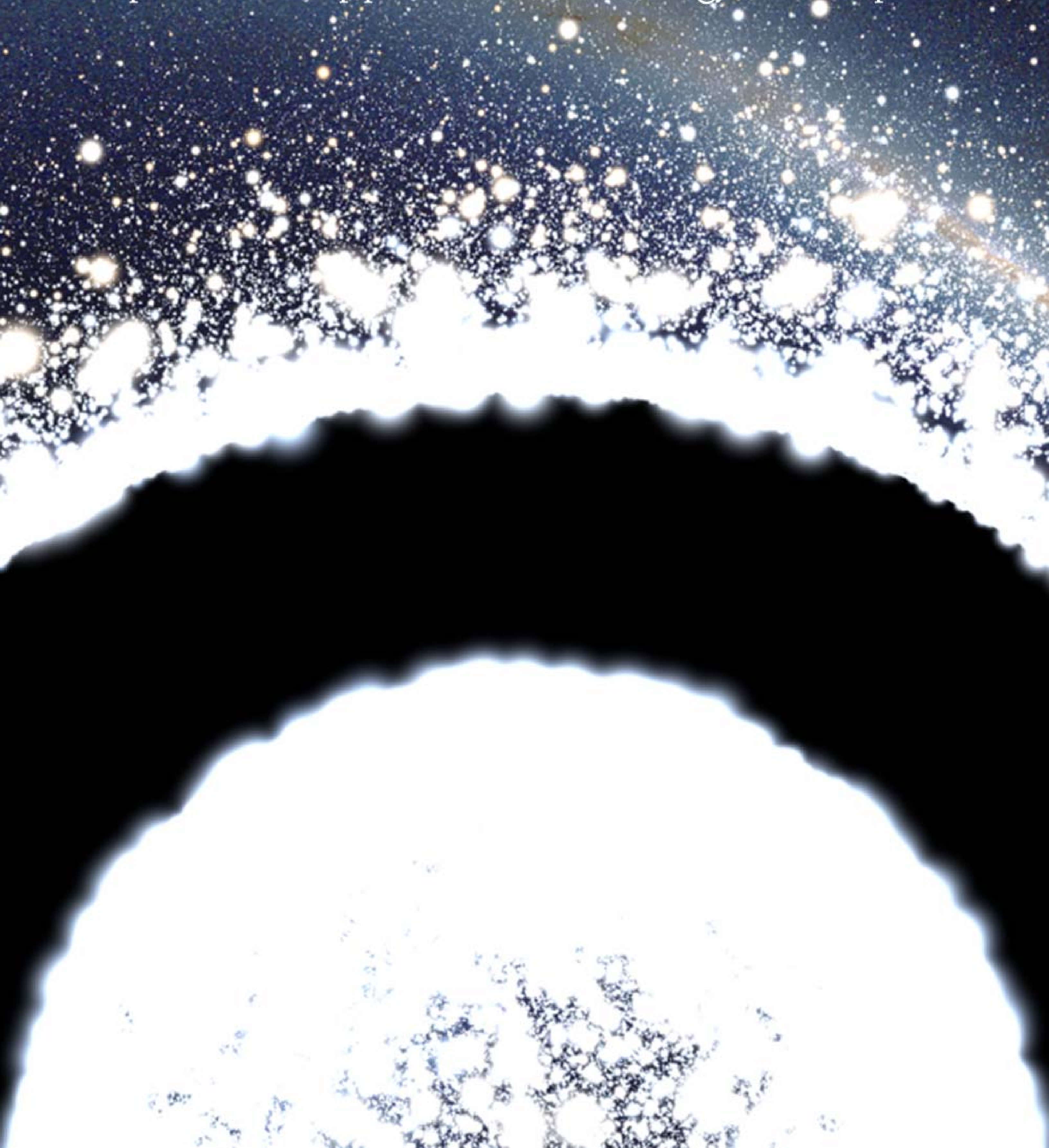
# Engineering Wormholes

## A Speculative Approach to Technology Development

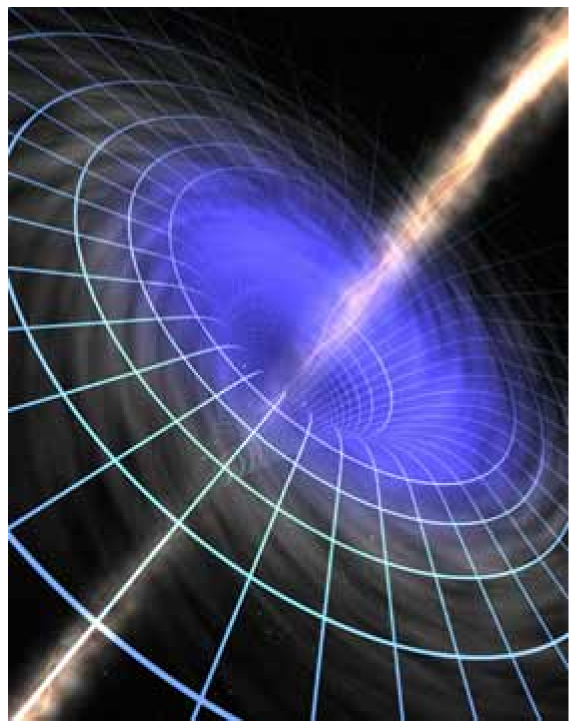


# Engineering Wormholes
## A Speculative Approach to Technology Development

By Tim Ventura, December 3rd, 2006

*Wormholes offer an opportunity to connect distant points in space, thereby bypassing the need for FTL propulsion – but they come at a cost, consuming vast amounts of energy to stabilize the wormhole's throat. Assuming that anticipated advances in science give us the ability to generate and control wormholes, this article explores the likely path of development for this speculative technology, presenting avenues for major advances from communications to even interstellar colonization…*

Realistically speaking, the concepts related to stabilizing and expanding the throat of a quantum-wormhole using exotic matter have only been given serious consideration for the last couple of decades, and it wouldn't be at all surprising if a breakthrough occurs to allow point-to-point wormhole connections a reality within the next few years. When this is achieved, it will then lead to a number of questions relating to how wormholes can be engineered for practical applications, as well as leading to questions about what those applications might be, and how this technology might evolve over time as it matures…



**Quantum Wormhole:** Near-term nanoscale connections between distant points in space?

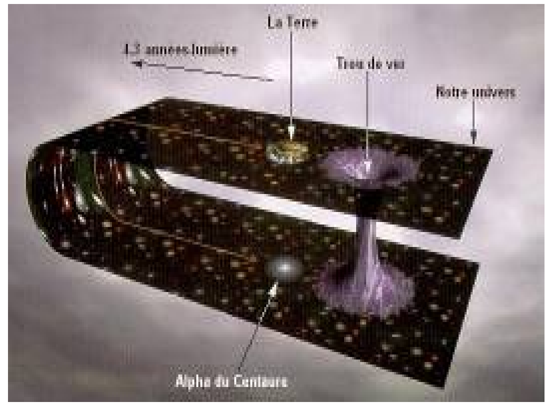
Arthur C. Clarke addressed this topic in his science-fiction classic, "The Light of Other Days". The primary focus of his novel was to examine the social impact of exactly what might happen if a "wormhole-camera" was developed that could ostensibly provide an unrestricted real-time view of any location in space ...when published, his focus was to offer an extreme case-example focusing on the limits of privacy and what it means in an increasingly sophisticated society. The mechanism for this was a stabilized quantum-wormhole measuring only an atom's width across, connected to a processing unit to enhance the few photons' worth of light that it captured into a visible image from the wormhole's endpoint.

Like Clarke, I imagine that this technology would start small, mostly due to the power-limitations involved with stabilizing a quantum-wormhole. The initial application would most likely be point-to-point communications, with both ends of the wormhole connected to high-sensitivity transceivers to overcome the inherent limitations in amplitude associated with passing only a few photons through the hole's tiny aperture.

Using today's technology, a radio or data signal could be transmitted quite easily, and a visual signal like the type that Clarke described would be only marginally more technically challenging.

## *First-Generation*

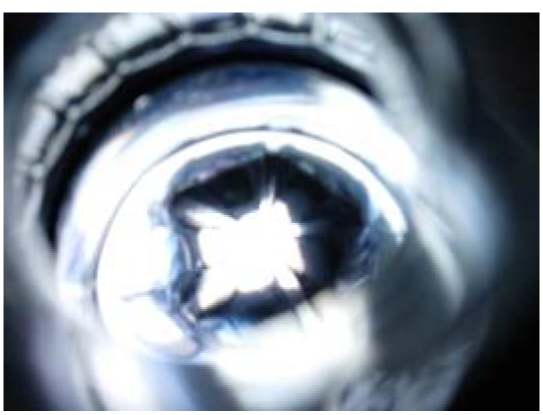
The initial device has two primary applications - the first of which is the equivalent of a "Faster than Light" signal that should prove useful for real-time communications and control for satellites, and the second is an uninterruptible, completely-secure means for transmitting sensitive data (for instance, as an alternative to today's low-bandwidth RF-based submarine communications). It is presumed that any signal capable of being sent using conventional broadcast-radio or fiber-optic technology could also be sent through a wormhole, which allows a high-level of integration into today's existing communications technology base.



**Point-To-Point:** Wormholes might allow FTL signals to take a shortcut through space.

There is one variable relating to point-to-point wormhole communications that Clarke did not address, which plays a critical role in how this technology might be deployed. Each set of wormholes form the endpoints of a communications bridge, meaning that for our purposes at least 1 signaling link can be established. However, it has not been determined whether multiple units may interfere with each other's operation. It is assumed for the sake of argument that each wormhole is an entity unto itself, and that signals cannot mix in the "subspace" or extra-dimensional region between wormhole points. (This is consistent with known physics, which assumes that the neck of a wormhole is normal space, albeit warped).

The second variable relating to point-to-point communications is far more critical: the minimum physical size of the communications device required at each of the wormhole endpoints. If the device is the size of a typical personal-computer, then communications is possible, but will resemble today's internet proxy-server - functioning as a communications gateway for multiple channels between two points. If the device is smaller, however, such as a crystalline nano-lattice developed using near-term vapor-deposition technologies, then the wormhole communications device can then be highly integrated into conventional electronics architectures, and may be used ubiquitously for point-to-point communications within computers, consumer-electronics, and all manner of common applications normally served by copper-wire or fiber-optic cabling. Simply put, this defining difference serves to determine whether wormhole communications are used between devices or within devices - a distinction with serious implications for future technology development.


**Communications:** First-generation apps might resemble a fiber-optic communications

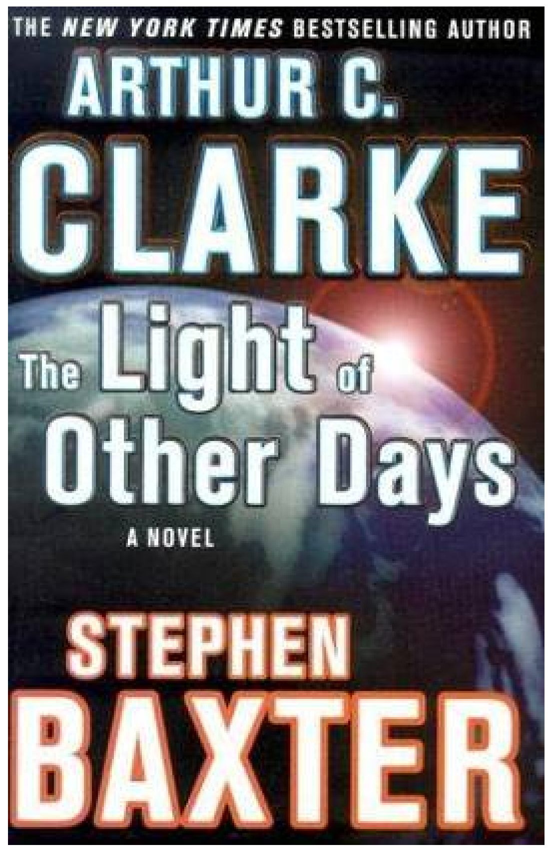
It should be noted that traditional market-economic forces will inevitably drive R&D efforts to refine the size & production-cost for any type of wormhole communications system over time, so a system that begins at the size of a personal computer may in fact end up being constructed on the nanoscale, much like the similar progression of transistor size within modern commercial CPU's. Regardless of the actual cost for first-generation devices, market forces also typically drive radically new technologies to higher-price points, making it likely that a first-generation system will be reserved for high-end communications needs, typically found in military or space-applications.

## *Second-Generation*

The obvious applications constraints associated with point-to-point communications via two bound-wormholes will lead to an evolution of the technology to allow transmission through an asymmetrical, or "unbound" wormhole communications system. This system will be defined as having 1 end of the wormhole generated and bound to a communications transceiver, and the other end being a free-floating quantum-wormhole in 3-space. The term unbound is appropriate despite one end being bound to a transceiver, given the ability for this wormhole to instantaneously be repositioned at any point in space - without the requirement for a local stabilizing mechanism - provides a tremendous degree of additional application flexibility.

A second-generation wormhole communications device will exhibit not only the ability to transmit and receive conventional data signals from any nearby communications devices in a manner identical to the first-generation technology, but will also by able to "eavesdrop" in the manner described by Clarke. It may be able to directly receive small bundles of photons as a form of "remote-camera", thus allowing the user to reposition a "virtual wormcam" to any point in space to capture a picture of nearby objects. Clarke also envisioned that the wormhole could receive audio-signals by tracking the vibrational movement of nearby atoms in response to sound waves.

Clarke used examples of this technology to show the immediately destructive influence of ubiquitous information access on contemporary society: his vision demonstrated a form of "surveillance society" with a twist: everyone in the society is conducting surveillance on everybody else, and nobody is aware at any given time who may be watching them. This leads to such a wide range of immediate social changes that I'm literally unable to list them all here. Clarke's vision also suggested an immediate revolution in physics and astronomy, given our new ability to view both the very small and the very large from viewpoints never before imagined. For instance, Clarke suggested mapping the surface of other planets using automated scanning-technology, capable of taking in the surface terrain of an entire planet within a matter of hours.



**Implications:** An idea examined by Arthur C. Clarke in “The Light of Other Days”.

## *2.5-Generation*

While highly speculative, Clarke also suggested that given the quantum-nature of the wormhole communications device, it might be capable of viewing different points in time as well as space. "The Light of Other Days" constrained this idea by suggesting that it only functioned to view events that have already occurred, thus preventing paradox from occurring. Even so, this capability offers an entirely new range of social implications - exemplified by Clarke's speculation that most politicians would be removed from office for a variety of scandals very shortly after this device is introduced. Clarke also suggested that this device would revolutionize history in the same manner that the second-generation device revolutionizes cosmology and physics.

## *Third Generation*

Clarke's vision ends with the speculative notion that it might be possible to pass matter through a wormhole - obviously in very small quantities, given the tiny aperature and power-requirements of the device. Clarke's final thought in "The Light of Other Days" revolves around the notion of importing a stream of matter from the center of the sun to create a form of pseudo-stable fusion on Earth for power generation. My own speculation extends this to the ability to immediately weaponize this technology into delivering an atom's-width stream of energy to a directed point in time-space, which I jokingly dubbed "the UFO gun" (not because I would expect to see it on a UFO, but because it would be capable of being instantly deployed to destroy a craft with even the remarkable flight capabilities ascribed to UFO's).


**Particle Beam:** A wormhole could also transmit a deadly beam of directed energy.

Perhaps it is better to offer the generic statement that a third-generation device should be capable moving disorganized matter from point to point as a high-energy stream, opening up a variety of weapons & energy-production/transmission possibilities.

## *Fourth-Generation*

A fourth-generation wormhole technology would presumably be capable of harnessing the energy it's capable of collecting to create a wide-enough wormhole aperture to transmit matter in organized manner: i.e., like a StarGate. This might require utilizing two sets of wormholes at once - one for capturing the energy, which is then converted to open a wide-aperature wormhole to allow the physical transmission of objects. It is unknown whether tidal forces or radiation within the wormhole would destroy objects passing through it, and given the predicted advent of nanotechnology in the early 21st century, it's entirely likely that a fourth-generation wormhole would be used only to transmit matter to a location the first time.

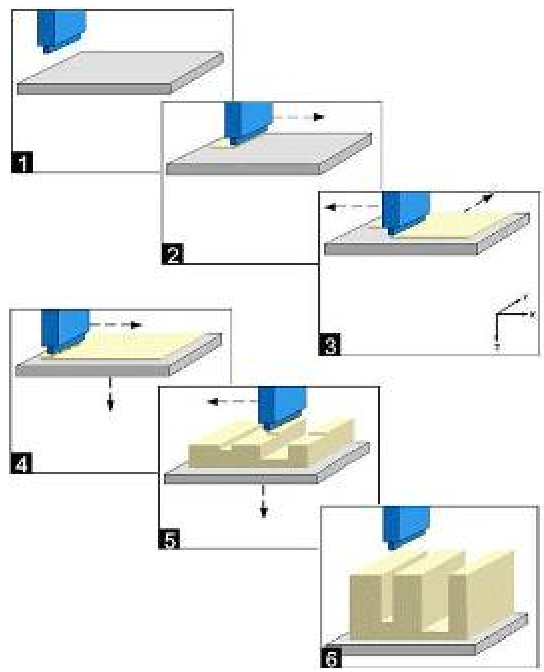

**4th Generation:** Macro-scale wormholes as commonly shown in science-fiction.

For example, a wide-aperture wormhole is opened to the moon to transmit a series of nano-assembly equipment, which then constructs a space-habitat for human colonization. The astronauts themselves could be transmitted without damage in a manner similar to the Star Trek transporter: the astronaut is scanned atom-by-atom, coded into a data-stream, and then sent as a blueprint to the same assembler that built the space-station. Thus, living tissue can be transmitted through a wormhole even if the tissue would be damaged in the process by coding it into an artifact for later reconstruction.

Neither energy nor matter can be destroyed, merely dissipated as entropic process. It is conceivable that at some point the massive amount of energy required to create a very wide-aperture wormhole could be reclaimed as the wormhole is destroyed - thus allowing a storage system to power future wide-aperture wormholes on-demand. While the exact amount required for an advanced process is unknown, contemporary physics by Eric Davis suggests that a useable wormhole (3 to 6 feet wide) might require up to a solar mass to be stabilized. While working with such massive amounts of energy, however, it's important to note that even minor disturbances in the stability of such a massive wormhole might lead to tidal forces great enough to be lethal to anything passing through. Again, however, modern error-correction techniques make it likely that while wormholes may never be passable to substantially-sized physical objects, they should allow the transmission of data without noticeable flaws.

## *A New Paradigm for Colonizing Worlds*

The process begins using a 2nd-generation wormcam to analyze a distant solar system for habitable worlds. While none are immediately found, several rocky asteriods in stable orbits are found in orbits stable enough to begin colonization. The choice of location in the system is based primarily to facilitate the collection of data from nearby planetary objects and a diversity of raw materials resources.



**3D-Printing:** Distant habitats and even people could be "printed" by a wormhole.

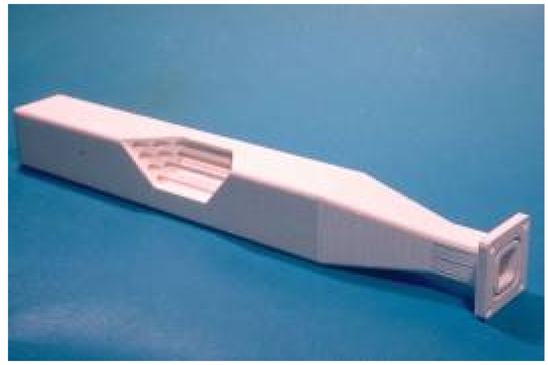
After a location is chosen, a wide-aperture wormhole is opened to the destination from a facility in our solar system. It is powered by a solar-collection facility in orbit around the sun which stores its energy as antimatter for quick-release in creating a wide-aperture wormhole. The hole is 1-centimeter wide, and a tube-shaped nanotech assembly station is rapidly deployed through it. After reaching its destination, the device is remotely activated by a communications wormhole, and immediately begins the construction of a computing substrate to facilitate data-processing. It is then fed complex assembly data on how to construct a large-scale nano-assembly apparatus, and once that is complete it is fed data on how to begin constructing a full-scale space habitat.

While remote, the construction process is iterative in nature, and the combination of engineering experience on Earth and machine logic in the remote station is sufficient to locate, collect, process, and assemble the required materials for a full-scale habitat in the distant solar system. Most likely a telescope of some type is also assembled there, and high-resolution digital photos are fed back to Earth as station construction progresses. While 2nd-gen cameras will already have detailed images of the local system, a high-resolution camera can feed back high-detail data feeds to provide a scope of data unattainable by the wormcam itself.

After the habitat is created, a team of astronauts are scanned, rapidly disintegrated, and then fed through the data-stream to be reconstructed at the remote station. Their bodies are recreated from raw materials using nanotechnology and blueprints transmitted from Earth. Presumably, they are indistinguishably copies of the original astronauts on Earth, and emerge at the remote station immediately capable of undertaking their mission.

Note that the primary constraint to this technology is the power required for a given wormhole aperture. It is assumed that a pinpoint aperture is difficult to achievable to create - enough for a stream of disorganized atoms to travel through. Even if this is the absolute limit of the technology, it is possible for the wormhole to "etch" enough of the basic components out of local materials to build a bootstrapping system capable of creating the required nanotech hardware. Thus, given enough computing and communications technology, the bottom limit of a wormhole is the ability to transmit energy from one point in space to another - preferably as a stream of matter, but perhaps just a stream of electrons.

While the notion of moving a atoms around one at a time to eventually build a space-habitat sounds unappealingly time-consuming, it should be taken into consideration that the speed is limited by computing power here on Earth, as well as the ability for the wormhole to establish a connection to any given point in space. The rate to establish a signal is probably the defining characteristic for the speed to construct remote objects, but may be rapid enough to complete even large-scale facility construction in a matter of hours.

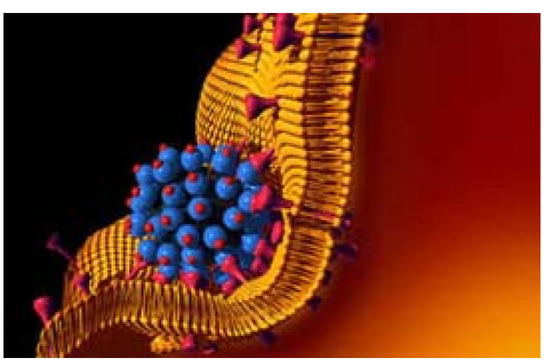


**Micro-Deposition:** Today's 3D printers can produce complex mechanical components.

## *Final Thoughts*

Reading through this, it may seem as though this summary of potential applications is as focused as much on Information Technology as it is on the potential for wormholes. This is for two reasons - the first being the remarkable power requirements in conventional physics for anything large enough to transmit substantial amounts of matter, and the second being a realization of the profound impact that Information Technology and Nanotechnology will have on all branches of science & engineering in the 21st century. The working speed of these emerging technologies is questionable, but it nanotech can hopefully be expected to operate at least nearly as fast as biological growth in bacteria and yeasts.

A 3rd-generation wormhole capable of transmitting a stream of disorganized matter as ions can presumably construct complex objects by first constructing rudimentary tools and then programming them. In principle, one method might consist of laying down a substrate layer and adding complex components on top of it much like an ink-jet or 3-D printer functions. Another method might work by eroding a material into a pattern to function as a simple tool, which could then be driven to construct tools of increasing complexity. Thus, the need to transmit organized matter is not required, but is assumed to be easier & less time-consuming than bootstrapping nanotech systems to construct complex matter from raw materials.



**Nano-Deposition:** Tomorrow's 3D printers will produce anything, including living tissue.

It has been predicted that one social-change to be expected as a result of 3-D printers by 2020 is a surge of compatible-designs openly available on the web for download. Presumably, by directing a nozzle capable of spraying streams of materials in a fairly-precise manner, these printers should be capable of following commonly available "patterns" to produce a variety of devices, including potentially complex electronics, on the macro-scale, as well as on the nanoscale. It is possible that a wormhole could be used as a spray-nozzle to similarly build devices at a macro-level given a means of precise & rapid positioning.

Presumably, modern computing power will not be sufficient for a number of years to correctly position a wormhole for pinpoint construction activities of this complexity. Positioning in remote space will probably require calculating for drift in the planetary (orbital and rotation), solar (drift, eccentricity and change in ecliptic), and galactic (drift) movement - in the case of solar it will require the calculation for movement by both systems in relation to a common reference point. However, these factors will probably be solved in a stepwise manner of increasing complexity, as the short-distances involved with preliminary work will probably require no corrections at all (transmitting a series of precision pulses to corresponding outputs across a room).

A preferred means of positioning might be some type of entanglement for a remote reference-point (to allow remote positioning around a relative point rather than an absolute point). However, since a wormhole is a singular quantum entity, I'm not sure how you could "track" the position of an entangled particle (both are unrelated systems). Nevertheless, a marker of some type would be a preferred means of positioning.

It is also worth considering that multiple wormholes operating in tandem may be able to facilitate the construction of large objects quite rapidly in contrast to a single stream. These could be coordinated with one another in a manner similar to the way in which data is split and parsed in threads in parallel computing architectures, thus providing an existing model for subdividing highly-complex, partially non-repetitive, technical labor across a variety of tools run in concurrent fashion.

**Space Colony:** By combining IT & wormholes, we can colonize other worlds one atom at a time

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Tim Ventura is the Founder of the American Antigravity, a 501c [3] non-profit dedicated to community space activism and support for breakthrough technology development. You can learn more about him online at http://www.americanantigravity.com