Quotes

Intel® 4004 processor celebrates 40th anniversary

Quotes by current and former Intel executives and employees

Federico Faggin

Federico Faggin was part of the team that developed the Intel 4004, the world's first commercial microprocessor, which was released in 1971.

Quotes:

"We are fascinated with creating machines built in our image. The microprocessor is arguably the greatest of them all."
NewScientist – "Computers rule OK", Dec. 5, 2009

"Today there is no industry and no human endeavour that hasn't been touched by microprocessors or microcontrollers."
NewScientist – "Computers rule OK", Dec. 5, 2009

"Don't use computers! Very expensive."
Faggin's manager tells him to minimize the use of computer simulation when working on a design for testability while working on the 4004.
(Federico Faggin in his speech at the Computer History Museum in Mountain View at the 35th microprocessor anniversary event)

Masatoshi Shima: ***"You bad! You bad!"***
Faggin: ***"I just arrived here! I just was hired yesterday!"***
Masatoshi Shima: ***"You late!"***
Masatoshi Shima, the Busicom engineer, arriving from Japan to check the designs of the 4004, which was supposed to be in layout as described by Federico Faggin in his speech at the Computer History Museum in Mountain View at the 35th microprocessor anniversary event.

"Here's the instruction register, the instruction decoder, the control logic of the two memory blocks. This is the index register. This is the stack pointer, the program counter, the incrementer-decrementer is here, this is the ALU, the control logic of the ALU, this is the timing, this is the control logic for the external memories (…) And those are my initials, by the way: "FF."
Faggin outlining the design of the Intel 4004 die. He had etched his initials "FF" in the lower-right corner of this first-run sample die.

"Oh, my God. How could I have screwed up so bad?"
In late December 1970 Hoff received the first wafers for the 4004. When he loaded them up…nothing happened. Federico Faggin in his speech at the Computer History Museum in Mountain View at the 35th microprocessor anniversary event.

"It works!"
Faggin to his wife at 4 a.m. the night the 4004 was born. After testing the new silicon all night he returns home tired but very happy.

Ted Hoff

lntel employee number 12, Marcian Edward "Ted" Hoff, was recruited by Robert Noyce and led the project that created the first microprocessor. In 1980 he was named the first Intel Fellow - a position only for the most esteemed engineers. In 2010 U.S. President Barack Obama presented Hoff with the National Medal of Technology and Innovation.

Quotes:
"It's a nice feeling."
Hoff commenting on the fact that a microprocessor controls his pacemaker and, in turn, his heart.

"I had met the fella once before. His name was Bob Noyce. He told me he was staffing a company and asked if I would consider a position there."
Hoff commenting on phone call he got from Robert Noyce, founder of Fairchild Semiconductor, who patented the silicon chip. Now Noyce was bringing together a team to help realise is new ambitions. Ted accepted and became Intel employee number 12.

"At that time, it didn't really make sense to talk about personal computers."
Hoff commenting in 1969 on the time when he was approached by Busicom, a Japanese electronics maker, shopping around for new chips to power a new range of calculator. It would take another three years and four chip generations before one of Intel's processors made it into a commercially available PC.

"One of the things I fault the media for is when you talk about microprocessors, you think about notebook and desktop computers. You don't think of automobiles, or digital cameras or cell phones that make use of computation."
Hoff commenting on the fact that while microprocessors are now ubiquitous, he believes the breadth of their versatility is still under-appreciated.

"I have a whole bunch of computers here at home. I still like to play around with micro-controllers. I like to programme and make them solve technical problems for me."
All above Ted Hoff quotes: www.bbc.com - "the man who invented the microprocessor," May 4, 2011

Andy Grove

Andy Grove participated in the founding of Intel in 1968 together with Robert Noyce and Gordon Moore. From 1987 to 1998 he served as the company's CEO and from 1979 to 1997 he served as President.

Quotes:
"The revolution, started (…) with a small sliver of silicon known as the microprocessor, has had a phenomenal impact on changing the way people work, communicate and obtain information. l believe that we are only at the beginning of this revolution in progress, and the best in personal computing is yet to come."
Grove, commenting on the 25th anniversary of the microprocessor in November 1996 in his Comdex keynote speech Nov. 18, 1996.

Gordon Moore

Gordon E. Moore is the retired Chairman and CEO of Intel Corporation. Moore co-founded Intel in 1968, serving initially as executive vice president. He became President and CEO in 1975 and held that post until elected Chairman and CEO in 1979. He remained CEO until 1987 and was named chairman emeritus in 1997. Moore is widely known for the theory he delivered in 1965 - "Moore's Law" - in which he predicted that the number of components the industry would be able to place on a computer chip would double every year

Quotes:
"Obviously, nothing like this can continue forever. The nature of exponentials is that if you extrapolate them far enough, they always predict a disaster."
Gordon Moore on the future of Moore's Law, April 13, 2005

"We've come to the point where participants in the semiconductor industry recognize they have to move along at least at that rate or fall behind technologically. And in this business that can be a disaster…"
Gordon Moore on Moore's Law as the driving force of technological innovation moving forward, April 13, 2005 on the 40th anniversary of Moore's Law

"I think the world has a lot of problems to deal with in that timescale. But I think the technology that's going to develop in that time period is going to be mind boggling."
Gordon Moore when asked how excited he is about the next 40 years in the industry, April 13, 2005

"When I was Chief Executive at Intel I remember one of our young engineers coming in and describing how you could build a little computer for the home. I said, 'gee that's fine. What would you use it for?' And the only application he could think of was housewives putting their recipes on it. I didn't think that was going to be a very powerful application."
Gordon Moore, April 13, 2005

"I would certainly like to have a much simpler interface – although I don't know what it ought to look like."
Gordon Moore, when asked if computers should be easier to work with for the average consumer, April 13, 2005

"What computers do well and what human brains do well are really completely different. I believe to get to real human intelligence we'll have to go back and… understand how the brain works better than we do now and take a completely different approach."
Gordon Moore, when asked if computers will ever reach human levels of intelligence, April 13, 2005

"I think once the computer understands language well, you can start to have an intelligent conversation with your computer. And I think that will change the way computers are used rather dramatically. But we're a long way from that now…"
Gordon Moore, April 13, 2005

Justin Rattner

Justin Rattner is Intel's Chief Technology Officer (CTO) and head of Intel Labs where he directs Intel's global research efforts in processors, programming, systems, security, communications and, most recently, user experience and interaction.

Quotes:

"The sheer number of advances in the next 40 years will equal or surpass all of the innovative activity that has taken place over the last 10,000 years of human history. At this point, it's fair to ask, what lies ahead? What lies beyond multi-core and many-core computing? And the answer… is called extreme-scale computing. This is multi-core and many-core computing at the extremes. Our 10 year goal here is to achieve nothing modest: a 300x improvement in energy efficiency for computing at the extremes."
Justin Rattner, September 2011, Intel Developer Forum, San Francisco

"Today, a petaFLOPS computer is burning somewhere between five and seven megawatts. So if we just scaled it up by 1000x it would be in the gigawatt range and I'd have to buy everyone a nuclear reactor to run that machine; maybe a couple of nuclear reactors."
Justin Rattner, commenting on Intel's Exascale computing efforts, September 2011, Intel Developer Forum, San Francisco

"When I step back and think about it, I realize we're at a very significant point in time. It's a time where technology is no longer the limiting factor. What limits us today is really our own imagination."
Justin Rattner, September 2011, Intel Developer Forum, San Francisco

"The PC has continuously demonstrated its ability to change with the times. It's an extremely adaptable animal and is undergoing some fairly dramatic changes."
Justin Rattner, BBC News, "How to breathe new life into the PC," Oct. 12, 2011

"While accurately predicting the future has proven to be extremely difficult, inventing the future is actually much more straightforward."
Justin Rattner, October 2011

Paul S. Otellini

Paul S. Otellini is President and Chief Executive Officer of Intel Corporation.

Quotes:
"The transformations in computing have unleashed wave after wave of business and personal productivity and have provided billions of people with their first real opportunity to participate in the global economy. Yet, today I would submit that we are still at the very early stages in the evolution of computing. We've just begun to see its impact on the course of history."
Paul Otellini, September 2011, Intel Developer Forum, San Francisco

"Almost from the very moment of the implications of Moore's Law being posed and becoming understood, there's been speculation that this will some day end… Yet each time the Intel engineers have found a way to innovate, past, around and through perceived obstacles, using new materials, inventing new technologies along the way."
Paul Otellini, September 2011, Intel Developer Forum, San Francisco

"The world needs Moore's Law and Intel is committed to making this happen."
Paul Otellini, September 2011, Intel Developer Forum, San Francisco

"Computing is undergoing the most remarkable transformation since the invention of the PC. The next decade is going to outstrip the innovations of the past three combined."
Paul Otellini, September 2011, Intel Developer Forum, San Francisco

"In the early 1970s, Intel had a breakthrough with the 4004 chip. It had 2300 transistors on it – it was an engineering miracle. Today, Intel makes approximately 5 billion transistors per second in our fabs at Intel. You could fit 100 million of today's 22nm transistors onto the head of a pin. You could spread 4000 of them across the width of a human hair. This is the innovation imperative at work."
Paul Otellini in his speech at Santa Clara University (USA), October 2011

"If there is any great lesson I take from Moore's Law, it is that future innovation is always possible, always in doubt…and always very demanding."
Paul Otellini in his speech at Santa Clara University (USA), October 2011

Sean Maloney

Sean Maloney is Executive Vice President and Chairman of Intel China

Quote:
"As Andy Grove said on the 25th anniversary in 1996, 'the best is yet to come.' He has been proved right. In 2011, 'the cloud' is reaching out to one third of the human race, with microprocessors leading the rest of world to get connected. And yet, the best is still yet to come!"
Sean Maloney, October 2011

Brian Krzanich

Brian Krzanich is Senior Vice President and General Manager of Manufacturing and Supply Chain.

Quote:
"Continuous innovation drives what we do here at Intel. It really requires us to look forward beyond what's out there today in front of us. We have to look and say 'What will people want? What will people need out in the future?' And it's through this innovative spirit that we're delivering higher performing computing at lower cost in high volume to everyone from the rural villager to the research scientist. That's really what drives us."
Brian Krzanich, October 2011 (See video: http://www.youtube.com/watch?v=5WSbIr39l4A)

Quotes by industry analysts

Richard Fichera

Richard Fichera is Vice President and Principal Analyst for Forrester Research.

Quote:
"Clearly the microprocessor ranks up there with such fundamental innovations as writing, agriculture, the wheel and steam power – technologies that rippled through the entire world and transformed civilization. Unlike things that let us do existing things more efficiently, the microprocessor has enabled entirely new relationships between people and their perception of reality as information has changed from something that was manipulated in the abstract to part of the fabric of society."
Richard Fichera, October 2011

Dan Hutcheson

Dan Hutcheson is CEO, Chairman, and Principal Analyst for VLSI Research.

Quote:
"The roots of all things smart, mobile, and personal is the Intel 4004."
Dan Hutcheson, October 2011, (see http://www.chiphistory.org/ for more)

Jon Peddie

Jon Peddie is President of Jon Peddie Research

Quote:
"No one knew at the time the Intel 4004 was developed what it could or would evolve into. Nothing less than brains of everything we use from our cars to our TVs, phones, dishwashers, and the airplanes we travel in. The microprocessor and subsequent technological revolution was the biggest change to ever happen and far surpassing the industrial revolution in terms of wealth creation, quality of life, communications, and understanding."
Jon Peddie, October 2011

Peter Kastner

Peter Kastner is an industry analyst who founded research firm Scott-Page LLC

Quotes:
"Looking forward, systems on a chip and mega-servers will drive enormous - almost unfathomable - changes in research and science, electronic commerce, medicine, national defense, manufacturing, and personal computing. Science fiction becomes reality."
Peter Kastner, October 2011

Nathan Brookwood

Nathan Brookwood is a research fellow at Insight64.

Quotes:
"When the Intel 4004 with its 2300 transistors first appeared in 1971, few imagined how its descendants would reshape every aspect of modern life. The microprocessor enabled personal computers, which in turn begat the laptops and smartphones we take for granted today. Early in my career I stood inside a Univac II CPU that used tens of thousands of vacuum tubes, but not one transistor. Now I think nothing of slipping a phone that contains over a hundred billion transistors into my pocket. Microprocessors operate invisibly to enhance the safety and energy efficiency of the vehicles we drive and the buildings in which we live and work. Microprocessors have improved worker productivity, restructured industries, and created great fortunes for those clever enough to exploit the changes they wrought."
Nathan Brookwood, October 2011

Dean Freeman

Dean Freeman is a Research VP with Gartner Research.

Quote:

"There are many different things you could say about the 4004. I think the bottom line was that it set the stage for the digital era that we are living in. Without the microprocessor we would not enjoy the productivity we have today. Banks are able to be open virtually 24 hours a day due to the computing power provided by the microprocessor. We are able to connect nearly anywhere in the world, and it enables spell check software so I can type faster. The invention of the microprocessor has created a digital world that is affordable to nearly everyone and has given our lives a significantly greater freedom than I think we ever could have imagined 40 years ago. As we look 40 years into the future, and if computing power continues to grow at the rate of the past 40 years, I think the possibilities of what can be done far exceed the imagination as to what the microprocessor will be able to facilitate 40 years in the future."

Dean Freeman, October 2011

Quotes by futurists

Brian David Johnson

Brian David Johnson is Intel's futurist

Quote:

"We cannot forget to let ourselves be surprised by innovation. We can't forget to be open to that silly idea that turns out to be brilliant and changes the world. Increasingly, these ideas will come from all over the world. Each year new innovators are born. I've been to universities all over the world and I'm impressed and wonderfully surprised with the passion and scientific power of our students. The future is theirs. Let them surprise us. That is my prediction for the next 40 years of computing—we will continue to be surprised and it will be awesome."

Brian David Johnson, futurist, Intel Corporation, October 2011 (also see Hunting for the Future of Computing PDF).

Stephen Balkam

Stephen Balkam is CEO of the Family Online Safety Institute

Quote:

"In the early days of the microprocessor, Bill Gates had a vision: a computer on every desk and in every home. At the time, 1977, that statement seemed wild and crazy, even silly. So here's a crazy idea for 2041: a chip in every brain. Why not? The next frontier is nano-technology, neuroscience and where hardware meets wetware. Why can't we, as Larry Page has suggested, just simply search an idea from within our heads? Sounds silly, doesn't it?"

Stephen Balkam, CEO, Family Online Safety Institute, October 2011

Sheryl Connelly

Sheryl Connelly is the futurist at Ford Motor Company

Quote:

"Moore's Law suggests that speed, capacity and cost will improve at such an exponential rate it is almost impossible to imagine how dramatically different computing will be 40 years from now. Perhaps hardware in the modern sense will be obsolete or at least invisible - no mouse, no keyboard, no screen. Could computer interfaces be embedded into the human brain such that all computer functionality is controlled through thoughts? What if the microprocessor was embedded in humans as an enabling device like the pacemaker supports heart functioning. The microprocessor would enhance the brain's capabilities and speed of function but not replace it. Indeed, it would only be called into to function on demand."

Sheryl Connelly, futurist, Ford, October 2011

Andrew Hessel

Andrew Hessel is the Bioinformatics/Biotechnology co-chair, Singularity University and founder, Pink Army Cooperative

Quotes:

"In the coming decades, computers catch up to where biology's been for billions of years - self manufacturing, self-assembling, dynamically programmed, and solar powered."

"One day, anything that processes information will be recognized for what it is: alive."

"Carbon's had a good run. Now it's silicon's turn."

"With the convergence of biological, social, and electronic networks, planet Earth becomes a superorganism."

Andrew Hessel, Bioinformatics/Biotechnology co-chair, Singularity University and founder, Pink Army Cooperative, October 2011, http://about.me/andrewhessel

Miscellaneous quotes

"Announcing a new era of integrated electronics"

The original 1971 Intel advertisement for the 4004 microprocessor

"What the hell is a microprocessor good for?"

Robert Lloyd from IBM's Advanced Computing Systems Division in 1968

"The first microprocessors had limited functionality, low performance, and poor reliability compared with existing computer technology, but they were inexpensive."

Don Alpert – "How microprocessors Upset the Computer Industry", Microprocessor Report December 2006

"There is no reason for any individual to have a computer in his home."
DEC chairman Ken Olson in 1977, when the first microprocessor-based personal computers that didn't require assembly began appearing.

About Intel

Intel (NASDAQ: INTC) is a world leader in computing innovation. The company designs and builds the essential technologies that serve as the foundation for the world's computing devices. Additional information about Intel is available at newsroom.intel.com and blogs.intel.com.

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