Forward 150 Timeline

This timeline of predicted inventions, adaptations, developments and discoveries offers a briefing that includes major statements made in 2006 or earlier by futurists, technologists, scientists and other experts. These experts see the items on this list as highly likely changes to come over the next 150 years. Those listings that are not attributed to one or two specific individuals are developments that are commonly accepted by many experts as proven to be likely, and they are being brought to reality by a number of innovators at many locations around the world.

2010-2014

An Improved Internet; RFID/GPS Tracking Everything; Interactive Guidebooks; Super Supercomputers; Food as Designer Medicine; Intelligent Fabrics, Materials; Other Possibilities

2015

Teleportation; Genetic Profiling; Human Cloning; Autopilot Vehicles; Smart, Adaptable Materials; Customized Food/Smart Packaging; Other Possibilities

2016-2025

Immersive Virtual-Reality Worlds; Ubiquitous Robots; Emotion-Control Devices; Paint-On Power Generation; Holographic Television; Other Possibilities

2026-2045

Biostasis in Space; The Singularity; Space Elevator/Moon Base; Other Possibilities

2046-2150

Time Travel; Brain Downloading; Other Possibilities

Forward 150 Resources

Links and books for more information on the future

Forward 150 - 2010-2014

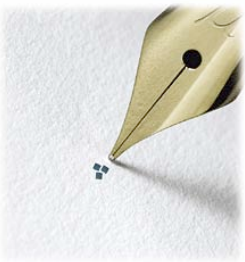
2010 - An Improved Internet

The National Science Foundation is funding a program to develop a re-design of the next-generation Internet, creating a new network that will be suitable for years to come. It is called the Global Environment for Networking Investigations (GENI). The new Internet will focus on security as its main concern. It is expected to be able to handle the increase in Internet traffic expected as more people come online, and also be geared for the increase in content-delivery demands as more video and other large-scale projects are made available online.

The development got under way in August 2005 when the U.S. government provided six small planning grants to the National Science Foundation to begin the project. Internet pioneers support the NSF idea; Leonard Kleinrock said it must be built to handle the boom in internet demands from sources other than computers, such as cellular phones, GPS/RFID-type tracking and hand-held organizers; David Clark, a senior research scientist at the Laboratory for Computer Science at MIT, said while the turn-of-the-century internet is operating at an acceptable level, "There are some things where you say, 'That doesn't work right.'" He said he expects this project will go beyond current efforts such as IPv6 (Internet Protocol Version 6), which would only incrementally improve the internet.

Goals for the GENI initiative include new naming, addressing and identity architectures for the internet; advanced security architecture; a design built to handle a great deal more material at faster rates; traffic documentation; and new applications and services. The NSF announcement said GENI will "enable the vision of pervasive computing and bridge the gap between the physical and virtual worlds by including mobile, wireless and sensor networks."

2010 - RFID/GPS Can Track Anything



Radio-frequency identification detectors are already in heavy use today, but by 2010 they will be even more ubiquitous, woven invisibly into everything everywhere. As of 2006 companies were using RFID in: ID cards to track employees at work; pre-paid passes that record usage and deduct payments at mass-transit systems and tollbooths; tags that monitor student attendance and location in some schools; tracking of shipments of goods and delivery of services.

Global positioning systems (GPS) allow the calculation of the exact position of anything anywhere in the world. By 2006, these were being incorporated in car-safety systems and

in cellular phones, making the devices tools by which people can be tracked and located.

By 2010, you may be able to skip going through any sort of checkout and payment process when you shop or travel. You and all items you intend to purchase will have RFID tags; as you pass out of the door, you will be instantly billed for the items you carry. Passports are also being equipped with RFID tags. Hitachi introduced the tags above in 2005. They are tiny when compared with the tip of a pen.

Some humans and animals are already carrying RFID devices implanted under their skin for identification purposes. Lost pets can be found and returned more easily when they carry such tags. Humans tie their medical records to the RFID number, and emergency personnel can access their identity and medical history (blood type, allergies, pre-existing problems) by using an RFID reader and matching a code number to a patient's file.

This can also be tied to the idea of "IP on everything," which network engineers use to explain that nearly all material items will be networked in the future, from shoes to toasters.

The sort of continuous tracking enabled by GPS, RFID and IP on everything has some negative implications in regard to freedom and privacy. These tools can be used by criminals or others to exert control over people and track them. A debate will continue to rage over the negatives and positives of the use of these devices and their networking.

2010 - Interactive Guidebooks Educate

Innovators are developing interactive guidebooks tourists can use while traveling in vehicles or on foot, alone or in groups all over the world. These tools use GPS signals and allow travelers to hear a guided narration of what they are viewing along with related pictures and sound effects. Some of the places mapped to introduce the new guidebooks are Alcatraz in San Francisco, the Louvre in Paris, Edinburgh Castle and the Van Gogh Museum in Amsterdam. These types of guides will also be applied in other settings, including industrial training on special equipment, possibly even being used to train robots in future decades beyond this period of time.

2011 - SUPER Supercomputers

Computational capabilities are accelerating rapidly, as indicated by IBM's announcement in 2005 that it had doubled the performance of the world's fastest computer, named Blue Gene/L, from 136.8 trillion calculations per second (teraflops) to 280.6 trillion teraflops.

Supercomputer speed rankings are released every six months, and there is a healthy competition among top computer scientists. The United States has plans to create a supercomputer with petaflop capability by 2010. A petaflop - which equates to 1,000,000,000,000,000,000,000,000 operations per second - is equal to 1,000 teraflops.

A supercomputer that will operate at a speed of 10 petaflops (or 10 quadrillion floating-point operations per second) is the 2011 goal of Japan's technology ministry. This would give it a capability close to the computational capacity of the human brain. High-speed computers are used to run simulations (for example, to study the formation of galaxies and to project the paths of hurricanes). Many scientists say they expect that computers will soon surpass the intelligence capacity of humans.

2012 - Food as Designer Medicine

Nearly everything we eat is derived from livestock, crops and microorganisms bred specifically as food. Humans have been modifying these products and redistributing the genes geographically for most of their history. Thanks to gene research, computer modeling and the sharing of new knowledge in science and technology through the internet, the positive attributes of modified foods will continue to be refined.

Crops will continue to be developed to be resistant to diseases, pests and herbicides; they will be developed to screen out allergens (such as the allergenic proteins found in nuts); vaccines will be bred into plants or possibly into livestock - for instance in milk in dairy herds. Fruit can be bred to carry additional essential vitamins and other medicines. People may be able to get necessary medical treatments just by eating.

2012 - Intelligent Fabrics, Materials

By 2012, clothing may be equipped with sensors that can detect body warmth and send a signal to the thermostat controlling the temperature of the room to automatically decrease or increase the temperature of the room based on your body temperature. The sensitive fabrics may also be able to sense your mood and can be set to automatically adjust the lighting in a room.

Clothes may eventually be able to sense and respond to the weather, monitor your vital signs, deliver medications, interface with information systems and automatically protect injuries.

E-ink and e-paper and flexible, foldable computer displays were already in testing stages in 2006 and by 2012 to 2015 they may be common. They can allow, for instance, the easy and instantaneous changing of the printed price tags on every item in a store; easy-to-change signage on trucks, inside and outside retail outlets and along highways; the constant updating of the stories and photos in a newspaper - with moving photos or video possible.

Other Possibilities by 2010-2014

The following are excerpted from the British Telecom Technology Timeline (information was compiled by Ian Neild and Ian Pearson from worldwide sci-tech reports in 2005):

- Artificial Intelligence units used as classroom assistants
- Toys have built-in tracking technology
- People have some virtual friends but don't know which ones are virtual
- Mood-sensitive home décor comes into use
- First divorce due to virtual affair with computer game character
- Addiction to online games seen as a major problem
- DNA used to assemble electronic circuits
- First bacterium assembled from scratch
- AI soccer teams as TV entertainment
- Chips with 10 billion transistors
- Electronic prescriptions reduce fraud and improve speed
- Quiz shows screen for implant technologies
- 24/7 blood-chemistry monitoring
- Laser-activated drug capsules
- Ultrasound or radio-activated medicine capsules
- Blood-analysis chips
- Supermarkets used as major source of medical alerts
- Remote control of insects by neural implants
- Emotion detection used in businesses to select front-line staff
- Instant electronic identification of pathogens
- Lifestyle monitoring and insurance linked to medical records
- Online surgeries dominate first-line medical care
- Video tattoos
- Cyber-drugs (electronically activated drugs)
- Automated pain relief for soldiers
- Bacteria in toothpaste to attack plaque
- Antibacterial coatings on domestic appliances, phones etc, especially in hospitals
- Smells embedded in ordinary household objects
- Flexible displays used for body monitoring and alerts
- Emotional jewelry
- Hand-held scanner to detect tumors using tissue resonance interferometer
- Smart pill bottles remotely monitor medication taking and use alarms
- Hotels offer some hospital services
- Extensive remote sensing use in environmental management
- Effective prediction of most natural disasters
- Chips on food packaging tell when food is at its best
- Most homes have wireless networks
- Smart paint available (contains microchips or nanomaterials)
- Digital bathroom mirrors
- Personalized response from household gadgets
- Mood-sensitive light fixtures/bulbs

- Smart, responsive home and work environments
- Virtual windows open new worlds
- 1 billion internet users in 2010
- Automatic video capture of personal events
- Electronically mediated tribes become major social structures
- Viewers able to pick any angle or player view while watching sports events
- Augmented reality at sports grounds to enhance spectator experience
- Frequent use of multiple Net identities causes personality disorders
- Cheap miniature cameras cause social backlash
- Personal black boxes record everyday life
- Ability to digitally replace or enhance people in your field of view
- 3D "Minority Report"-style air display for information appliances
- Projected augmented reality
- Full-voice interaction with computers
- Voice synthesis quality up to human standard
- Data loss because of format changes becomes major business problem
- Chips with 1 billion transistors
- Quantum effect interferometer for flux measurement
- Use of carbon fullerenes for on chip interconnect
- Self diagnosis using gene chips for domestic use
- Liquid drop lenses for camera phones, etc.
- Terahertz scanners
- Self organizing adaptive integrated circuits
- Molecular sized switches
- Intelligent materials with built-in sensors, storage and effectors
- Smart skin for intelligent clothing and direct human repair
- Use of bacteria to assemble small circuits
- Optical neuro-computers
- Simple quantum computer, 4 Qubits
- 100GB memory sticks (typical 2005 HD capacity)
- Ultra-simple computing - just in time OS
- Bacteria used in detection of explosives
- Autonomous weapons authorized to fire at own discretion
- Household access by facial recognition
- Criminal tagging augmented with video and audio sensors
- Extensive use of electronics to monitor police behavior
- Immersive VR shopping booths
- 60 percent of internet accesses from mobile devices
- Single address for emails, phone calls, etc.
- HDTV over broadband
- Assisted lane-keeping systems in trucks and buses
- Most new cars fitted with positioning systems as standard
- Pollution-monitor chips built into cars
- Light emitting fabrics used in clothes
- Smell emitting clothing, uses context
- TV quality video screens built into clothes

- Jewelry that changes shape, color and texture
- Portable translation device for simple conversation
- Shape changing fabrics
- Terahertz jammers in clothes as personal modesty shield
- Dual appearance - you can change how you look with quick tech
- Laws restrict what can be shown on video clothing
-

Forward 150 - 2015

2015 - Teleportation is Developing

We are probably at least 50 years away from teleporting humans from one location to another, a concept commonly found in science-fiction stories like those told in the "Star Trek" films and TV series. But British astronomer David Darling writes convincingly in his 2005 book, "Teleportation - The Impossible Leap," that we are close to being able to teleport individual atoms and molecules - the first step toward human movement. Next would come the teleportation of macromolecules and microbes, which would eventually lead into the teleportation of humans.

How possible is this? As of 2005, researchers had successfully teleported beams of light across a laboratory bench, and the quantum structure of a trapped calcium ion to a second calcium ion had been teleported. Networked quantum computers are the key. They are more complex than today's commonplace, bit-oriented computers, and will be able to accomplish more complex tasks. They use quantum mechanical aspects such as "entanglement" and "superposition" to perform operations on data.

"Teleportation is going to play a major role in all our futures," Darling writes. "It will be a fundamental process at the heart of quantum computers, which will themselves radically change the world." He adds that replication of inanimate objects will also be developed through the same scientific developments. He says it is "a question of simply overcoming technical challenges," and adds that quantum computing is the "factor that changes the rules of what is and isn't possible."

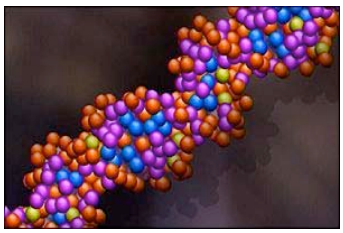
Michio Kaku, a co-founder of String Field Theory, also predicts this: "The nation which dominates the world economy may be the one which masters the nano world of atomic and quantum computing. Then quantum events … will be the source of the world's wealth. The Silicon Age is coming to a close. Welcome to the Quantum Age, where even button-down bankers will have to learn the mysteries of the multiverse."

Teleporting a living human would require a machine that can isolate, classify and track more than a trillion atoms then send them to another location for reassembly in perfect

order. Darling predicts robots or humans will be teleported to other planets or even across interstellar distances.

He projects that, when nanotechnology is mature, an automated nanoassembly unit could be teleported to any destination - perhaps a far-flung planet - and given remote orders to build a robot explorer from the molecular level to full functionality. The robot could then evaluate this new terrain and send the information back to Earth. No space travel involved. It could also be possible to build spacecraft in remote locations using local materials and then use the remote locale as a base from which to explore in the spacecraft.

2015 - Genetic Profiling has Many Uses



By 2015 developments in biotechnology will be improved in regard to profiling, copying and manipulating the genetic organization of plants and animals, facilitating better diagnoses of problems, new treatments and the tracking of disease movement. The human genome is made up of 3 billion chemical bases (or letters), strung in a sequence over 23 pairs of chromosomes. Each human's individual genome is nearly identical, but there are 10 million points in the sequence at which our individual codes may vary.

According to a projective study by experts at the RAND think tank, by 2015 genetic profiling will be used in new ways in security and law enforcement. Genetic engineering will be used to modify more plants, insects and animals in the food chain. Organisms will be further engineered to produce and/or deliver therapeutic drugs and organic compounds. Plants may also be further engineered to optimize their pollution-fighting properties and help the environment.

2015 - Human Cloning is Taking Place

Ethical and health concerns will probably limit wide-scale cloning of humans in regulated areas of the world in 2015. Most studies of the future by think tanks and UN-funded organizations project that fringe individuals or groups will probably be cloning humans (for those willing to pay a great deal for it) in unregulated nations or in illegal black-market operations. Cloning in regard to engineered agricultural products, livestock and research animals is expected to be much more common and create significant changes by 2015.

2015 - Autopilot Vehicles Common

It is expected that by 2015 a number of models of popular cars and trucks will be equipped to drive themselves at least part of the time with the help of on-board computers, GPS satellite navigation, and sensors, lasers and video cameras that will

detect other objects around them. However, most experts say that people will generally want to retain control for some aspects of driving and manual options will still be included in vehicles.

General Motors announced in 2005 that it expects it could have a self-driving car that could pilot itself in heavy traffic at a speed of up to 60 mph in production by 2008. A team from Stanford University won a $2 million cash prize in 2005 for designing a robotic car that maneuvered across a difficult 132-mile course in the Mojave Desert.

A car on autopilot would allow the driver to take a nap, read or complete work for his or her job. There might be a feature for dimming the windows or altering their look to provide a more soothing interior environment with few distractions.

KPMG analyst Bernard Salt says cars will also be "smaller and tailor-made to the owner's specifications; they will be micro-designed and micro-marketed; an electronic fusion of home and office; a communications center as much as a means of transportation." He says people may also have the option of owning cars that have changeable exterior colors to fit their moods.

2015 - Smart, Adaptable Materials Evolve

Scientists are working on making materials that have one or more properties that can be dramatically altered. At left is a smart fluid developed at the Michigan Institute of Technology. A new generation of "reactive" building materials and coatings equipped with sensors, actuators and computers will allow development of such things as:

- Aircraft skins that can adapt their shape to offer the best response to airflow.
- Prosthetic arms and legs that allow growth of natural tissue around them.
- Small robots that mimic the actions of birds or insects and can be used for exploration, research or spy missions.
- Retro-reflective material that can make it possible for clothing to make the wearer invisible - seemingly transparent.

Also, buildings, bridges and roads may be equipped to sense changes in the weather and respond, and they may also be made to detect cracks or other flaws and possibly self-repair them.

2015 - Customized Food/Smart Packaging

Everyone has wondered how long they should heat something up in the microwave, and sometimes a wrong guess can lead to an explosion. By 2015 food may come with microchips in the packaging that communicate with kitchen appliances regarding

complete storage and preparation instructions. Nutrition scientists also project that developments in food technology and engineering may enable marketers to offer convenient healthy snacks that are customized at the point of sale to meet each individual consumer's nutritional requirements and personal preferences.

Other Possibilities by 2015

The following are excerpted from the British Telecom Technology Timeline (information was compiled by Ian Neild and Ian Pearson from worldwide sci-tech reports in 2005):

- Highest-earning celebrity is synthetic
- Dolls come with a personality chip and full sensory input
- 25 percent of TV celebrities are synthetic
- Expert systems surpass average human learning and logic abilities
- Computer agents start being thought of as colleagues instead of tools
- Autonomous AI sales staff units become AI stalkers
- First multi-celled organism assembled from scratch
- Self-aware machine intelligence
- Computer-enhanced dreaming
- Thought-recognition used in sleep enhancement
- High-speed civil transport supersonic jet, 300 passengers, 1,500 mph
- GPS and engine-management systems linked to limit speed automatically
- Paper and coins largely replaced by electronic cash
- Most tickets electronic
- Personal taxation at point of sale
- Automatic dialing from smart business cards
- Augmented-reality overlays used in stores
- Reverse auctions in personal shopping devices (nearby stores bid to provide items on shopping list)
- Hotel in orbit
- Scalable AI as major military threat
- Positive clean ID required for access to many places
- Terrorist use of genetic modification to pollute crops and damage economy
- Most fighters and bombers flown remotely
- Use of network resonance as security threat
- Ambient intelligence detection of minor crimes & anti-social behavior
- Identity theft forces all transactions to use biometrics
- Domestic augmented-reality used to give virtual makeovers
- Biometric ID required for every phone call
- Use of mutant insects for attack purposes
- Robot dance tutors
- Nanowalkers, nanoworms, nanofish
- Mechanical intelligence using MEMS and NEMS
- Supercomputers with speed exceeding 1 ExaFLOPS
- DNA computer
- Use of bacteria for processing and storage

- Desktop computer as fast as human brain
- Use of polymer gels for information processing
- Kitchen rage caused by electronic gadgets
- Electronic implant equivalent to Botox
- Use of virtual-reality scenes in household rooms as decor
- Replacement of people leads to anti-technology subculture
- Most electronic toys are hybrids, with half on internet
- Anti-noise technology built into homes
- Active wallpaper responds to inhabitants' moods, etc.
- Neighborhood video surveillance networks
- Washing machine aware of contents and selects cycle
- Augmented-reality offices used in telework centers
- Palm-top printing puts buttons on skin
- Glasses-based computer displays dominate in the office
- Electronic responses can be automated based on conversational inference
- Windows with coatings to re-direct sunlight
- Nanotechnology toys
- Paper money replaced by smart media
- Spread of nomadic information companies leads to global taxation
- Academic learning is argued to be unnecessary in the age of smart machines
- Integrated taxation in all transactions
- Return-to-sender viruses, corporate counterattacks
- Nano devices roaming within blood vessels under own power
- Use of human's own tissues to grow replacement organs
- Direct electronic pleasure production
- Context-sensitive cyber-drugs
- Electronic stimulation of brain sensations as recreational substitute for drugs
- Some implants seen as status symbols
- Gene-gel stimulation of re-growth of natural teeth on demand
- Retina regeneration using fetal retinal cell injection
- Emotion logging and recording
- Emotionally specific drugs
- Micro-fluidic chips used for gene sequencing in every GP surgery
- Self-certification for prescriptions using electronic diagnostics
- Outpatients at home - remote tele-medical consultations
- Genetic links of all 90 percent of diseases identified
- Individual's genome part of their medical record
- Synthetic organs created by printing layers of cells
- Synthetic viruses created
- Sensory augmentation using sensory implants, nanoparticles etc.
- Use of stem cells to treat human brain after strokes or accidents
- Gene therapy generates new hair cells in humans
- Sensory implants allows direct sensing of cyberspace entities
- Robotic cleaners in hospitals
- Biometrics and medical tests linked to benefits and disability allowance

Forward 150 - 2016-2025

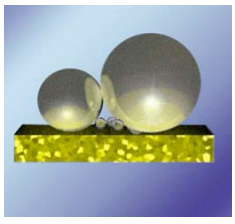
2020 - Immersive Virtual-Reality Worlds

People will spend a large amount of time in virtual-reality worlds in which they will compete, socialize, relax, be entertained and do business by the year 2020. British Telecom futurologist Ian Pearson says immersive computer-generated environments will give people "a life-size, 3-D image and the links to your nervous system allow you to shake hands, it's like being in the other person's office. It's impossible to believe that won't be the normal way of communicating." By 2005, GeoSim, based in Israel, was thoroughly digitizing detail about major cities - see the rendering of Philadelphia above.

Virtual reality may come to mean more to some people than our first reality, and this could generate a number of problems for humankind, especially because it will become prevalent and compelling at a time in our history when humans may actually be under threat of their own inventions. Due to the confluence of nanotechnology, robotics and genetic breakthroughs there is a possibility that control of the world may be shifting toward artificially intelligent entities. Humans have to be on their toes, and not lounging in some virtual paradise.

2020 - Ubiquitous Robots

Futurists and technology experts say robots and artificial intelligence of various sorts will become an accepted part of daily life by the year 2020 and will almost completely take over physical work. Our society will become a care economy. Robots will take over the physical jobs, they will evolve to be smarter than humans, and they are expected to be granted their own set of rights by 2020. Futurologist Ian Pearson projects that robots will be fully conscious, with superhuman levels of intelligence, by this time.



"Consciousness is just another sense, effectively, and that's what we're trying to design in a computer," he told The Observer, a UK newspaper, in 2005. He added that this could make it possible to program "emotional" machines, such as airplanes that are afraid of crashing. The image at left shows a nano-size electric motor created at Berkeley Lab in 2005. Attach wings or legs, and it could be as fast and nimble as a housefly. (Picture courtesy Zettl Research Group.)

Some futurists say humans will increase their intellects to keep up with their creations, others are concerned that the acceleration of technology will outrun humans' ability to keep pace. It is possible that by 2020 supercomputers and the enhancement of human intelligence through brain downloads or implants will allow humans to be equal or superior to artificial-intelligence entities.

No matter how it goes, as robots become more developed and human-like it will be necessary to adjust to the way in which such entities will fit within our social systems.

2020 - Emotion-Control Devices

Experts say psychopaths and criminals could be "cured" with the development of emotion-control devices by 2020. The devices will be placed in the areas of the brain that make these people different and help them to lead more normal, productive lives.

2025 - Paint-On Power Generation

Scientists say it is quite likely that developments in nanotechnology and the science of coatings will yield nano solar cells - each just a billionth of a meter in diameter. They will be sensitive enough to generate power from any light source - even infrared light that can be found indoors - and they will be painted or sprayed onto surfaces everywhere to provide a power source.

These inexpensive electricity-generating surfaces can keep our many digital devices fully charged without any effort on our part.

2025 - Holographic Television

It is expected that by 2025 or sooner humans will be able to watch three-dimensional programming, suspended in mid-air and delivering entertainment, informational and educational programs. Sporting events and film actors will seem to appear in the middle of your living room as if they were standing there in real life. It's also expected that humans will be able to make themselves characters in their favorite sporting events or films.

Other Possibilities by 2016-2025

The following are excerpted from the British Telecom Technology Timeline (information was compiled by Ian Neild and Ian Pearson from worldwide sci-tech reports in 2005):

- AI technology imitating thinking processes of the brain
- AI teachers get better results than most human teachers
- AI starts being noticed as a source of redundancy
- Computers write most of their own software

- Human knowledge is exceeded by machine knowledge
- Electronic pets outnumber organic pets
- Electronic life form given basic rights
- Artificial insects and small animals with artificial brains
- AI entity becomes a Member of British Parliament
- Smart bacteria contains electronics and is linked to net
- AI brings chimpanzee or dolphin up to human-level intelligence
- AI entity awarded Nobel Prize
- Virus wipes out half of the electronic pet population
- Remote-control devices built into living pets
- AI entities given the right to vote
- Nanotech-based organism colonies built
- Synthetic bacteria is created
- Artificial sensors used in cosmetic upgrade surgery
- Smart makeup works to improve people's looks
- Listing of individual's DNA for $1 (10M key base pairs)
- More people using telework centers than home working
- Telework centers double as community resources
- Police force privatized in many nations
- Films where viewers can choose who acts in each role
- Autonomous production plants make everything
- Retirement age begins to be linked to a person's medical history
- Holodecks using room lined completely with polymer screens
- Thought recognition as an everyday input process
- Self-diagnostic, self-repairing robots
- War fought entirely between robot armies
- ID cards replaced by biometric scanning
- Fuel cells replace internal-combustion engines
- Life expectancy approaches 100

Forward 150 - 2026-2045

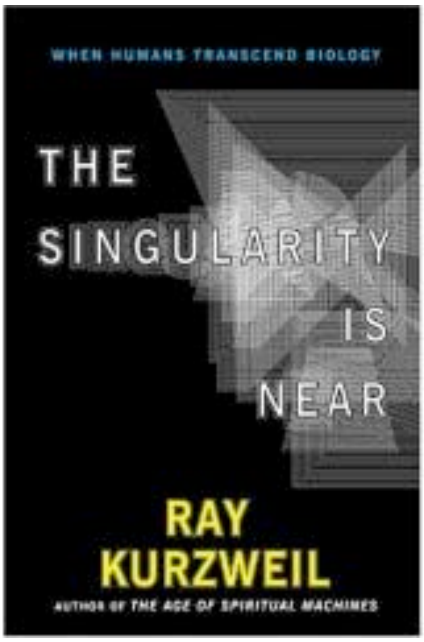
2035 - Biostasis in Space

As technology accelerates, space travel is expected to become as prevalent and easy as people expected it to be by now. In the 1930s, some people expected humans would have accomplished intergalactic travel by the year 2006. While that was not the case, it is expected that by 2035 it will be possible for astronauts to travel extremely far distances to visit other planets without aging.

If teleportation has not yet been accomplished at this point, humans will enter into a state of hibernation for long journeys. The body's metabolism will be slowed to prevent aging on trips that last several decades. The astronauts or travelers will sleep the entire trip

while being connected to drips that will provide them with nutrients and vitamins necessary to live.

2045 or Beyond - The Singularity



The Singularity is a phrase that describes a time at which the simultaneous acceleration of nanotechnology, robotics and genetics change our environment beyond the ability of humans to comprehend or predict. At this point, new realities will prevail and there will be a new norm. Scientists, including National Technology Medal winner Ray Kurzweil (author of "The Singularity is Near") say economic, social and political structures will completely change - possibly overnight. Vernor Vinge, a scientist and teacher, says The Singularity could arrive as instantly as an earthquake and completely change all terrain as we know it.

"When greater-than-human intelligence drives progress," Vinge writes, "that progress will be much more rapid." This accelerating loop of self-improving intelligence could cause a large jump in progress in a very brief period of time - this is being called a "hard takeoff" by people interested in this theory of development.

Kurzweil sees a more gradual acceleration - a "soft takeoff" - one in which humans work to also extend their intellectual capacity to keep up with artificially intelligent entities. Still, he predicts that The Singularity could come as soon as 2045.

The Singularity presents the idea that biological life may eventually be replaced by self-engineering, self-replicating intelligences. Some people posit the extreme, "grey goo" scenario, in which nanotechnology - not the sleek, humanoid robots seen in popular films, but a mass of gunk - displaces humans. Some researchers say that matter could be engineered to embody vast computational capacities - that entire planets or stars may be converted to what is sometimes called "computronium," a form of matter that is an intelligence.

2040 to 2045 - Space Elevator/Moon Base

Planning has already begun for a carbon nanotube cable to run from one or more floating ocean platforms to one or more satellites, connecting Earth to space. Cargo and passengers will be sent up and down the cable as on a really, really tall elevator. The orbiting station to which each cable connects can be used as a launching area for further space exploration, a space-based observation post and a facility for accomplishing

experiments and manufacturing efforts that are best completed in zero gravity. A village on the moon will also be established.

Other Possibilities by 2026-2045

The following are excerpted from the British Telecom Technology Timeline (information was compiled f by Ian Neild and Ian Pearson from worldwide sci-tech reports in 2005):

- AI entity sets up higher-level prize for advanced intelligence
- Learning superseded by transparent interface to smart computer
- Robots physically and mentally superior to humans
- Emulation of bio life form inside the computer using protein emulation
- Living genetically engineered teddy bear
- Production, storage and use of antimatter
- Space factories for commercial production
- First war without any casualties from friendly fire
- Robots outnumber soldiers on battlefield
- Smart bacteria used as military threat to mankind
- Attacks based on facilitating natural disasters
- Smart-bacteria weapons
- Gated cities for civilized people
- Use of solar wind deflectors to set fire to cities
- Nanotech-based virus communicable between machines and people, sent over net
- Asteroid diversion used as weapon
- Moon base the size of small village
- Insect-sized robots banned in gardens due to effects on wildlife
- Robotic delivery for internal mail
- Robotic exercise companion
- More robots than people in developed countries
- Android gladiators
- Genetic modification used to make organic robots
- i-Robot-style robots with polymer muscles and strong AI
- Emotion transmission and conversion (feel love or anger)
- Digital image overlays enhance relationships
- Global voting is held on some issues
- Network-based telepathy begins to take place online
- Language teaching decline due to machine translation services
- Learning superseded by transparent interface to smart computers
- 95 percent of people in advanced nations are computer literate
- VR extensively used in retirement homes
- Restricted capability home genetic engineering kits
- Experience recording allows retention of complete set of sensations
- "Running man"-style entertainment shows using androids
- Widespread use of sensors in the countryside
- Artificial precipitation induction & control
- Global environmental-management corporations

- Electronic memory enhancement
- Many new forms of plants and animals from genetic engineering
- Nanobots in toothpaste attack plaque
- Fully functioning artificial eyes
- Electronic brain implants
- Genetic, chemical and physiological bases of human behavior understood
- DNA compression used to create optimal organisms
- Virus crosses over from machine to human
- Synthetic immune system
- Artificial peripheral nerves
- Sims game using real genetics

Forward 150 - 2046-2150

2050 - Mars Colony

A small group of scientists and explorers will form a colony on Mars. The group will be completely independent, growing their own food in greenhouses. Both the U.S. space program and the European Space Agency have projected a long-term vision of a mission to Mars before 2030, with the idea of developing a colony. Many supporters for such a colony are already making plans. You can read about them at various sites, including Red Colony.com, which offers the mars exploration illustration above.

2050 and Beyond - Time Travel

Amos Ori, a physics professor at Technion University in Israel, said in 2005 that he has compiled a mathematical model that defines the conditions under which time travel might be successful. He said our laws of physics do not rule out the possibility of time travel, and he said "I write mathematically. That doesn't mean I know how to implement it practically. However … if inhabitants of some highly advanced civilization could set up the conditions … they might be able to travel in time." He is quoted in an article in USA Today saying it will require "absolute emptiness - a vacuum … That means that, in principle, a closed, time-like curve could happen naturally, possibly through cataclysmic astronomical collisions in the abyss of space."

2050 and Beyond - Brain Downloading

According to Ian Pearson, a British Telecom "futurologist," humans will be able to download information, images, memories, feelings and more to their brains by the year 2050. Also, by this time everything already in your brain can be downloaded to a

computer and saved. This will allow digital immortality, because a person's brain activity can be saved forever and also downloaded and uploaded forever.

Other Possibilities by 2046-2150

The following are excerpted from the British Telecom Technology Timeline (information was compiled by Ian Neild and Ian Pearson from worldwide sci-tech reports in 2005):

- Political correctness creates new dark age
- Whole generation unable to effectively read, write, think, and work
- Human genetic engineering creates hostile super-race
- Humans assimilated into net
- Time travel works with humans
- Immortality chip - people move into cyberspace
- Faster-than-light travel by 2100

Forward 150 - Related Resources

SITES - For online information about the future, try these links:

Kurzweil Accelerating Intelligence Network:
http://www.kurzweilai.net

The Institute for the Future:
http://www.iftf.org/features/reports.html

The Foresight Nanotech Institute:
http://www.foresight.org/

Acceleration Studies Foundation:
http://accelerating.org/

The British Telecom Timeline:
http://www.btplc.com/Innovation/News/timeline/TechnologyTimeline.pdf

The Millennium Project of the United Nations University:
http://www.acunu.org/

World Futures Studies Federation:
http://www.wfsf.org/index.shtml

Global Business Network - consultants exploring the future:
http://www.gbn.com

The Worldwatch Institute:
http://www.worldwatch.org

The World Future Society
http://www.wfs.org

The Foundation for the Future
http://www.futurefoundation.org

Association of Professional Futurists:
http://www.profuturists.com/perspective/

The Club of Rome - global think tank:
http://www.clubofrome.org

The Long Bets Foundation - Accountable Predictions:
http://www.longbets.org

Future Studies page:
http://www.future-studies.com/

Plausible Futures Newsletter - News and Analysis for Future Studies:
http://www.plausiblefutures.com

RAND - a non-profit think tank
http://www.rand.org

The National Intelligence Council Report on the Future:
http://www.ey.com/global/content.nsf/International/Biotechnology_Report_2005

The Harrow Technology Report:
http://www.theharrowgroup.com/

Center for Responsible Nanotechnology:
http://www.crnano.org/action.htm

Institute for Alternative Futures:
http://www.altfutures.com/

The Extropy Institute - a transhumanist site
http://www.extropy.org

Hawaii Research Center for Futures Studies:
http://www.futures.hawaii.edu/

The DaVinci Insitute - Unlocking Your Future:

http://www.davinciinstitute.com/

Red Colony.com - The Future of Mars Today:
http://www.redcolony.com

Space.com:
http://www.space.com

Futurist.com:
http://www.futurist.com

FUTUREdition - The Arlington Institute:
http://www.arlingtoninstitute.org/

Future FEEDER.com:
http://futurefeeder.com

BOOKS - To read more about the future, check these titles:

The staff at the Acceleration Studies Foundation recommends the following 50 titles as being best for studying accelerating change and projecting what might come in the years ahead:

Big Picture - "A Brief History of Everything," Ken Wilber, 2001; "Global Brain: The Evolution of the Mass Mind from the Big Bang to the 21st Century," Howard Bloom, 2000; "Guns, Germs, and Steel: The Fates of Human Societies," Jared Diamond, 1999; "Nonzero: The Logic of Human Destiny," Robert Wright, 2000; "The Singularity is Near," Ray Kurzweil, 2005.

Business - "Creative Destruction," Richard Foster and Sarah Kaplan, 2001; "It's Not the Big That Eat the Small, It's the Fast that Eat the Slow," Jason Jennings, 2002; "Leading the Revolution: Making Innovation a Way of Life," Gary Hamel, 2002; "Seeing What's Next," Clayton Christiansen, 2004 ; "The Balanced Scorecard: Translating Strategy into Action," Robert Kaplan and David Norton, 1996; "The Fortune at the Bottom of the Pyramid," C.K. Prahalad, 2004; "The Intelligent Investor," Benjamin Graham, 2003; "The World is Flat," Thomas Friedman, 2005.

Science/Science Theory - "An Introduction to General Systems Thinking," Gerald Weinberg, 1975/2001; "Biocosm," James Gardner, 2003; "Cosmic Evolution: The Rise of Complexity in Nature," Eric Chaisson, 2002; "Life's Solution: Inevitable Humans in a Lonely Universe," Simon Conway Morris, 2003; "Linked: The New Science of Networks," Albert Barabasi, 2002; "Six Degrees: The Science of a Connected Age," Duncan Watts, 2003; "Ubiquity: The Science of History, Or Why the World is Simpler than You Think," Mark Buchanan, 2001.

Society, Politics, and Humanism - "Development as Freedom," Amartya Sen, 2000;

"Diffusion of Innovations," Everett Rogers, 2003; "Extraordinary Popular Delusions and the Madness of Crowds," Charles MacKay, 1841/1995; "From Third World to First: The Singapore Story, 1965-2000," Lee Kuan Yew, 2000; "In Defense of Globalization," Jadgish Bhagwati, 2004; "Millennials Rising," Niel Howe and William Strauss, 2000; "Out of Control: The New Biology of Machines, Social Systems, and the Economic World," Kevin Kelly, 1994; "The Future of Freedom," Fareed Zakaria, 2003; "The Mystery of Capital," Hernando De Soto, 2003; "The Tipping Point: How Little Things Can Make a Big Difference," Malcolm Gladwell, 2002; "The Wisdom of Crowds," James Surowiecki, 2004.

Technology - "Digital Biology", Peter Bentley, 2000; "Flesh and Machines: How Robots Will Change Us," Rodney Brooks, 2002; "Nanotechnology: A Gentle Introduction to the Next Big Idea," Mark Ratner, 2002; "Natural-Born Cyborgs: Minds, Technologies, and the Future of Human Intelligence," Andy Clark, 2003; "Net Attitude," John Patrick, 2001; "On Intelligence," Jeff Hawkins, 2004. "Our Posthuman Future: Consequences of the Biotechnology Revolution," Francis Fukuyama, 2002; "Persuasive Technology: Using Computers to Change What We Think and Do," B.J. Fogg, 2002. "The Age of Spiritual Machines," Ray Kurzweil, 1999; "Visions of Technology: A Century of Vital Debate about Machines, Systems, and the Human World," Richard Rhodes, 2000; "Visualize This: Collaboration, Communication, and Commerce in the 21st Century," Joe Clabby, 2001; "When Things Start to Think," Niel Gershenfeld, 2000.

Trends and Indicators - "2000 Index of Economic Freedom," Gerald O'Driscoll, 1999 - "Global Trends 2005: A Owner's Manual for the Next Decade," Michael Mazarr, 2001; "It's Getting Better All the Time: 100 Greatest Trends in the Last 100 Years," Stephen Moore and Julian Simon, 2000; "Penguin Atlas of War and Peace," Dan Smith, 2003; "Penguin State of the World Atlas," Dan Smith, 2003; "The First Measured Century: Trends in America, 1900-2000" Theodore Caplow et. al., 2000; "The Progress Paradox: How Life Gets Better While People Feel Worse," Gregg Easterbrook, 2003; "World Factbook 2004" Central Intelligence Agency, 2003; "The World in 2020," Hamish MacRae, 1996

World Security/Outlook/Environment - "Of Paradise and Power," Robert Kagan, 2003; "Global Crises, Global Solutions," Bjorn Lomborg (Ed.), 2004; "The Pentagon's New Map," Thomas Barnett, 2004; "The Skeptical Environmentalist," Bjorn Lomborg, 2001; "The Transparent Society," David Brin, 1998

Youth Reading - "Tackling Tomorrow Today," Art Shostak (Ed.), 2005. (Four-volume set).

Excerpted the Elon University/Pew Internet
Imagining the Internet site: www.elon.edu/predictions