Technology

Tools are used to adapt, change, or control an environment. Tool-using cultures are groups of beings (not necessarily sophonts) with the ability to find or make tools. But, using tools is not enough:

Technology is the ability to use tools <u>to make other tools</u>.

When societies make the leap to using tools to make tools, they become technological. Technology builds on the successes of earlier tool-making experiences, and progresses to ever higher levels.

Many beings (not necessarily sophonts) make and use tools. Technological cultures make the leap to intelligence when they discover how to use tools to make other, more sophisticated, tools.

UNDERSTANDING TECHNOLOGY

Technology's value is three-fold:

A person using technology can do more (often much more) than a similar person not using technology. **Technology is a labor multiplier.**

A person using technology can achieve higher quality (often much higher) than a similar person not using technology. **Technology enhances quality.**

A person using technology can create objects or results which are impossible without the use of technology. **Technology can achieve impossibilities.**

Defining Tools

Tools are defined very broadly. They are the objects by which sophonts manipulate the universe.

A hammer is a tool for construction. A communicator is a tool for information exchange. A hazmat suit is a tool for safely handling hazardous materials.

Tools and Tools^2. Because technology is the use **of** tools to make tools, a special term is required: tools^2 (in place of the longer and more tedious term tool-making tools.)

Tools Shape Us. A technological society is shaped by the tools it makes and uses. A society with efficient biological tools becomes focused on biological structures and concentrates its research and output on biological machines.

DESCRIBING TECHNOLOGY

Technology is classified by Technological Level (or Tech Level, or TL): each TL represents a significant increase in the capabilities of the previous TL.

Powers of 10. Each TL represents a combined order of magnitude increase in capability (measured across the three measures of technology: labor enhancement, quality improvement, and achievement of impossibilities).

Technological Levels. Technological Levels are numbered on a theoretically open ended scale beginning with Zero and extending through 15 and higher. At much higher levels, technology becomes incomprehensible to much lower levels.

For example,

The Tech Level for an object is often appended to an object name. Rifle-5 is a tech level 5 firearm. Comm-10 is a tech level 10 communicator.

Tech Level is often used to describe a world or a society. Regina (the world) is TL-10. The Aslan Colonies which span the Great Rift are TL-12.

There Are Alternatives To Technology

There are non-technological activities which can achieve the results of technology. Social groups with poor access to tools (abyssal societies with limited access to fire; hydrogen societies with limited access to solid objects; those with clumsy manipulators; swimmers and aquatic cultures) may develop alternative or non-technological cultures.

Cultures. Some societies use Culture (the norms of behavior for a society) as a substitute for technology. A culture that expects higher labor output per individual, or greater attention to quality, or even spontaneous response to challenges is substituting cultural imperatives for technology.

Disciplines. Some individuals adopt disciplines which increase their efficiency or improve their output quality. Members of a martial arts discipline are more effective (efficient) because of their devotion to its principles.

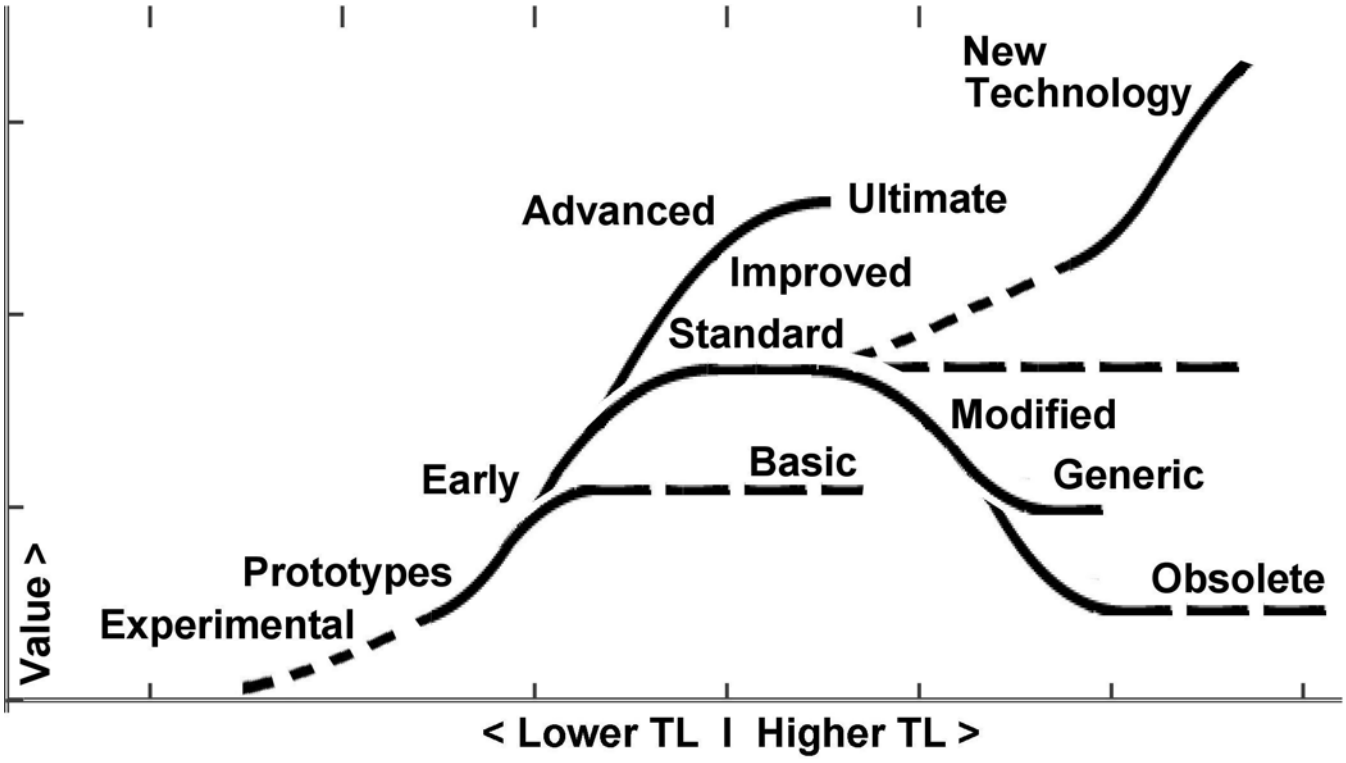
Geneering. Some species develop the ability to alter their own genetics. These altered individuals become tool-substitutes. The **Pseudo-Technological Hypothesis** remains unsettled: If a geneering culture creates a being (a tool) which can then create other and different geneered beings (other tools), does that meet the definition of technology?

Parasitism or Symbiosis. Some sophonts are themselves unable to use tools: they attach themselves to hosts (sophont tool users). The parasites themselves are not tool users, but may achieve the benefits of technology through their hosts.

Nevertheless

The vast majority of sophont cultures throughout the universe (90% of sophont cultures; 99% of sophont cultures reaching beyond their own homeworld) are technological.

TECHNOLOGICAL LEVEL STAGES



Tech Level Stages

A Tech Level shows devices that an industry with available tools can manufacture, maintain, and use. Tech Levels are an inexact approximation: they shade into earlier and later TLs. Such gradations are expressed as Stages. Tech Level Stages describe locations in the long term cycle of technological development. For example,

Experimental is handmade by inventors excited about the potential of a new technology, usually one-of-a-kind, and often dangerous and unreliable.

Prototype is the first step before early mass production. There are perhaps a dozen examples of any one prototype.

Early is the first mass-produced design, before the technology has been completely refined.

Basic is a cheaper, bulkier, less-featured version of the standard item.

Standard is the version with the expected features for the technology when it is mature and stable.

Alternate is a rethinking of the application of technology, often emphasizing different results or outputs.

Improved is the implementation of additional features.

Modified is a specialized version created in response to specific needs..

Generic is an equivalent to the standard version produced at lower cost using higher tech level manufacturing capabilities.

Advanced has significant capabilities added.

Ultimate implements significant improvements learned over the life cycle of the product. Beyond Ultimate is new technology.

UNDERSTANDING TL STAGES

Analyze a common type of device (a car, a rifle, an entertainment system, a communicator) by assigning it TL Stages and visualize precisely what each Stage means.

Stage	Device	Device
Experimental	Car	Rifle
Prototype	Car	Rifle
Early	Car	Rifle
Basic	Car	Rifle
Standard	Car	Rifle
Alternate	Car	Rifle
Improved	Car	Rifle
Modified	Car	Rifle
Generic	Car	Rifle
Advanced	Car	Rifle
Ultimate	Car	Rifle

TECH LEVEL STAGE EFFECTS

TL	Stage	Q	R	E	B	S	Comments
-2	Experimental	F	- 2	- 3	+3	- 3	One of a kind. Lesser capabilities. Much heavier. Very costly.
-1	Prototype	F	- 2	- 2	+2	- 2	One of very few. Lesser capabilities. Heavier. Costly.
-1	Early	F		- 1	+1	- 1	Lesser capabilities. Heavy. Costly.
0	Standard	F					Typical of available models.
0	Basic	F			+1		Heavier. Cheaper.
+1	Alternate	F					Some different capabilities.
+1	Improved	F	+2	+2			Some improved capabilities. Greater Ease of Use.
+2	Modified	F		+1		+1	Lighter.
+2	Generic	F					Functionally equivalent to Standard, but cheaper.
+3	Advanced	F	+2	+2	- 2	+2	Lighter. Added capabilities.
+4	Ultimate	F	+2	+3	- 2	+3	Lighter. Most effective. Costlier.

F= Flux (the value may vary depending on the manufacturer).

DECIMAL TECH LEVELS

Any Tech Level can be subdivided into decimal sublevels to highlight or rank differences.

Historical Differences. Decimal Tech Levels allows a greater understanding of the historical relationships between devices. Tech Level 1 is filled with inventions and decimal levels help rank them.

Situational Differences. Objects within a TL may differ in their sophistication. Detailed comparisons of objects at a specific TL may call for decimal levels. Some Stages of objects represent differences of less than a full TL and decimal levels may be appropriate.

LEAPS IN TECHNOLOGY

The steady increase in Technological Levels is punctuated by occasional Leaps: major advances that introduce new concepts. The effects of such leaps are felt for many levels to follow.

TL-1. Using Tools To Make Tools. By far, the greatest technological leap is the first one: the increase from TL-0 to TL-1. The culture, which already uses simple tools (rocks; clubs) discovers the ability to use them to make other, more sophisticated tools.

TL-4. Division of Labor and Mass Production. The invention (or the discovery) of division of labor and mass production marks the transition from individual craftsmen to relatively unskilled labor. Objects show a significant increase in labor efficiency and an increase in quality.

TL-7. Processors. The widespread availability of information processors and integrated electronic circuits makes possible sophisticated devices which supplant tedious sophont thought processes.

TL-10. Gravity Manipulation. The development of practical gravity manipulation and its associated transportation systems revolutionize travel and the movement of goods.

TL-13. Effective Biological Sciences. Cloning, supplemented by forced-growth processes, makes geneering possible.

TL-16. Artificial Persons. The widespread availability of artificial persons, including practical robots, artificial intelligence in computers, and self-aware mechanisms replaces sophonts in most non-creative activities.

TL-19. Matter Transport. The availability of elemental matter portals (transporting raw materials across Au distances efficiently) transforms concepts of physical value.

TL-22. Individual Transformations. The lines between individuals blur as bodies become customizable, replaceable, and disposable.

TL-25. Psionic Engineering. Technological tools based on psionic principles revolutionize communications and manufacturing.

TL-28. Stellar Scale Physical Manipulation. Technology develops capabilities to manipulate worlds and stars.

TL-31. Pocket Universes. The ability to create and manipulate pocket universes infinitely expands available resources and turns all but the most adventurous inward. Includes reality manipulation.

TL-33. The Technological Singularity.

AN INEXACT PROGRESSION

The Technological Scale ranks technology; it does not define how far a society will go, or how fast it will progress.

Technological progress is often (as here) presented as a linear sequence: a steady progression from TL-5 to TL-6 to TL-7.

The reality is far more complex:

Societies Are Contaminated By Other Technologies.

Unless a society develops in true isolation, it absorbs other technologies as it encounters them. There is no **Prime Directive**: no external rules that protects developing technologies from interference. Individuals and companies are free to sell technology to any markets that will buy it.

The result is that societies have a wide range of available technologies: imported devices, local adaptations, crude imitations, and even local alternatives. Once a society knows something is possible (because a visiting star captain had a working device), it can attempt to duplicate it.

Not All Technological Societies Advance

Technology does not mandate advancement. Societies may adopt enough technology to meet their needs and then be content with stability.

A culture which values reproduction (at a non-conscious, genetic level) may discover technological means of enhancing reproduction, leading to overpopulation leading to societal and technological collapse.

A pleasure-seeking culture may advance in some areas but ignore technology which does not advance its pursuit of hedonism.

Some cultures value social stability: technology that disrupts society may be banned or suppressed.

Not All Technological Societies Survive

Technology does not mandate survival. A society may faces challenges which overwhelm its tech level. Or technology may itself destroy a society.

Plague or disaster can wipe out a society whose Technological level is insufficiently advanced.

A violent culture may discover nuclear weapons and destroy itself (or follow cycles of development and regression).

An irresponsible culture may adopt nuclear power without sufficient safeguards, or genetic modifications or industrialization without considering the long-range consequences.

Not All Technological Societies Prosper

Technology does not guarantee prosperity or quality of life.

An oppressive society may depend on technology to maintain its domination of the population.

A culture may concentrate its technology (for reasons incomprehensible outside of that culture) in areas other than the general welfare: in strange or useless or peripheral activities that do not improve or advance society in general.

THE PARADIGM SHIFTS

There are a very few significant technological advancements that most societies never discover. These **paradigm shifts** are concepts that require such a profound change in basic understandings of principles that they are discovered only phenomenal genius, or phenomenal luck.

The total number of possible paradigm shifts is unknown but probably very small. Three known examples are:

Jump Drive. Jump Drive technology enables a ship to transition into Jump Space and emerge some great distance away within a reasonable time, effectively multiples of 170 times the speed of light.

Jump drive makes interstellar flight practical.

Fusion Plus. Fusion Plus (or cold fusion or Fusion+ or F+) produces an efficient (very little waste heat) energy output through catalyzed fusion of hydrogen.

Cold fusion disconnects ordinary activity from the cost of energy.

Cold fusion is distinguished from Fusion by its small size: Fusion is suitable for large multi-kiloton installations; Fusion Plus is a small, relatively portable installation suitable for vehicles and homes.

Reality Manipulation. Reality engineering allows editing of reality on a real-time basis: manipulation of physical laws, and revision or reversal of event flow.

The Favored Society Effect. A very few (one in a thouand) societies independently make a paradigm shift at the proper time to discover one of the crucial technological advances. These favored, fortunate societies gain in two ways: they have an important technological principle that gives them power over their less fortunate neighbors, and the discovery imparts to their collective self-image a level of confidence or self-esteem that makes them to a dominant position in interstellar society.

For example, the discovery of Jump Drive by the Vilani (at a time when all of its neighbors were using NAFAL Not-As-Fast-As-Light drives) gave them a technological advantage and reinforced their own self-image as the natural rulers of interstellar space. They used their discovery to found an empire that lasted five thousand years.

The Favored Society Effect Inverse. Many societies send out expeditions to the stars and find the universe is already settled. Some societies are visited by starfarers bringing new technology and the implied message that the stars are home to better, stronger, superior cultures. Most such societies retreat to their own territories, content to rule their homeworld and focus inward.

When the Kisthdra first ventured beyond their system in NAFAL ships, the crews returned home aboard Vilani starliners. The realization that the stars had already been conquered, and belonged to someone else, crushed the collective spirit of Kisthdra society: they rarely venture beyond their world even now.

The result is interstellar domination by a favored few sophonts, and many worlds each home to a unique race and its own introspective interests.

THE TECHNOLOGICAL SINGULARITY

Technology builds on technology. Each Tech Level is built on the previous ones.

Technological knowledge increases exponentially. Each Tech Level represents an expanding body of knowledge: many of the advances increase the rate at which new advances can be made.

Technological progress accelerates. The time between technological levels decreases, assuming a large population working on technology sufficient resources being devoted to it, and assuming the cultures involved care about advancing technology.

There Is A Maximum

Ultimately, the tool-making tools of technology surpass the capabilities of the sophonts who use them. Computers may surpass sophonts in intelligence, and more importantly, in sophont-like insights. Computer interfaces may raise the abilities of sophonts to new levels. Geneering and medical science may increase the intelligence and talents of sophonts to a degree that accelerates technological advance.

TL-Z =
The Technological Singularity=
TL-33

The Technological Singularity. There is an endpoint in the TL scale where tools become self-replicating, self-improving, and panscient (all skillful). With these features in place, technology becomes meaningless and is no longer an applicable term.

At the Technological Singularity, everything is possible: tools^2 respond to virtually all needs without discernible delay.

For example, as a society advances beyond TL-24 and approaches TL-Z, technology provides everything, in high quality, on demand, to everyone in the society. Robots or sophontoids do all the work; artificial intelligences manage all of society's systems; individuals can choose any number of entertainments or challenges, learn or access most of the knowledge of the universe, do anything, experience anything, do anything, and all without risk, and strangely enough, without challenge of reward. At that point, sophonts must either grow, or die. Various societies choose various options, but in every circumstance:

The Technological Singularity is Unstable. The features and the abilities of the Technological Singularity promote any number of consequences, all of which lead to changes that end the Technological Singularity.

Some consequences are:

; Society transcends technology advancing to metaphysical pursuits which transcend the physical plane.

; Society retreats to a simple, non-technological pastoral existence.

; Society collapses from the strain. It loses its high tech tools and begins the cycle of technological development again.

; Society fragments; some factions transcend; others retreat; still others struggle to maintain or reacquire the TS.

The Single Example of a Technological Singularity

History recognizes one period in which the Technological Singularity was approached (if not actually achieved).

Insert your guess here. _____.

The March of Technology-1

Technological Levels define the point in the technology continuum where specific objects can commonly be produced.

TL

Energy, Society, Environ, Comm

		Era	Energy	Society	Environments	Communications
	0	Primitive. Stone Age.	Personal Effort. Fire.	Tribe. Clan.	Natural. Crude Shelters.	Personal Senses. Messengers.
Vlow Tech	**1**	Bronze Age 3500 BC	Water Power	Ethnic Groups	Settlements Villages	Memorization.
	1.3	Iron Age 1300 BC			Towns Roads, Canals	Writing
	1.6	Middle Ages 600 AD		Kingdoms	Cities	
	2	The Age of Sail 1500 AD	Wind. Sail.	Nations		Printing
	3	Industrial Revolution 1700 AD	Coal. Steam.	Democracies		
	3.3	1800				
	3.6	1850				Code By Wire.
Low Tech	**4**	Mechanization 1900 AD	Electricity		Skyscrapers	Sound by Wire. Image Capture.
	5	1930 AD	Petrochemicals.	Dictators		Broadcast Sound. Sound Recording.
	6	Nuclear Age 1950 AD	Nuclear Fission.	Political Superpowers		Broadcast Images. Video Recording.
Mid tech	**7**	1975 AD	Geothermal. Solar.			
	8	2000 AD	Renewables.			Personal Comms
	9	2020 AD	Early Fusion.		Arcologies	3D Images and Video
High Tech	**10**	2100 AD	Practical Fusion	World Communities		
	11	Imperial Average Circa Year Zero	[FusionPlus]			
	12					
VhighTech	**13**	Imperial Maximum Circa 550		Robots		CommPlus
	14					
	15	Imperial Maximum Circa 1107				
Xhigh Tech	**16**	Darrian Maximum	Anti-Matter	Artificial Persons. The Under Society.		
	17					
	18		Collector			
Uhigh Tech	**19**					
	20					Matter Transport
	21				Scattered Site Dwellings	

The March of Technology-2

Technological Levels define the point in the technology continuum where specific objects can commonly be produced.

TL

Transport, Medicine, Science, Computers

		Era	Transportation	Medical	Science	Computers
	0	Primitive. Stone Age.	Walking	Herbal Medicine Mystical Therapy		Counting
Vlow Tech	**1**	Bronze Age 3500 BC	Beasts of Burden	Basic Diagnosis.		Abacus. Quipu.
	1.3	Iron Age 1300 BC	Wheel			
	1.6	Middle Ages 600 AD	Galleys			
	2	The Age of Sail 1500 AD	Sailing Ships	Internal Anatomy.		Algebra
	3	Industrial Revolution 1700 AD		Crude Surgery.	Mechanics	Calculus
	3.3	1800	Steamships			
	3.6	1850	Railroads			
Low Tech	**4**	Mechanization 1900 AD		Antiseptics. Anesthetics.	Medical	Analog Computers
	5	1930 AD	GroundCars	Internal Imaging.	Polymers	Electric Calculators
	6	Nuclear Age 1950 AD			Electronics	Model /1
Mid tech	**7**	1975 AD	Rockets to Orbit	Organ Transplants. Slow Drug.	Programmer	Model /2
	8	2000 AD			Photonics	
	9	2020 AD	NAFAL	Cryogenics Fast Drug.	Gravitics	Model /3
High Tech	**10**	2100 AD	Gravity Manipulation Lifters. G-Drive.	Anti-Virals	Fluidics	Model /4
	11				Magnetics	Semi-Organic Brains Model /5
	12			Antigeriatrics		Positronic Brains, Model /6
VhighTech	**13**			Effective Cloning. Forced Growth	Biologics	Wafer Technology Model /7
	14			Geneering		Self-Aware Electronic Model /8
	15			Anagathics.		Model/9
Xhigh Tech	**16**					True Artificial Intelligence
	17					
	18					
Uhigh Tech	**19**		Elemental Matter Transport			
	20		Global Matter Transport			
	21		System Matter Transport			

The March of Technology-3

Weapons are further described by burden (size or bulk), stage (technological sophistication), user (human or other), and portability.

TL
Speed,
Weapons, Artillery

		Era	Speed1		Speed2	Weapons	Heavy Weapons
	0	Primitive. Stone Age.	Walking	**1**	5 kph	Clubs. Rocks.	
Vlow Tech	**1**	Bronze Age 3500 BC	Beasts of Burden	**2**	10 kph	Blades. Spears.	
Vlow Tech	**1.3**	Iron Age 1300 BC	Wheel				Massive Armies
Vlow Tech	**1.6**	Middle Ages 600 AD	Galleys	**3**	20 kph		Siege Weapons
Vlow Tech	**2**	The Age of Sail 1500 AD	Sailing Ships	**4**	30 kph		
Vlow Tech	**3**	Industrial Revolution 1700 AD				Musket	Cannon
Vlow Tech	**3.3**	1800	Steamships	**5**	50 kph		
Vlow Tech	**3.6**	1850	Railroads	**6**	100 kph		
Low Tech	**4**	Mechanization 1900 AD				Revolver	
Low Tech	**5**	1930 AD	GroundCars	**7**	300 kph	Rifle. MachineGun.	
Low Tech	**6**	Nuclear Age 1950 AD		**8**	500 kph		
Mid tech	**7**	1975 AD	Rockets to Orbit	**9**	700 kph		
Mid tech	**8**	2000 AD		**10**	1000 kph		
Mid tech	**9**	2020 AD	Civil SST	**11**	2000 kph		
High Tech	**10**	2100 AD	Civil Space Transport	**12**	3000 kph		
High Tech	**11**						
High Tech	**12**						
VhighTech	**13**						
VhighTech	**14**					Psi-Shield	
VhighTech	**15**						Black Globes
Xhigh Tech	**16**						SR Tractors
Xhigh Tech	**17**					Fusion Rifle	
Xhigh Tech	**18**					Personal Damper	LR Tractors
Uhigh Tech	**19**		Elemental Matter Transport			Disintegrator Pistol	
Uhigh Tech	**20**		Global Matter Transport			Disintegrator Wand	
Uhigh Tech	**21**		System Matter Transport			Relativity Rifle	

The March of Technology-4

Technological Levels define the point in the technology continuum where specific objects can commonly be produced.

TL
Energy, Society, Environ, Comm

		Era	Space Travel	Power Plants	Technologies	Armor
	0	Primitive. Stone Age.	Stargazing			
Vlow Tech	1	Bronze Age 3500 BC				
	1.3	Iron Age 1300 BC				
	1.6	Middle Ages 600 AD				
	2	The Age of Sail 1500 AD	Navigation			
	3	Industrial Revolution 1700 AD				
	3.3	1800				
	3.6	1850				
Low Tech	4	Mechanization 1900 AD				
	5	1930 AD			Electronics	
	6	Nuclear Age 1950 AD				
Mid tech	7	1975 AD			Programmer	
	8	2000 AD		[OverClock Rates]	Photonics	
	9	2020 AD	Maneuver-1 Jump-1 possible	PP-2 OC= 20	Fluidics	
High Tech	10	2100 AD		PP-3 OC= 40	Gravitics	
	11	Imperial Average Circa Year Zero	Jump-2	PP-4 OC= 60	Magnetics	
	12		Jump-3	PP-5 OC= 90		
VhighTech	13	Imperial Maximum Circa 550	Jump-4	PP-6 OC= 100	Biologics	
	14		Jump-5	PP-7 OC= 110		
	15	Imperial Maximum Circa 1107	Jump-6	PP-8 OC=120		
Xhigh Tech	16	Darrian Maximum		PP-9 OC=130		
	17		[Jump- 7]	OC=140		
	18			OC=150		
Uhigh Tech	19		[Jump- 8]	OC=160		
	20			OC=170		
	21		[Jump -9]	OC=180		

Overclock Rates are historical.

Extreme Technology

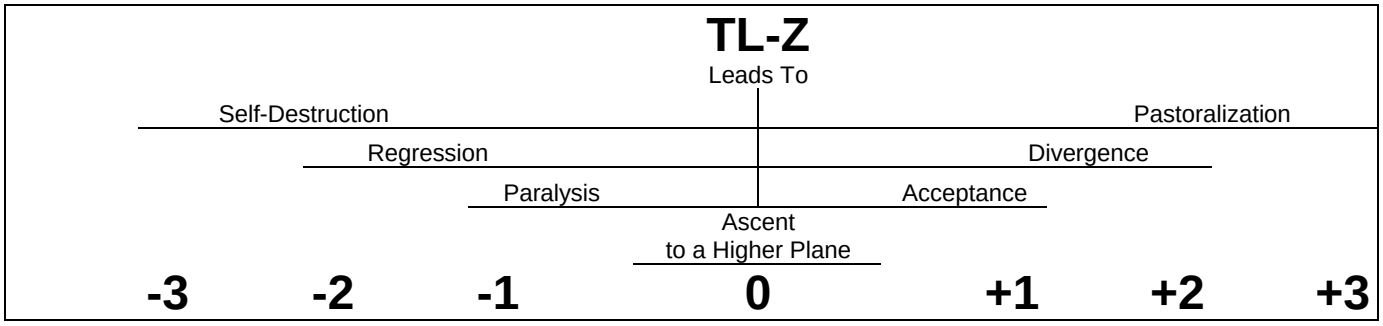
Technological Levels define the point in the technology continuum where specific objects can commonly be produced.

TL
Extremes

	Flux=	- 5	- 4	- 3	- 2	- 1	0	+1	+2	+3	+4	+5
	Pts=	- 2		- 1		0			+1		+2	
22				Individual Transformations.								
23		Grey Goo		Mythical “Hop” Drive					Rosettes		Practical PsychoHistory	
24		Planetbuster Bombs				Many Capsule Dyson Sphere			Portals			
25				Inertialess Maneuver					Psionic Engineering		Rapid Terraforming	
26		World Scale Physical Constructs				Socieneering			Rumored “Skip” Drive			
27				Group Personalities		Ring Worlds						
28												
29		Reality Manipulation				Rigid Dyson Spheres					Reality Manipulation	
30		Implantable Ethics		Stellar Scale Physical Constructs							Implantable Ethics	
31				Pocket Universes								
32												
Z		----- The Technological Singularity -----										

Levels above 21 are called Accelerating Tech Levels: each is of short duration and each leads at an accelerating pace to the next. The technology addressed by TLs above 21 is frighteningly powerful and susceptible to misuse or disaster.

Which Way? As a society progresses to each new Tech Level, Flux determines the focus technology column for the Level (although the other technology also becomes available). When the society reaches TL-Z, the sum of the Points for that technology is a DM on a single Societal Flux for Destiny.



0. Ascent To A Higher Plane. Society as a whole transcends its position as a tool making and tool using culture and progresses to a non-material existence, leaving behind ruins or relics of its former existence.

+3 or more. Pastoralization. Society transcends its dependence on, or focus on, increases in technology. The majority of society embraces a pastoral existence emphasizing social and familial relationships. There may be some level of (sophisticated, self-maintaining) technology operating in the background.

+2. Divergence. Society diverges along several paths (roll flux 3 times for the different paths).

+1. Acceptance. Society accepts some or all of its technological foundation and settles into a comfortable existence using what technology it has.

- 1. Paralysis. Society is overwhelmed by the power of its technology and is frightened into a period of inaction.

- 2. Regression. Society is overwhelmed by the power of its technology; factions within society fight for ascendancy and in the process create widespread destruction.

- 3 or less. Self-Destruction. Society is overwhelmed by the power of its technology, factions within society fight for ascendancy and in the process destroy society completely.

Extreme Technology

Extremes of technology are indeed extreme: "Any technology is magic to those who do not understand it."

TL
Extreme

Individual Transformations. The ability to change physical capabilities of individual sophonts, including enhanced characteristics, alternate bodies, and the ability to change between those alternatives.

Grey Goo. Self-replicating nano capable of reducing objects (people, cities, living matter, worlds) to a disorganized froth.

Mythical "Hop" Drive. Interstellar drive alternative to the Jump Drive. Ideally of greater range, greater fuel efficiency, and higher effective speed.

Rumored "Skip" Drive. Interstellar drive alternative to the Jump Drive. Ideally of greater range, greater fuel efficiency, and higher effective speed.

Rosettes. A gravitational system of a heavier and lighter bodies orbiting in a regular repeating pattern around a common barycenter. The mechanics of creating a Rosette are the first step in the process of creating Dyson Worlds.

Practical PsychoHistory. The ability to make exact predictions of the social behavior of large groups of sophonts, and based on those predictions to shape the course of future history.

Planetbuster Bombs. The ability to create devices which will destroy worlds. The term Planetbuster assumes actual fragmentation of worlds; alternative technologies include Nova Bombs capable of exploding stars, "scrubbing" world surfaces with kinetic impacts or nuclear fire, and anti-atmosphere weapons which merely destroy the life-sustaining aspects of the world.

Many Capsule Dyson Sphere. A system of multiple worldlets (capsules) dedicated to capturing the energy of a central star in support of the power needs of the local population.

Portals. The ability to create portals: instantaneous connections between distant locations.

Inertialess Maneuver. The ability to eliminate inertia in spacecraft. Inertialess ships are unrestricted by velocity vectors and achieve very high speeds nearly instantaneously. When intertialessness is turned off, the ship reverts to its previous state of inertia.

Psionic Engineering. The ability to manipulate matter (at all scales from the sub-atomic to the macro) without physical interaction: the psionic engineer "encourages" matter to move and interact to accomplish the desired results. Psionic engineering is a prerequisite to many large scale physical constructs.

World Scale Physical Constructs. The ability to manipulate the non-stellar elements of a star system. World scale physical constructs includes the ability to create worlds (star mining the matter required) within reasonable time frames (typically less than a sophont adulthood).

Rapid Terraforming. The ability to manipulate the characteristic elements of a world. Rapid Terraforming includes the ability to restructure existing worlds, change their orbits, and change their atmospheric and surface details to conform to some desired standard, all within a reasonable timeframe somewhat less than a sophont adulthood. The term Terraforming includes any world specification (not just Terra-like).

Group Personalities. The ability to blend distinct personalities into one master personality (temporarily or permanently). Group personalities reflect a variety of experiences and abilities for greater efficiency, creativity, and responsibility.

Ring Worlds. The ability to create a solid habitable ring around a central star.

Engineered Societies. The ability to create a social and cultural structure based on created specifications. Just as Geneering manipulates genetic structure, Socieneering manipulates social and cultural structure to improve efficiencies, reflect desired values, and propagate them throughout society.

Reality Manipulation. The ability to edit reality, primarily through redos: limited restrospective changes to past event to alter their effects on the present.

Rigid Dyson Spheres. The ability to create a solid shell surrounding a central star. The shell provides vast land surface area and efficiently captures the energy output of the star.

Implantable Ethics. The ability to define right conduct and to implant its constraints on individuals.

Stellar Scale Physical Constructs. The ability to manipulate the elements of a star system, including the star itself. Stellar scale physical constructs includes the ability to create stars and their associated worlds within reasonable time frames (typically less than a sophont adulthood).

Pocket Universes. The ability to create very small parallel universes (small in a relative sense) containing isolated star systems and accessible from the true universe through a variety of portals.

Rate of Technology Advance

Technology advances at various rates based on the society and culture of the world. This rate is rarely constant, and is punctuated by wars, foreign intrusions and contacts.

TL
Rate Of Advance

		Era	Lethargic	Average	Fast	Historical (Earth)
	0	Primitive. Stone Age.				0
Vlow Tech	**1**	Bronze Age 3500 BC	1D x 10,000 y	1D x 5,000 y	1D x 2,000 y	10,000 y
Vlow Tech	**2**	The Age of Sail 1500 AD	1D x 10,000 y	1D x 2,000 y	1D x 1,000 y	5000 y
Vlow Tech	**3**	Industrial Revolution 1700 AD	1D x 5,000 y	1D x 1,000 y	1D x 500 y	250 y
Low Tech	**4**	Mechanization 1900 AD	1D x 5,000 y	1D x 500 y	1D x 500 y	200 y
Low Tech	**5**	1925 AD	1D x 2,000 y	1D x 200 y	1D x 50 y	25 y
Low Tech	**6**	Nuclear Age 1950 AD	1D x 1,000 y	1D x 100 y	1D x 50 y	25 y
Mid tech	**7**	1975 AD	1D x 5,000 y	1D x 500 y	1D x 50 y	25 y
Mid tech	**8**	2000 AD	1D x 2,000 y	1D x 200 y	1D x 50 y	25 y
Mid tech	**9**	2025 AD	1D x 1,000 y	1D x 100 y	1D x 50 y	25 y
High Tech	**10**	2125 AD	1D x 5,000 y	1D x 500 y	1D x 200 y	
High Tech	**11**	Imperial Average Circa Year Zero	1D x 2,000 y	1D x 200 y	1D x 100 y	
High Tech	**12**		1D x 1,000 y	1D x 100 y	1D x 50 y	
VhighTech	**13**	Imperial Maximum Circa 550	1D x 5,000 y	1D x 100 y	1D x 200 y	
VhighTech	**14**		1D x 2,000 y	1D x 100 y	1D x 100 y	
VhighTech	**15**	Imperial Maximum Circa 1107	1D x 1,000 y	1D x 100 y	1D x 50 y	
Xhigh Tech	**16**	Darrian Maximum	1D x 5,000 y	1D x 500 y	1D x 200 y	
Xhigh Tech	**17**		1D x 2,000 y	1D x 200 y	1D x 100 y	
Xhigh Tech	**18**		1D x 1,000 y	1D x 100 y	1D x 50 y	
Uhigh Tech	**19**		1D x 5,000 y	1D x 500 y	1D x 200 y	
Uhigh Tech	**20**		1D x 2,000 y	1D x 200 y	1D x 100 y	
Uhigh Tech	**21**		1D x 1,000 y	1D x 100 y	1D x 50 y	
	22-23-24		1D x 50 y	1D x 30 y	1D x 20 y	
	25-26-27		1D x 30 y	1D x 20 y	1D x 10 y	
	28-29-30		1D x 20 y	1D x 10 y	1D x 5 y	
	31-32-33		1D x 10 y	1D x 5 y	1D x 1 y	

Shown is expected time to the next TL, in years. If the die roll is 6, reduce TL one level and shift one column to the left. If the die roll is 1, reduce the period by half and shift one column to the right.