Message from discussion Karl Guttag Conference on Delphi TI Net

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Jeff White jhwhi...@ulkyvx.bitnet

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TI INTERNATIONAL USERS NETWORK
CONFERENCE TRANSCRIPT

Karl Guttag
of Texas Instruments

Designer of Video Display Processors
Microprocessors
Graphics Processors
and More.

Sunday, September 20, 1992

GROUP LIST: 21:33:07
39) Karl Guttag Conference
JeffW, Don O'Neil, Dan Eicher, KarlG, Joe S., JERRYC, Brad Snyder,
JeffG, HYPERION
- idle
AVAILABLE LIST: () = in conf
MARCLEVINE, (TELEDATA/W), (JHWHITE/CFHY), (MYARC/R), LEIGHTYM,
YPSILON,
C_BOBBITT, (JSYZDEK/HY), (DONEIL), (BRADSNYDER), (EICHER),
(JERRYC/A),
(HYPERION/X), CAL47
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.JeffW> Karl Guttag join Texas Instruments in 1977. He worked on the designof the 9918(A) video display processor, was the IC architect of the 9995 and 99000 microprocessors, and specified the design of the 340 family of graphics processors. The 9918(A) is used in the 99/4A and other computers of the early 80's. The 99/4A-compatible MYARC Geneve uses the 9995. Several upscale video platforms running Microsoft Windows and X Window Systems use 340-based boards to speed graphics. 340-based video boards are available for mid-level systems as well, such as the Commodore Amiga.

.JeffW> Karl Guttag is currently the strategy manager for TI's Computer Video Products. We welcome him tonight to discuss past and present projects he has worked on for TI. Karl, do you have any opening words? Or are you ready to take questions?

.KarlG> Nothing much other than I am new at this conference so please bear with me. ga

.JeffW> Karl, could you run your story here in conference? ga

.JeffW> If your TE has an ASCII upload, you might use it. ga

.KarlG> OK, I will give it a try

.KarlG> From Sprites to the TMS34010 Graphics System Processor I lot of people when they think of TI and graphics, think of the 9918 and sprites (the term "sprites", a greek fairy, was coined by one of the 9918's definers). Some people have asked about why the 34010 did not have sprites, and my answer is that the 34010 was designed to handle many more "sprites" and with more capability than the 9918 ever could, but it does them differently. It so happens I was one of the designers of the 9918 and I was in charge of the definition of the 34010 -- and yes there is a connection. Below is that story.

.KarlG> Perhaps the most outstanding feature of the TMS9918 and 9928 (the 9928 was digitally identical to the 9918 but it had different analog outputs) VDP's developed in 1977-78 were the sprites. The sprite concept meant that one could move an object around the screen by merely changing the X and Y coordinate. The '18 was designed in the days when the microprocessor's processing power was very limited and thus "bit-blting", the bit aligned movement of pixel arrays, was not practical.

.KarlG> While sprites were great for games (the 9928/18 were used in Colecovision, TI's home computer, the Japanese home computer standard MS/X, plus a vast number of consumer video products), they have their limitations. For every sprite to be displayed on a given line there had to be a set of hardware which included shift registers, color latches, and counters. The 9918/28 had sprite pre-processing logic (that I designed) that sorted through a list of 32 sprites to show those sprites that would appear on a given line AND kept track of priority (who was on top of who), but due to hardware limitations only 4 sets of display hardware existed. Also limits on the amount of hardware meant that a given sprite could only be 1 color and the size of the sprites were limited to 16 pixels wide (this could be magnified by 2). To have more colors per sprite would mean more shift registers and to have wider sprites would mean longer (bigger) shift registers.

.KarlG> On top of the hardware requirements of sprites, there were bandwidth issues as well. Sorting through the list of sprites consumed a number of the few available memory cycles. If the sprites where bigger or had more colors there would not have been enough bandwidth to support over the 9918's 8-bit bus. Did you know why the 9918 never supported full color bitmapping? - it was because there was not enough memory bandwidth available.

.KarlG> After the 9918, I went off to architect the TMS9995 and TMS99000 16-bit microprocessors for the next 3 years -- they were well designed chips but were late and not well marketed (oh well). In late 1981 I was considering what I wanted to do next, when an application group from TI in England claimed they could do "bit-mapped sprites" (generate sprite like objects on a bitmapped display) IN SOFTWARE with a 9995. The 9995 has an 8-bit external bus and 16-bit internal bus with a 16-bit-wide 256-byte on-chip 333ns RAM which could be used to store tight loops (which made it a lot faster than an 8088 at some things).

.KarlG> Even so, I thought they must be wrong (heck, I knew what they both could do), but I pulled out a calculator, pencil, and paper to see. The calculations showed that the 9995 could handled a few "bitmapped sprites". The reason was that while the 9918 would have to construct each sprite, line by line, which wasted lots of time and memory bandwidth, the 9995 could be much more organized in moving "bitmapped sprites." -- for

example, the 9918 had to constantly re-fetch information on each scan line to define a sprite, where the 9995 would work on each sprite from start to finish into the bitmapped frame buffer.

.KarlG> The nasty problem with the 9995 handling sprites was the bit alignment and field extracting and inserting problems in the moves, which severely restricted the number an size of sprites it could handle. The 9995 could not do everything that the 9918 could, BUT it could do some things that we would not have tried on the 9918 such as multicolored sprites and big sprites.

.KarlG> I then started to consider what could happen if one designed a processor that could handle the bit-aligned manipulations. I worked out that you could generate such sprite effects that it would be prohibitive to build a "hardware sprite chip" that could even come close. You could have more sprites on a line and each of them could be multi-color and not have the severe size limits that hardware imposed.

.KarlG> It turn out that some of the operations "bit-mapped sprites" required already had a name. Xerox had coined the term BitBlts (bit block transfers). In the same time frame as I was calculating "bitmapped sprites" and what they could do, Xerox's Smalltalk graphics kernal article appeared in Byte (August 1981 pp 168-194). I was hooked, and the rest, as they say, is history.

.KarlG> We had very lofty goals for this new chip concept. We wanted to go beyond what was already being done. Particularly there was NOTHING we could find written about COLOR -- so we started creating. The first problem to solve was "TRANSPARENCY", this was the concept that while you might define a object by a rectangle, there could be "holes" in the rectangle defined by place-saver "transparent" pixels (we had "transparency" on the 9918 and we were not going to give it up -- but note a number of the "new" graphics chips DON't support transparency). We invented (or re-invented as some of these concepts may have first been thought of elsewhere but had not been published that we could find) arithmetic operators, plane masking, binary to color expansion, and transparency. In the end, we called the new set of color options (including the boolean operations) PixBlts, since we thought of them as pixel rather than simply bit operations.

.KarlG> When our people were writing the MS-Windows driver, they needed a "hardware" cusor (essentially a "hardware sprite"). They used a technique I developed back when looking a bitmapped sprites. What you do is just before the cursor is to be displayed you save the image under where the cursor is to be drawn, then inhibit drawing until the lines having the cursor have been displayed, and then un-draw the cusor by replacing the saved image. This technique may sound on the surface wasteful (and it is, there are more efficient methods), but on a 640 by 480 display with a 16 by 16 cusor it only takes up about 3% of the total bandwidth (ie you could but up many cursors this way). And the net effect is just what you would get with a "hardware cursor" only you can support more of them with less restrictions than any chip I know of that has "hardware cursors" -- ah, but that is what the 34010 was about in the first place.

.KarlG> --- the end -----

GROUP LIST: 21:45:03
39) Karl Guttag Conference
JeffW, Don O'Neil, Dan Eicher, KarlG, Joe S., JERRYC, Brad Snyder, JeffG, Hype, CAL47, GENNA, Michael., JCARVER, C_BOBBITT, TIMTESCH
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(BRADSNYDER),
(EICHER), (JERRYC/A), (HYPERION/X), (CAL47)
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.JeffW> Okay. Here is how we normally work questions and answers in TI Net conferences.

.JeffW> If you have a question for Karl Guttag, our special guest tonight, type "q" or "?" and the moderator, which is I, will recognize when it is your turn. Such as "ga,".

.JeffW> The guest will answer your ?, end his response with "ga", and I will tell the next person in the ?-queue to ask his/her question.

.JeffW> Let's get to it.

.JeffW> ga, Hype. Ask your question. ga

.Hype> karl, glad to hear that 340 has bitblt/sprite orientation of it functions as well as just line draw etc. Curious: Can it be added/integrated with any graphics board type (ie VGA, XGA as well as TIGA) ?

.KarlG> Normally, a TIGA/340 board runs with a VGA-pass though option. Generally, the old DOS aps run on the VGA, while things like MS-WINDOWS runs on the 340. ga

.Don O'Neil> ?

.Hype> Follow up/clarification?

.JeffW> ga, Hype with your follow-up. But please keep it brief. ga

.Hype> I am just trying to get an idea of how 340 will fit into future of highend graphics (couldn't think how to phrase, thnx)

.Hype> ga

.Dan Eicher> ?

.KarlG> The 34010 was introduced in 1986 with the 34020 being introduce around 1989. They are primarily used today as MS-Windows accelerator X-windows Terminals. Also they are used a lot for PC CAD.

.KarlG> I'm now working on a revolutionary new processor that is target at image processing, which will be the next big future market for the desktop. ga

C_BOBBITT> ?

JERRYC> follow-up Hype - then Chris ga

JERRYC> Ga Chris then Don and Dan

C_BOBBITT> Oh,thanks.

C_BOBBITT> Lots of questions Mr. Guttag, but will only ask one this

time <smile>.. I'm no engineer, but I was wondering how difficult it would be to use.. a 34020 or some variation as a stand-alone microprocessor (albeit with a.. graphical bent). Would make one heck of a Nintendo machine :> - ga

.KarlG> Yes, definitely it can and could be. The 34020 is a full fledge programmable microprocessor. I tried for 2 years to sell it to several game manufacturers a few years back as a super game/ simulator/ virtual reality (abeit simple) machine. At the time they were afraid to take on Nintendo. ga

.Don O'Neil> With the architecture of the 34 series processors, do you believe that it is possible to emulate a 9918 and/or 9938 using the 34010/20?

.KarlG> I guess you could, but it would not be very practical. There might also be some screen hickups since the 340 might not be able to do everything in real time. Another problem would be some of the hardware interfaces to the host, by the time you cleaned it up, it would be cheaper to just buy a 9118 (the problems are somewhat like trying to emulate a 8086 with a 68000). ga

.JeffW> ga, Dan

.Dan Eicher> Karl, even to this day. The 99xx has one of the richest instruction sets available. Very little changed from the 9990-9995, then with the addition of the 99105 and macro store, users could in essance write their own micro code. Had there been a 990000 what direction do you think it would have taken?

.KarlG> Boy, a lot of attempts and millions of dollars where spent at TI on that question. The first thing that has to be fixed is the address reach, and the second would be to move the "workspace registers" into a cache. Note, the SPARC from SUN basically has a workspace cache. Other things like more registers and at least 32-bit registers would have to be done. ga

.Don O'Neil> ?

.JeffW> ga, Don

.Dan Eicher> ?

.Michael.> ?

.Don O'Neil> Why did TI "forget" about the 99000 series? When it was first introduced, it was _the_ hotest performer on the market.

.KarlG> Basically, it was too little, too late when the 99000 came out. I had a 68000 under a microscope before I started on the 99000. Intel and Motorola already had big support programs behind their chips, while at TI we had never generated much software for the microprocessors (the systems division developed minicomputers that ran the same basic instructions, but had different memory management so that almost none of their software would run on the 9900/99000). Yes the 99000 did burn rubber in its day; it could access memory every 166 ns (the 68000 could only cycle memory at 400ns). But this fast bus speed was necessary to get any performance out of the memory to memory architecture, but it then required us to use fast memory. I have often lamented that if we could have had a register to register architecture with the 99000's design we would have had a real barn burner. ga

.Don O'Neil> ?

.JeffW> ga, Dan

.Dan Eicher> With home electronic becoming more and more complex... Has TI ever thought about re-releaseing a 99xx compatable chip to replace the TMS-1000 as an embeded controller, using cheaper silicon manfacturing technology? Any thoughts on the 68689 ASIC Version of a 9995?

.KarlG> No. TI did do a version of the 9900, called the 9940, in 1976-78 that was a bit of a disaster, that was a 16-bit microcomputer. It was both too early and a very poorly designed chip. They finally got it working with a complete re-design but by then the market had past.... I don't think there is much chance of reviving the 9900 family in the way you suggest. Note TI is very involved in building 16-bit microprocessors today. There have been some announcement, for example, a major program called PRISM which is a 16 bit microcomputer with a very modular architecture. (the first applications for PRISM will be in automotive) ga

GROUP LIST: 22:25:54
39) Karl Guttag Conference
JeffW, Don O'Neil, Dan Eicher, KarlG, Joe S., JERRYC, JeffG, HYPERION,
CAL47, Michael., JCARVER, C_BOBBITT, TIMTESCH, TIRUGED, MARKANDERMAN,
SHH
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(LEIGHTYM), (TIRUGED), (MARKANDERMAN), (C_BOBBITT), (JSYZDEK/HY), (DONEIL),
(SHH), (EICHER), GPEARSON, (JERRYC/A), (HYPERION/X), (CAL47)
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.JeffW> ga, Michael

.Michael.> Is there any plans in the future for the 99XXX series of processors, or has TI let that line die?

.KarlG> I understand that the Military Group still develops some 9900 compatible processors, but that is about it (the government has very long design-in design-out cycles, that their contractors support). ga

.Dan Eicher> ?

.JeffW> ga, Don

.Don O'Neil> Do you know of any plans to introduce an ASIC version of the 99000, similar to the SM68689 (asic version of TMS9989)? If not, is it possible to do such a thing (providing funding is there)>

.KarlG> As far as I know, TI has no plans. Generally we would need to see a market for a few 100K units to entertain such a plan. TI is more focused on future products. ga

.JeffW> ga, Dan

.Michael.> ?

.JeffW> ? (I'll put myself in the ?-queue to keep things fair.)

.Dan Eicher> After looking at the spec's in BYTE on DEC's new Alpha processor, one would think that all other processors just become obsolete, have you reviewed the Alpha proc. and do you have any thoughts on it and its impact?

.KarlG> I have only briefly looked at DEC's Alpha (ironically the code name for the 99000 at TI was ALPHA). There are a number of factors that determine the best processor, such as speed, cost, software base, etc. The processor I'm currently working would require a general purpose processor with over 2 Billion operations per second to keep up with it AT IMAG PROCESSING. ga

.Don O'Neil> ?

.JeffW> ga, Michael

.Michael.> What in the form of tech info and programming info, aside from the databook, is out there on the 99105? and where can I get it?

.KarlG> Unfortunately, the product is basically obsolete at TI, and there is very little else other than the data manual that you can get from TI. ga

SHH> ?

.Dan Eicher> ?

.JeffW> Some of our may be interested in why the 99/4A is as it is, with the 8-bit bus and interpreter GPL. Could you tell that story? Maybe even backup to the 9985?

.KarlG> Yes. A few questions back I mentioned the 9940. Well, even though the 9940 was a disaster of a design, it was spun off into a a chip called the 9985. The 9940/9985 was achitected with an 8-bit data path -- essentially it was an 8-bit processors emulating a 16-bit processor (the problem was it took almost as much hardware as a full 16-bit design so it cost too much and had lower performance).

.KarlG> Meanwhile, the home computer group was "ordered" (by the then TI president J. Fred Bucy -- or at least that is how the story goes inside TI) to use a TI processor. So the 9985 was chosen (it may have been that the 9985 coversion was done expressly for the home computer). But as I say, the 9940 and thus 9985 didn't work! But .... the home computer group had already designed the home computer around the 9985. So in the hope that eventually the 9985 would be fixed, they took the 9900 and ADDED hardware around it to make it look like an 8-bit bus 9985 -- thus they paid for a 16-bit processor and hobbled it to an 8-bit bus. BTW, you may also note that the 9985 was to have 256 bytes of SRAM on-chip, and that is the RAM that was put next to the 9900 (all other RAM on the 99/4 was off on the other side of the 9918 (and thus slow to access). Regarding GPL, the story goes that what the home computer designers really wanted was their own, more Z80 like CPU that would run an opcode set called GPL (originally Games Programming Language, later re-cchristened Graphics programming language). Well ... in hope (boy they had a lot of hope) that they would eventually get the CPU of there dreams (ala one that executed GPL directly), they interpreted EVERTHING into GPL. THUS when you ran BASIC, a BASIC instruction is fetch from the 9918's memory over an 8-bit bus, then converted into GPL, then converted into 9900 assembly code. The other engineers at TI at the time used to say, "The TI has the best bag of parts of any home computer, they just put them together wrong"

.KarlG> Some of the above, may be apocryphal, but it is as I saw or heard of it. ga

.JeffW> ga, Don

.Don O'Neil> Do any of the logic diagrams still exist for any of the 9900/99000 series chips? Is it possible to get any copies of these?

.KarlG> I have the logic diagrams for the 9900, 9995 and 99000 in my office, but we/TI do not generally give that kind of information out... BTW, the 9995 was originally called the 9985A but it was several times faster than the 9985. I designed it with a 16-bit bus to be much faster and smaller than the 9985 and it eventually was called the 9995. ga

.JeffW> ga, SHH

SHH> could you briefly tell me what the limiting factors are for realistic tv like movement and realism , and do you see it available soon for pc's soon?

.KarlG> Over the next few years I think a destop system will be able to provide some fairly realisted simulation graphics (equivalent to a high end workstation today). I expect that we will see about 500K fill trangles per second drawing speeds (today's PCs are at perhaps 1 to 10K). We will have two way video confererencing capability. The system will be able to read a greater than a page a second any typical printed page. The technology is already being developed, and the chips will come out over the next couple of years. It may take about 5 years before it is commonplace. ga

.JeffW> ?

.JeffW> ga, Dan

.Dan Eicher> Karl, TI since the days of calculators with LED's had been a leader of Advanced handheld calculator I think the line was ti-85, cc-40, ti-74, procalc-95. Then something happened at TI. No NEW calculators that push the leading edge have been introduced. It seems TI has relinquished the leadership position to HP, Sharp and Casio. TI seems happy pumping out millions of low dollar/medium functionality calculators. Do you think someday TI will reenter that market as a performance leader?

.KarlG> TI has focus their efforts on more educational calculators, such as one that handles fractions (ie it can add 1/3 plus 3/4ths). We still make scientific calculators as well. The calculator market as a whole is not that big a business when compared to the PC and rest of the electronics industry, which may explain a lack of focus on high end calculators. Also for the most part calculators are by today's standards low tech products.

.Dan Eicher> ?

.JeffW> Could you tell us more about the revolutionary imaging processor you are currently working on developing?

.KarlG> I can't say too much about it yet. There will be an overview article about in in the November IEEE Computer Graphics and Applications (I'm also guest editing the issue along with Jack Bressingham, of line drawing fame, and Nick England, from SUN). The chip is capable of over 2 billion RISK-Like operations per second and is targeted at image processing (it

is meant to be like TI's DSPs/320 chips only targeted at imaging). What is both interesting (and a little scary 1000 times faster than a 34020. ga

.JeffW> ga, Dan

.Dan Eicher> Karl, yesterday, while digging around at a ham fest, I came upon a chip labled TMS9996, having memorized, alarge portion of the 99xx databooks, I took this chip home to look for it.... I can't find it! Have you heard of it?

.KarlG> I think that might be a 16-bit bus version of the 9995. The 9995 had a 16-bit internal bus (that when to 256-bytes of internal 16-bit wide RAM) but brought out an 8-bit external bus (ala the 8088 or 68008). It may also have been a special chip for supporting our hardware emmulator (or both). ga

.JeffW> Since there is no one in the ?-queue, I'll ask another.

.Don O'Neil> ?

.JeffW> Did any other major computer manufacturer ever consider using a 9900 family CPU in a personal computer?

.Dan Eicher> ?

.KarlG> I really don't know. The 9900 was used in a number of products other than the home computer (note it was about 4 years old when the home computer came out), but I am not very familiar with its other uses. ga

.JeffW> ga, Don

.Don O'Neil> What are the current pixel height/width/depth limitations of the 340x0 series processors? What's in store for the next 340x0 processor? Why the 010, 020, 030 suffixes? Is there any link to the Motorola suffix(industry rumour).

.KarlG> There are essentially no resolution limits of the 340 architecture. It can handle 1,2,4,8, 16, or 32-bits per pixel. Other than some speed enhancements of the 34020, there are no plans for a 34030. The suffix is just TI's way of numbering follow-on family members, it may have been patterned after Motorola's, but I can't say -- Intel for example has kept with their "lucky" 86 nomenclature and has used the middle digit to signify generations. TI's next step in the graphics/imaging market will be more revolutionary than evolutionary. ga

C_BOBBITT> ?

.JeffW> ga, Dan

.Dan Eicher> Do you know, what kind of deal was struck between Yamaha and TI that allowed them to continue development of the 9918. Aka... The 9938, 9958 ect. If you where on Yamahas 9938 design team, would you have done anything different?

.KarlG> As far as I know, there was no deal. TI was working on a new follow-on to the 9918 that we also called the 9938 (code name was AVDP). But the video game market collapse didn't materialize (the group doing videotext went on to found Prodigy), and the AVDP design had a lot of problems. Faced with a falling market and a design with problems TI stopped the program. My understanding is the Nintendo is based on a 9938 clone and that the Yamaha 9938 was a 9918 clone (I understand they emulate all the 9918 registers etc.) ga

.Dan Eicher> c: Nintendo has the same problem with sprites "dissapearing" if more than 5 per line...

.JeffW> ga, Chris

C_BOBBITT> Lately there has been a lot of interest in a 99/4A.. emulator that runs on PC compatibles. I've heard that the latest.. version runs about full speed on a 386-40Mhz. Is there any processor on the... market today that would be fairly amenable to running a 9900 emulation? ga

.KarlG> It is hard to emulate any processor exactly on any other processors. A rule of thumb is that the same function will run about 100 times slower. It can also be very difficult to emulate in software. Thus, it is often cheapest and easiest to just use the original processor. ga

C_BOBBITT> what if it isn't readily available, like the 99105? <smile>

.JeffW> c: Newark Electronics will sell you a 99105, Chris.

.Dan Eicher> c: or a thousand!

.Dan Eicher> ?

.JeffW> ga, Dan

.KarlG> I think you can still get the 99105, but I'm not sure. You would have to run one of today's fastest processors to get close to emulating a 99105 in "real time". ga

.JeffW> ?

.Dan Eicher> The 9901 is a neat chip, but is getting hard to find. Do you have any pointer on designing one with perhaps two pals and the prologic compiler?

.KarlG> I don't know, The 9901 was a pretty simple chip. It was also a poor combination in that it combined the interrupt interface, of which you need 1 per system with I/O ports that you may need many per system (ie people ended up with mulitple interrupt controllers they did not need to get enough I/O ports). ga

JERRYC> ?

.JeffW> I was looking around for a possible functional replacement for the 9901. I noticed that Motorola makes an 8 interrupt, 8 parallel I/O, and 4 timer chip. Wonder if that -901 suffix is coincidence? Er, chip number is 68901.

.KarlG> I think it is purely coincidental, The 9901 was based on the 9900's CRU interface which was specific to the 9900 family

.KarlG> --- How about a few last questions and rapping things up ---

.KarlG> ga

.JeffW> ga, Jerry

JERRYC> I heard that the 340x0 designs profited from coordinated ram chip designs -- is TI pursuing this approach further?

.KarlG> Yes, I was one of the original definers of the Video RAM that

was used with the 340. I am now very involved with TI's new 4 Megabit Video RAM. It can be a big advantage when designing a processor to know (and have input into what the RAMs will look like when the processor comes out). ga

.Michael.> ?

.JeffW> ga, Michael

.Michael.> The CRU addressing scheme is an interesting design, I wonder If you could reflect on it some more.

.KarlG> In hindsight, many at TI thought is was a mistake. The way CRU worked, the whole CPU and it's address bus gets tide up and it only sends 1 bit of data per I/O cycle. From a design point of view, the CRU instructions were amoung the most complicated instructions to microcode (the code inside the chip that interprets the instructions). Most of us felt that it would have been much better to have put a serial shift register that the CPU could load in one cycle to shift off the chip, and another serial register for shift on the chip (essentially was most microcomputer chips have today). ga

.Michael.> ?

.JeffW> ga, Michael (this will be the last question taken tonight)

.Michael.> What drove TI to use the reverse convention on the address and data bus, ie A0 is the MSB instead of the LSB?

.KarlG> In the days of that decision, IBM used "Big Endian" (MSB=0), and DEC used little endian (LSB=0). TI choose to follow IBM. Intel followed DEC and Motorola's 68000 was all mixed up (they numbered their bits LSB=0 but ordered it. the bytes so that the most significant byte was 0). It turns out that both floating point and graphics are more "naturally" big endian, and integer operations are more naturally little endian. Unforturnately it is a big mixed up world (PC's are little endian, MAC are basically big endian). Today many processors, including the MIPS, 34020, and some other new processors can power up to be either big or little endian. By the way the 9918 was originally designed in "little endian" and at the last miniute, to be 9900 compatible is was switched to big endian (which is why the address bus may appear to be kind of funny in how it connects up when using different size RAMs). ga

.JeffW> Thanks for being our guest tonight, Karl. If you have any questions about using Delphi, let us know.

.Michael.> Thanks Karl, Jeff. Great CO tonight.

.KarlG> I enjoyed it too

.JeffG> Karl, as System Manager of TI NET, I would like to thank you for taking the time tonight and share with us your knowledge. Forthe Staff of TI NET, we thank you and hope you'll be able to join us again at a future time. We appreciate it. Jeff Guide

JERRYC> Thank you Karl!

.KarlG> I appreciate that, now it time to get to bed!

.JeffW> Thanks again, Karl. And if you have any questions on what is happening in the 9900-world today, Delphi is the place to find

out.

.KarlG> bye

.JeffW> Goodnight.

.KarlG> - signed off -

This conference transcript was edited to make the reading of it easier to follow. No significant material was removed or edited.

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Here is signup information for Delphi, which has the TI International Net SIG visited by many notables in the TI 99/4A community.

Cambridge MA, December 9, 1992 -- DELPHI, an international online service, now provides full access to the Internet including real-time electronic mail, file transfers with "FTP," and remote log-ins to other Internet hosts using "Telnet." With this announcement, DELPHI becomes the only leading consumer online service to offer such a wide variety of Internet features.

Russell Williams, DELPHI's general manager, explains the significance of this announcement. "Because DELPHI is a well known consumer online service, the Internet will now be easily accessible to much broader base of personal computer users. DELPHI has easy-to-use menus, low access rates, and over 150 services in addition to the new Internet gateway. DELPHI is also easy to reach; there are access numbers in over 600 cities and towns throughout the US and in many other countries. The combined resources of DELPHI and the Internet is a great package for anyone interested in online services."

The Internet is considered the world's largest computer network. It is comprised of thousands of companies, colleges, schools, government agencies, and other organizations. There are currently an estimated 4 million users. "This incredible reach of the network will mean better and more specialized services for all users" adds Mr. Williams. "For example, users can take electronic courses conducted by leading universities, access reports from government agencies, and get product information and support directly from companies. There are also mailing lists and discussion groups for almost every special interest imaginable. Electronic mail can be used to send private messages to anyone on the Internet and even many commercial networks like Compuserve and MCI Mail."

DELPHI's connection to the Internet works both ways: In addition to offering access out to other networks, DELPHI provides value-added services to people already on the Internet. Any user of the Internet can access DELPHI to use services such as Grolier's Academic American Encyclopedia, the Dictionary of Cultural Literacy, Reuters and UPI newswires, stock quotes, computer support, EAASY Sabre travel

reservations, special interest groups, real-time conferencing, downloadable programs, and multi-player games. All these services can be reached through the Internet simply by joining DELPHI and then telnetting to the address "delphi.com" via the commercial Internet.

In order to help new users with questions related to the Internet, DELPHI has an area online to provide support. The Internet Special Interest Group (SIG) includes an active message forum where members and staff can exchange useful information. Comprehensive guide books, downloadable software, and information files are also available.

DELPHI has two membership plans: the 10/4 Plan is $10 per month and includes the first 4 hours of use; additional use is $4 per hour. The 20/20 Advantage Plan is $20 per month, includes 20 hours of use, and is only $1.80 per hour for additional time. Rates apply for access speeds up to 2400bps; 9600bps access is currently being tested in a few locations. The Internet service option is an extra $3 per month and includes a generous transfer allocation of 10 megabytes (the equivalent of about 3,000 type-written pages). Access during business hours via Sprintnet or Tymnet carries a surcharge.

Through a special trial membership offer, anyone interested in learning more about DELPHI and the Internet can receive 5 hours of access for free. To join, dial by modem, 1-800-365-4636 (current Internet users should telnet to "delphi.com" instead). After connecting, press return once or twice. At the Username prompt, enter JOINDELPHI and at the password prompt, type INTERNETSIG. DELPHI Member Service Representatives can also be reached by voice at 1-800-695-4005.

DELPHI is a service of General Videotex Corporation, a leading developer of interactive and online services based in Cambridge, Massachusetts.

For further information, send email to Walt Howe, DELPHI Internet SIG Manager (walth...@delphi.com).

Reply to author Forward