumps out real-time full-color **action-packed video** with digital sound. Seventy-two minutes worth to be exact. Phillips hoped to get 7 or so minutes of real-time video

So **expect nothing** to come of the RCA chips and expect the confusion in the business to remain, thus allowing the clunky CD-ROM standard to gain the foothold it needs to survive. More moola for Microsoft.

You'll never get anyone to admit that the game is nothing more than jockeying for quick bucks. I ask about the DVI: "Is it a CD-I killer?" "I wouldn't want to be quoted saying that," said Gates smiling. "Is it a CD-I killer?" "I wouldn't want to be quoted saying that," said Arthur Kaiman, RCA Digital Products Lab Director, smiling and **obviously reading from the same script.**

Okay, I'll say it. It's a **CD-I killer.**

Dave House – Ex-Intel

PCWEEK

THE NATIONAL NEWSPAPER OF CORPORATE COMPUTING | NOVEMBER 1, 1993 | VOLUME 10, NUMBER 43 $3.95

WOBBLY WABI?
Sun will ship its Windows-on-Unix software this month, but it may have significant bugs.
Page 8

WALL ST.
BALANCING ON THE BOTTOM LINE
IBM surprises Wall St. with narrow quarterly loss, while DEC disappoints and looks to drum up cash.
Page 145

COMDEX PREVIEW: SUBNOTEBOOK SPLASH

Epson and Toshiba lead charge with lightweight 486 portables

By Neal Boudette

A portable PC blitz at Comdex later this month will hit just in time for users frustrated with the current crop of subnotebooks.

Epson America Inc. and Toshiba America Information Systems Inc. will lead the way with new lightweight 486 models, and Hewlett-Packard Co. will kick in OmniBook up to the 486 level, sources close to those companies said.

Epson will showcase at the Las Vegas trade show its ActionNote 700—a full-featured color notebook light enough to compete against subnotebooks, sources said. The Torrance, Calif., company also will demonstrate a color notebook, the ActionNote 500C, priced to compete against monochrome portables, the sources said.

Meanwhile, Toshiba, of Irvine, Calif., next week will release a 486SX-based monochrome subnotebook weighing just less than 4 pounds, sources said. The machine will feature a 4-hour lithium ion battery, they said. The PC is expected to come with 4M bytes of RAM, a 120Mbyte hard

See Portables, Page 13

Bugs haunt WP 6.0 for Windows

WordPerfect readies interim 6.0a release

Desktop videoconferencing edges closer to prime time

Wave of new products bringing technology within users' reach

By Erica Schroeder and Stephen Lawrence

The march of technology is moving videoconferencing from purpose-built boardrooms to the desktops of end users.

A handful of small companies, capitalizing on low-cost hardware and high-bandwidth networking, aim to make desktop videoconferencing a tantalizing choice for information-systems managers, with hardware/software systems priced as low as $2,000 per user.

Several new LAN-based videoconferencing packages, some

Get the picture?

Key videoconferencing issues for users

TwinCom's CoPhone, EyeTel Communications Inc.'s Communicator 5, and IntelCorp.'s CoProcessor, are shipping or

PC, and software for sharing PC applications.

Other companies, such as ShareVision Inc., VTel Corp., Northern Telecom Ltd., NCR, IBM, and Sun Microsystems Inc., already offer or are developing PC-based videoconferencing packages. At the same time, established vendors are starting to offer downsized versions of their more expensive boardroom products.

For example, Compression Labs Inc., of San Jose, Calif., began shipping its Connect View

ProShare brings PC users face to face

TEST ALLIANCE

Although getting the requisite ISDN service may be difficult, Intel's videoconferencing software is a boon for PC users who need to communicate and share data.

By KRISTIN MARKS

Organizations looking for PC-based video and document conferencing tools to bridge the geographic divides that often separate employees have someplace to turn. We recently spent some time using Intel Corp.'s ProShare Personal Conferencing Video System 200 product and were quite impressed with its capabilities. Its interface is close to impeccable, and the documentation, which isn't even needed, is easy to read. The hardware, in turn, is well designed and a snap to install.

But even though there's a lot to be excited about, users need to be aware of some shortcomings and problems. Intel will, over time, refine the video quality, but other problems, such as access to the requisite ISDN service, will require the cooperation of the phone companies.

We'd use ProShare all the time if we could, and we suspect that many other organizations would, as well. ProShare provides a way for personal computer users in geographically dispersed offices as well as for the growing ranks of telecommuters to share documents and carry on face-to-face meetings. Used wisely, it has the potential to let organizations reduce travel budgets and increase employee communication and productivity.

Unfortunately, the infrastructure necessary to support desktop videoconferencing isn't in place yet. ProShare requires an Integrated Services Digital Network line to carry on a videoconference, and this is where many potential users will confront their first obstacle. Getting this digital phone line isn't necessarily easy, as our experience indicates.

We went to three different states in the Northeast before we got a line, finally ending up at OmniTech Corporate Solutions in Teaneck, N.J., a systems integrator specializing in communications for the corporate market. Rumor has it that getting ISDN is easier in other parts of the country. (Maybe New York isn't the center of organizations looking for PC-based video and document conferencing tools to bridge the geographic divides that often separate employees have someplace to turn. We recently spent some time using Intel Corp.'s ProShare Personal Conferencing Video System 200 product and were quite impressed with its capabilities. Its interface is close to impeccable, and the documentation, which isn't even needed, is easy to read. The hardware, in turn, is well designed and a snap to install.

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Intel is doing its part to alleviate these difficulties. It has forged strategic alliances with the regional Bell holding companies to help speed nationwide deployment of ISDN technology. In addition, users who face resistant phone company representatives — ours laughed at us when we asked for an ISDN line — can call the Intel ISDN Connectivity Information Center's 800 number to find out if ISDN is available in their area.

Users simply need to give their area codes and the first three digits of their phone numbers, and Intel will tell them if their central office supports ISDN. Users who live in Bell Atlantic Corp. or Pacific Bell territory have the best hope for ISDN connectivity, while NYNEX Corp. customers have very little chance of obtaining it.

Users who get by this first hurdle must order the Intel Blue version of Basic Rate service. Sites may want to consider ordering the ISDN Ordering and Provisioning document (Document 8101) from Intel's FAX-back system by calling (800) 525-3019. This document gives every detail of the specification and is worth ordering for the glossary of terms alone. It also has detailed instructions for placing an ISDN order.

Then, of course, there's the pricing. We know of one firm that waited two months before its ISDN order was fulfilled. When it was, the price was twice the original quote.

ProShare also requires a Network Termination Type 1 (NT-1) box, which, as far as the phone company is concerned, serves as the ISDN line's termination point. As far as ProShare is concerned, it's simply the box that the ISDN card is plugged into. NT-1 boxes also allow the phone company to provide line maintenance and loopback testing.

Pricing for NT-1 boxes are not uniform. For instance, Northern Telecom, Inc. offers one for $130, while AT&T's costs $328. The Intel FAX-back document (Document 8109) contains NT-1 ordering information.

PACKAGING THE GOODS

ProShare is well put together

NET Result

Product:
Intel ProShare Personal Conferencing Video System 200

Key findings:
- Offers an intuitive interface.
- Obtaining the requisite ISDN service may be difficult.
- Video image is not perfect, but it is quite tolerable.

System requirements:
- 486 running at 33 Mhz
- 8M bytes of memory
- 7M bytes of disk space
- DOS 5.0 or higher
- Windows 3.1 running in enhanced mode
- Windows display driver with a 640- by 480-pixel screen resolution

Vendor:
Intel Corp.
5200 North Elam Young Parkway
Hillsboro, Ore. 97124
(800) 538-3373

Price:
$2,499 (includes camera, earphone/microphone combination piece, video digitizer and ISDN board)

arrives in a fat briefcase-style box, complete with a handle. The small swivel camera for mounting on a PC monitor), which comes with industrial-strength Velcro to keep it in place, plugs into a video digitizing 16-bit Industry Standard Architecture board. This camera relies on simple mechanics for its operation. Opening the lens door turns the camera on, while closing the door shuts it off. It's that simple.

Even though there's a lot to be excited about, users need to be aware of some shortcomings and problems with ProShare.

Intel also provides a phone cable for connecting the ISDN card to the NT-1 box.

The microphone is built into the speaker, which fits inside an ear comfortably. Users can also clip it to their clothes — just as newscasters do. A small holder attaches to the side of a monitor, providing a place to store the earpiece. The earpiece cable splits in half so it can be plugged into the back of a second 16-bit card that handles the ISDN connection.

The plugs have Macintosh-style icons on them to identify the port connections. And there are other useful touches, including cable ties to keep desks free of cable clutter and a screwdriver for installing the hardware.

We found the software installation for this Windows application a little more troublesome than we would have liked. During the installation, we were warned that we needed a 256-color driver for our video card. The documentation also mentions this requirement, which may pose problems for many users, who typically buy preconfigured systems and do not have access to their video display card's driver diskette.

We spent an hour and a half looking for the video card driver in the PC we used for testing — an Intel 486 DX/66 with a fairly standard ATI Technologies, Inc. video card. CompuServe subscribers can download from the Microsoft Library a high-speed 256-color display driver, SVGA256.DRV, which supports most nonaccelerated Super VGA cards with 1M byte of memory. We hope that in the future, Intel will distribute this driver on the ProShare installation diskettes or that Microsoft Corp. will include it with future operating system releases.

We were impressed with how well ProShare

Intel Inside the Computer Video Phone

Eric Dorsey, Ex-CLI

Key Dates in the History of Video Conferencing

- 1978 – Compression Labs (CLI) is founded by Wen Chen
- 1982 – 1st video conferencing product from CLI - $250K plus $1K per hour for leased T1 line
- 1986 – PictureTel releases product based on vector quantization selling for $80K
- 1988 – CLI releases Rembrandt II for $30K using TI C30 DSPs
- 1991 – CLI releases Rembrandt II/VP using VPC from IIT (8x8)
- 1992 – AT&T and CLI release 2500 Analog Videophone using 19.2Kbps modem
- 1997 – Vtel buys CLI
- 2001 – Polycom buys PictureTel
- 2006 – Cisco introduces Telepresence product line

Compression Labs Rembrandt II/VP and AT&T 2500

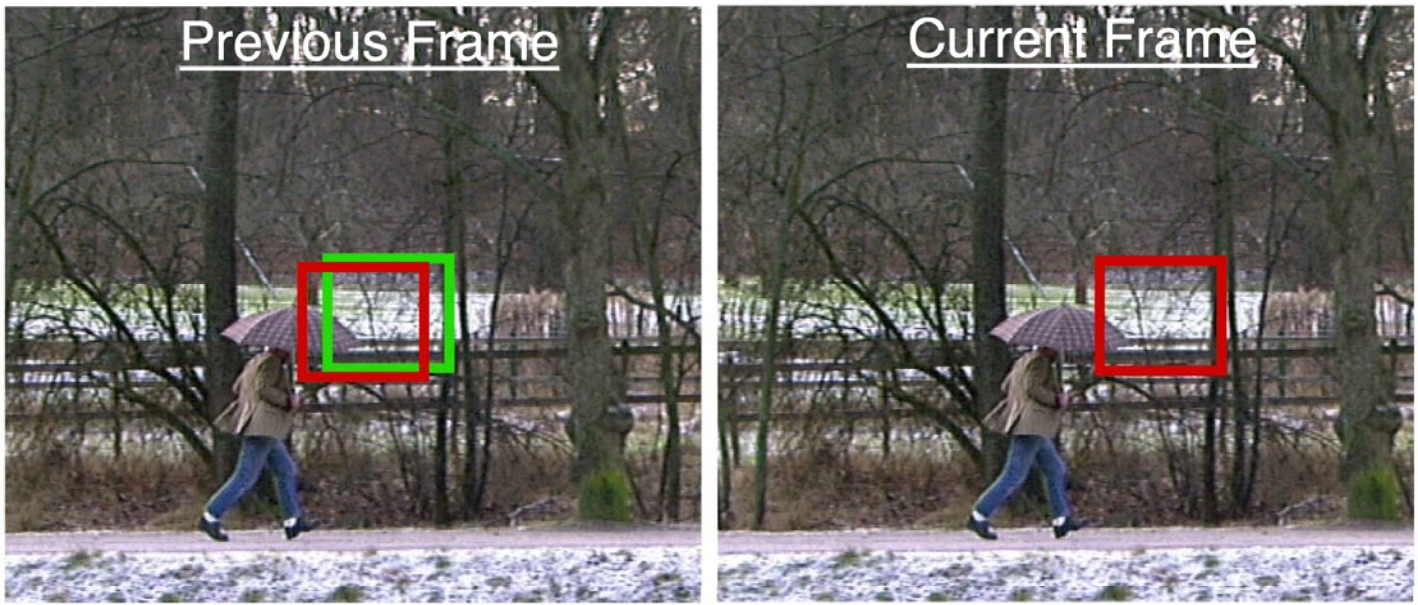
Key Dates in the History of Video Compression

- 1988 – H.261 – 1st video standard used in video conferencing created by CCITT using the DCT and entropy encoding with resolution of 352x288 at 30FPS
- 1995 – H.262 – Created for MPEG2 broadcast video and DVDs. Supports both SD and HD resolutions and multiple frame rates.
- 1996 – H.263 - Low latency codec for broadband use with resolutions similar to H.262.
- 2003 – H.264/AVC – Also known as MPEG4. Used in VC, broadcast and broadband applications. Supports 4K resolution and Blu Ray DVD. Has wider color gamut and color depth and supports 4x4 DCTs.
- 2013 – H.265 – Also known as HEVC. Supports up to 8K TVs and used by 4K Blu Ray players (UHD)
- 2019 – AV1 – Open Source video standard derived from VP10 work from Google.
- 2020 – H.266 – Ratified in July 2020 – supports fractional frame rates up to 120 FPS, HDR up to 10000 nits and wider color gamut

Major Components of Video Compression

- Differential encoding between frames
  - Break frames up into blocks and encode differences in frequency domain
- Motion Estimation
  - Track motion between frames to minimize differential error
- DCT (Discrete Cosine Transform)
  - Essentially a 2-dimension FFT, flips pixels from spatial domain into frequency domain
- Entropy encoding
  - Lossless encoding scheme based on Shannon's Source Coding Theorem. The length of each codeword is approximately proportional to the negative logarithm of the probability of occurrence of that codeword.

Motion Estimation



Measurement window is compared with a shifted block of pixels in the other image, to determine the best match

Block of pixels is selected as a measurement window

DCT Encoding

An example of an encoded 8×8 FDCT block:

$$\begin{bmatrix} -415 & -30 & -61 & 27 & 56 & -20 & -2 & 0 \\ 4 & -22 & -61 & 10 & 13 & -7 & -9 & 5 \\ -47 & 7 & 77 & -25 & -29 & 10 & 5 & -6 \\ -49 & 12 & 34 & -15 & -10 & 6 & 2 & 2 \\ 12 & -7 & -13 & -4 & -2 & 2 & -3 & 3 \\ -8 & 3 & 2 & -6 & -2 & 1 & 4 & 2 \\ -1 & 0 & 0 & -2 & -1 & -3 & 4 & -1 \\ 0 & 0 & -1 & -4 & -1 & 0 & 1 & 2 \end{bmatrix}$$

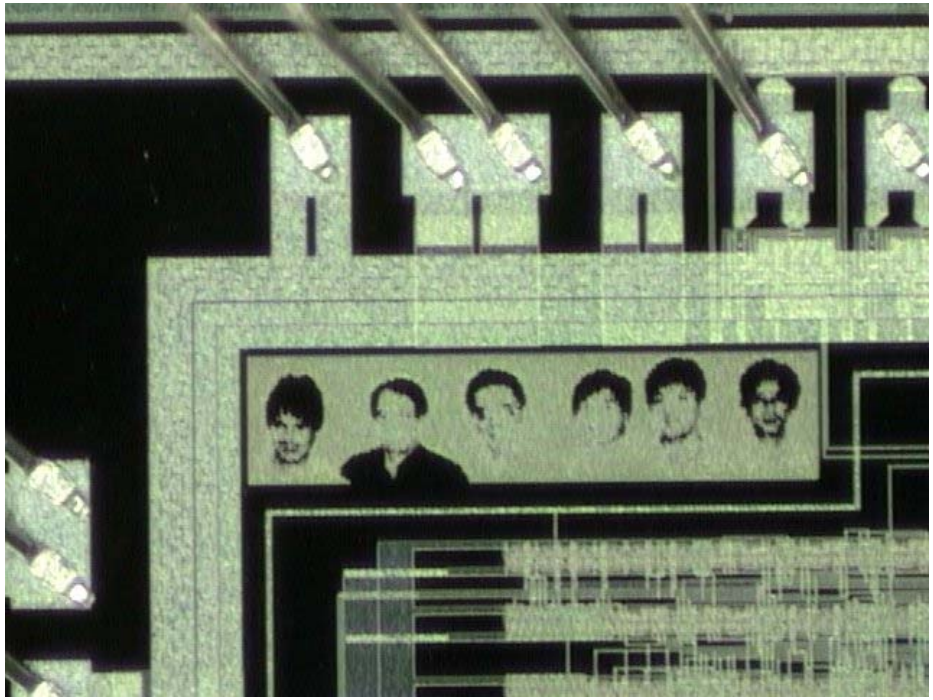
An example quantized DCT block:

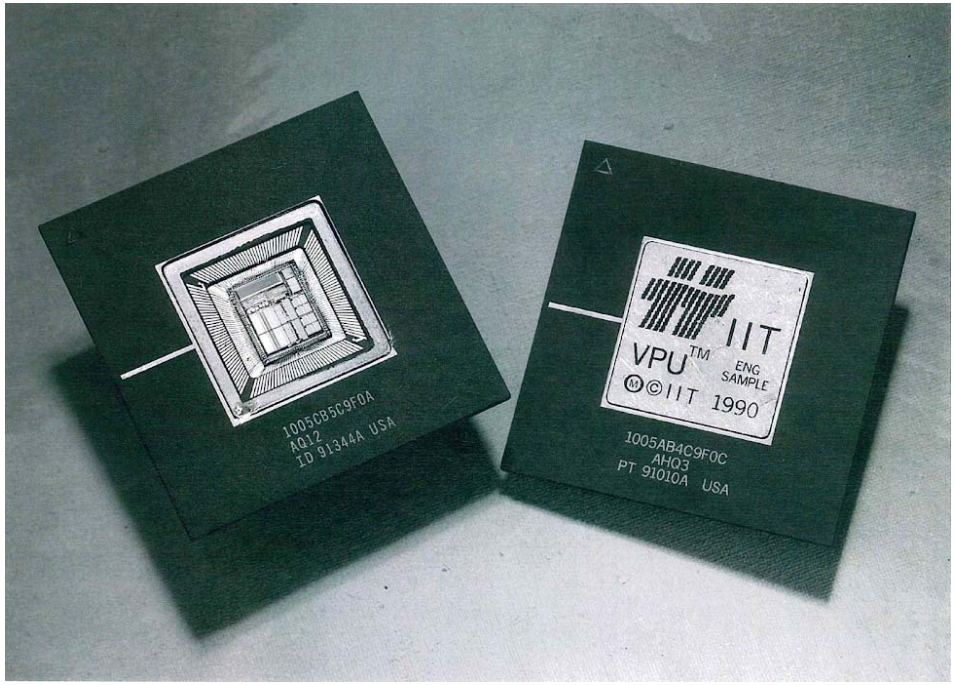
$$\begin{bmatrix} -26 & -3 & -6 & 2 & 2 & -1 & 0 & 0 \\ 0 & -2 & -4 & 1 & 1 & 0 & 0 & 0 \\ -3 & 1 & 5 & -1 & -1 & 0 & 0 & 0 \\ -4 & 1 & 2 & -1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Bryan Martin, 8x8

Compression Labs Rembrandt II/VP

Original Vision Processor chip (1990)





VCP chip which powered 8x8 ViaTV devices (1996)

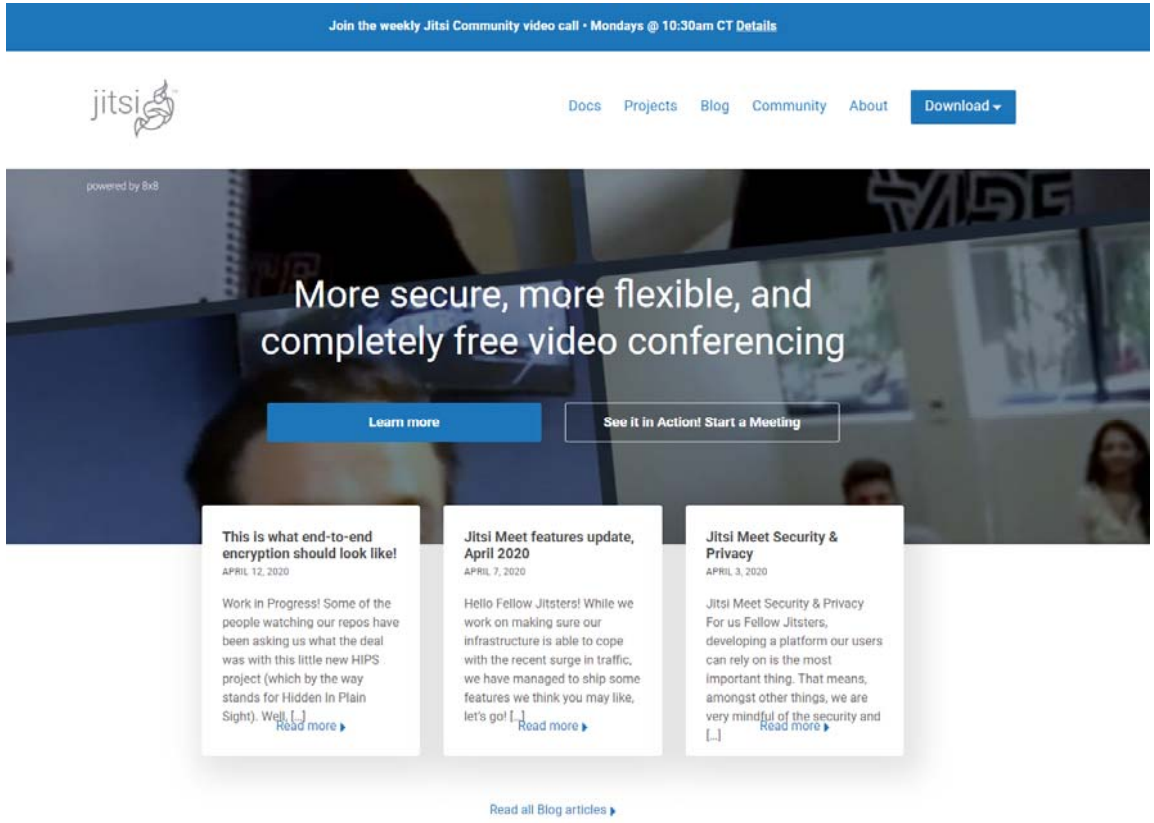
- 8x8's first attempt to consumerize videophone technology – ViaTV set top box
- $499 per videophone
- Full H.324 stack (PSTN modem), use existing TV and telephone for picture/audio
- H.263 Annex contributions to optimize video quality at low bandwidths

IP-based Videophones & VoIP (2000)

- 2003 - Microsoft announces Live Communications Server would only support SIP (Session Initiation Protocol)
- 2-way voice (Voice-over-IP) services launch with 8x8 and Vonage based on SIP (though video was always supported, just not used)
- Business models move to recurring Software-as-a-Service (SaaS) as opposed to hardware sales model
- Over the last 18 years voice and video have continuously benefited from:
  - Improved compute (move from hardware to software to WebRTC and public-cloud video bridges)
  - Improved transport (from PSTN/dialup to DSL to WiFi/Fiber)

jitsi.org (2006) and community.jitsi.org (2020)

- Public-cloud has enabled “reservation-less” video conferencing (see meet.jit.si)
- Pandemic has focused modern video communications on end-to-end encryption and security
- Jitsi.org – largest open source videoconferencing developer community (8x8 is Jitsi’s largest supporter)
- Continue to reimagine video collaboration needs in the new world of work/teach/play from anywhere



Question and Answer

From Personal Conferencing Work Group to h.323

"The 100-plus vendors that are members of Intel Corp.'s desktop videoconferencing consortium last week proclaimed they are serious about making their bevy of budding products interoperate with each other and H.320-based group conferencing systems." - David J. Buerger, Oct. 17, 1994

Back to Reality

IBM waves a management Karat; video vendors wave their own flag.

BY DAVID J. BUERGER

I don't know about you but I'm getting tired of hearing about network management products that do little more than monitor network screwups.

It's one thing to know when something breaks; fixing it is another. And that usually requires Joe Network Manager to leave his console-crammed war room and go to the trouble spot.

Often the biggest hassles are caused by glitches on one of the world's 170 million PCs, especially when it's part of a heterogeneous network. It's tough to diagnose PC problems because most are hidden from enterprise management platforms.

A slew of LAN management software vendors will read that and say, "Not with our product!" Trouble is, most require your network to be all Novell NetWare — and that just doesn't work in typical large environments.

What might work — possibly as soon as next year — is an emerging standard called the Desktop Management Interface from the Desktop Management Task Force. The DMTF has 75 formal members and 350 participating vendors.

Here's how the DMI will work. Vendors will embed software that complies with the spec in their products, such as LAN adapters, servers, printers, modems and applications. Service layer software running in the PC (using about 14K of memory) will pass operating information to a Management Information Format database, or MIF. That data is then passed to the management platform where applications allow net managers to monitor and manage the devices or applications.

Sounds simple. But does it work? Last week, vendors at the DMTF developers than 30 DMI-enabled products. Specs for PCs and adapters are finished, while work is proceeding on other committees.

The most impressive demo was IBM's, which showed SNMP-based NetView for Windows remotely managing a variety of PCs, adapters and operating systems.

IBM's secret weapon was the Karat Common Agent, which is PC-based software that feeds information from the MIF into a SNMP Management Information Base, or MIB.

The beauty of this outgrowth of IBM's Karat management strategy is that it allows any SNMP-based enterprise management platform to manage PCs and devices with DMI-enabled hardware and software applications. Very cool.

Unfortunately, IBM plans a March 1995 release of this agent software only for workstations running OS/2 or AIX. Vendors of other operating systems have pledged to fill in the gap by building DMI service layer software into their systems. IBM may release agents for other operating systems later in 1995.

The firm also plans to build DMI into OS/2 and AIX.

Microsoft Corp. says its next release of Windows (Windows95) will include DMI support. But only time will tell if Windows95 will work with any enterprise manager.

Microsoft has a powerful incentive not to provide that interoperability Systems Management Server (SMS) — formerly called Hermes — late next month. SMS will contain its own service-layer implementation of the DMI.

IBM is missing a terrific opportunity to make Karat a true gem and deliver Karat Common Agents for DOS/Windows and Macintosh OS right away. You know how hard it is to deal with applications on different management platforms. A common standard would be a godsend.

PCsee, PCdo

The 100-plus vendors that are members of Intel Corp.'s desktop videoconferencing consortium last week proclaimed they are serious about making their bevy of budding products interoperate with each other and H.320-based group conferencing systems.

The Personal Conferencing Work Group demonstrated multipoint conferencing between PC-based and group systems. I like this technology, but one reader flogged me for pitching packet-based video on LANs. "Too bandwidth-intensive and hard to manage," he said. (That's why ATM vendors are licking their chops.)

that reader's skepticism, claiming most desktop videoconferencing systems will be circuit-switched for at least the next 18 months. Gartner claims that only 5,000 desktop units are installed worldwide and projects that just 60,000 units will ship in 1995. 1996 is the year of "sea change," Gartner said.)

Pushing this technology is Intel's No. 2 priority, so expect lots of hype as you figure out how to manage yet another net on top of everything else.

ISDN update

NYNEX told me last week that in January it will roll out pervasive ISDN on Long Island and southern New York, much like Pacific Bell did in California. This will not be "pure" ISDN, however. Users without ISDN in their central office will receive the service from "forsign" switches, albeit at 56K instead of 64K bits/sec. NYNEX said it'll even throw in Intel ProShare videoconferencing for $1,000, almost $500 below its current street price.

Ya' know, I'm beginning to think this ISDN thing just might happen one of these years....

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	H.320	H.321	H.323	H.324
Approval Date	1990	1995	1996/1998	1996
Network	Narrowband Switched digital ISDN	Broadband ISDN ATM LAN	Non-guaranteed bandwidth packet switched networks	POTS, the analog phone system
Video	H.261 H.263	H.261 H.263	H.261 H.263	H.261 H.263
Audio	G.711 G.722 G.728	G.711 G.722 G.728	G.711 G.722 G.728 G.723 G.729	G.723
Multiplexing	H.221	H.221	H.225.0	H.223
Control	H.230	H.242	H.242 H.230	H.245
Multipoint	H.231 H.243	H.231 H.243	H.323	
Data	T.120	T.120	T.120	T.120
Communication Interface	I.400	AAL I.363 AJM I.361 PHY I.400	TCP/IP	V.34 Modem

Intel ProShare

Some Questions

Network Questions

- How did AT&T's efforts inform the idea of an integrated network?
- What would have been the fate of Video Conferencing if the Internet & broadband not occurred?

Business Questions

- Is video conferencing a product or a feature?
- What should be the priority & how do these priorities change with market (e.g business, consumer, etc.)?
  - Video resolution?
  - Refresh rate?
  - Display size?
  - Mobility?
  - Form-factor?
  - Ease-of-use?
  - Comfort?
  - Audio crispness?
  - Audio latency?
  - Ability to share environment (e.g. be able to white board)?
  - Ability of video conferencing to adapt to the user environment (stand, sit, move-around, etc)?
  - Security?
  - Integrate other senses (touch, smell, immersion, in general)
- What sort of cultural barriers remain (e.g. people like to travel, particularly when others are paying for it)?
- Open-source, standards, & interoperability – How do these play out in the long-term?
  - From an end-customer perspective?
  - From an industry perspective

And more questions regarding technology

- Compression
  - Many different compression approaches - some of the more recent efforts, h.265, VP9, AV1, VVC and MPEG-5 Part 1, MPEG-5, Part2 (LCEVC) – does this hinder interoperability?
  - Not certain what other conferencing systems use, but it seems like AV1 has some latency advantages and low-royalty costs
  - What is the future role of WebRTC – will is require Apple to tip it over the edge?
- Displays and cameras – what should we expect?
- Audio is often overlooked – what are the speakers' thoughts on what is still needed with regards to audio?

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- Treasure trove of AT&T video archives https://techchannel.att.com/
- History of AT&T's picture phone https://ethw.org/Picturephone
- Intel's ProShare circa July, 1994
- VSee – Interesting perspective, particularly about the idea of the importance of the network effect for widespread video conferencing adoption https://vsee.com/blog/video-conferencing-the-first-100-years/
- https://www.avinteractive.com/features/technology/av-at-40-video-conferencing-07-06-2012/
    - Tim Duffy, formerly of PictureTel “The adoption of video conferencing is not a technology issue – it’s a perceived value issue. If Skype users had to pay for video, the usage would collapse.” Duffy added: “In my view, the future is clearly in the personal space. Combined unified communications (UC) clients supporting audio, video and web collaboration will replace hardware units, and everyone will want it for free.”
- **SMPTE Conference - The Origins of Audio and Video Compression: Some Pale Gleams from the Past -** https://ieeexplore.ieee.org/document/7269369
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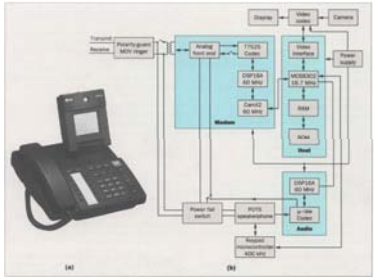
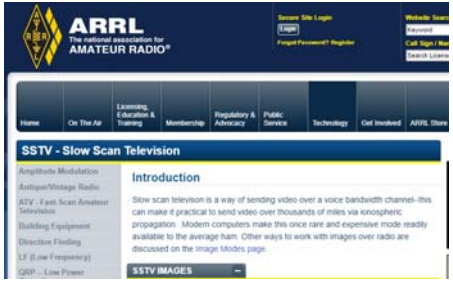
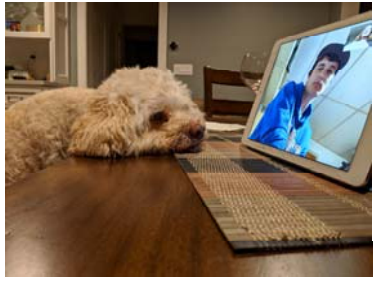


Extra - Some other images



AT&T, CLI to offer analog videoconferencing chipset

Product employs GVS, gives technology boost.