Fujitsu 10Gb Ethernet switches enable researchers to study the universe for signs of life.

SETI Tunes in to Interstellar Signals from Extraterrestrial Civilizations

The sheer scale of the search is difficult to fathom. There are over 300 billion stars in our galaxy alone, most with orbiting planets. Beyond that, there are a hundred billion more galaxies just like our own, each containing billions of suns and planets. That's billions and billions of potential civilizations just waiting to be discovered. No problem right? It's just a matter of finding the right signal on the intergalactic radio dial. Uh…not quite.

"We're trying to answer the questions: Are we alone? Is anybody out there?" says Dan Werthimer, who directs the SETI Program and the Center for Astronomy Signal Processing at UC Berkeley's Space Sciences Laboratory. "So we're looking for a signal. Maybe it's deliberate. Maybe it's not. Maybe they simply want to chat with us on the galactic Internet. The problem is that we're dealing with space, lots and lots of space, so the signals we're looking for are likely to be very weak. But that just means we need more powerful ways of searching."

With the support of Fujitsu, the University of California at Berkeley is leading the way in the search for intelligent life in the universe. The school operates several SETI (Search for Extraterrestrial Intelligence) projects that fall under the umbrella of the SERENDIP (Search for Extraterrestrial Radio Emissions from Nearby Developed Intelligent Populations) program.

Searching through static on the intergalactic radio dial

Here on earth, we send out all sorts of signals—radio, television, radar, cell phones, and other microwave telecommunications. All are considered to be the optimum band of the electromagnetic spectrum for interstellar communication. Television signals left the earth around 50 years ago, and have traveled past 10,000 stars already. So any planet within 50 light years of earth is now receiving episodes of "I Love Lucy" and "The Honeymooners." Perhaps, in some far away galaxy, young alien teenagers are shrieking in delight watching the Beatles first appearance on the Ed Sullivan Show.

"Are alien cultures leaking signals just like we are?" Werthimer asks. "They might have a transmitter of some kind, navigational beacons or something that we could detect."

Radio wavelengths are relatively free of the absorption and noise that afflict other areas of the spectrum. Additionally, stars are generally quiet in the radio wavelengths. So this makes radio frequencies a natural candidate for intentional interstellar communications.

There's a lot of static in space, and the goal of SETI researchers is to find a signal that's different or clear. Think of

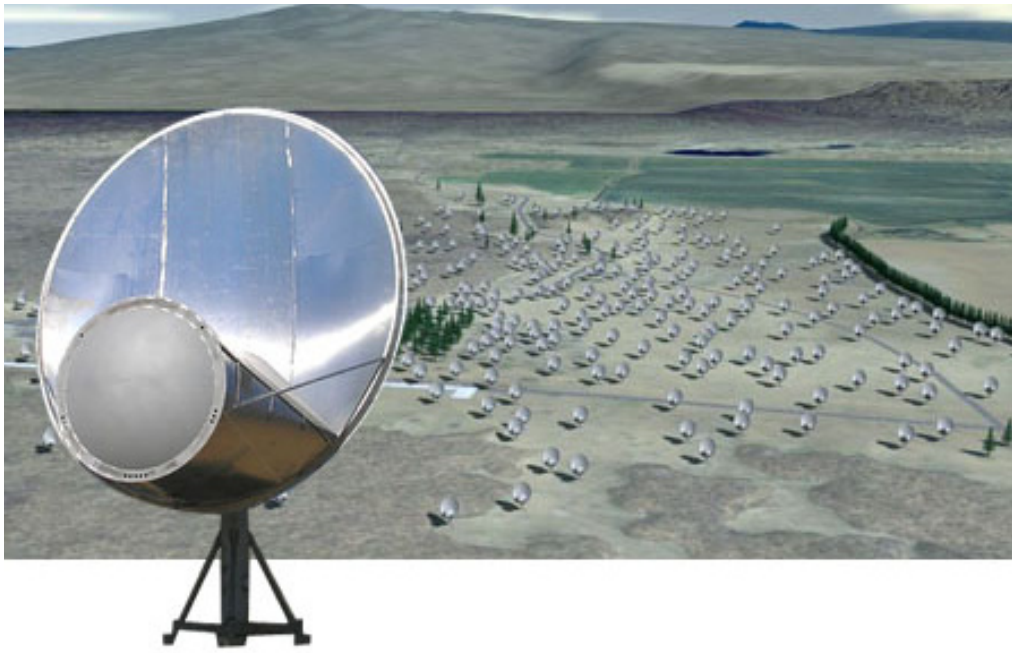
it like turning a radio dial and hearing nothing but static for the most part, but holding out hope that someday you'll come to a clear signal. Nature generally does not create signals relegated to one spot on the dial, so finding a clear radio signal on the galactic dial would be an almost certain sign of an alien culture. However, this approach to searching the universe requires sifting through an unprecedented amount of data collected by a series of highly advanced radio telescopes.

Many telescopes are better than one big telescope

In a remote valley in Hat Creek, California, radio telescopes dot the landscape, and a new generation of small dishes sprout up like spring flowers. Right now, there are 42 such telescopes, but soon there will be 350, all pointed towards the sky, signaling the potential discovery of intelligent life on another planet. With its growing number of telescopes, the ATA is dedicated to expanding its cutting-edge astronomical research and simultaneous search for signals of intelligent, extraterrestrial origin. The search field of the collective ATA telescopes is much larger than any single telescope, and it can capture millions of frequencies from multiple star systems simultaneously. Together, they will operate as a single virtual dish over 2700 feet across, making it one of the largest and most sensitive radio telescopes in the world.

"The Allen Telescope Array basically is all about speed," says Dr. Jill Tarter, Director of the Center for SETI Research. "Now we can look at more than one star at once. Whereas in the last decade, we've looked at about a thousand stars, in the next decade, we'll be able to look at a million."

By mass-producing the smaller, more affordable dishes, and stamping them out like license plates, researchers can look at larger portions of the sky and take advantage of many different kinds of technology rather than spending an entire budget on one gigantic telescope. By utilizing Fujitsu 10 Gb Ethernet switches, it is possible to collect and view millions of frequencies produced by the dozens of telescopes in order to study the universe for signs of life.



A never-ending supply of data

So where do you point the telescope? Where in the sky do you look? SETI researchers scan as much as possible. So there's an enormous amount of data coming in from all these telescopes, going through the switches and into the signal analyzers.

So, we're talking an infinite amount of information coming in from outer space. How on earth will all of this data be processed?

Fujitsu 10Gb Ethernet technology

SETI requires a high bandwidth switch that can handle short data packets traveling at a 300-gigabit per second aggregate data rate from one port to the next. To make maps of the radio sky, the FPGA-based "imager" for the antenna array processes real-time data at the rate of one terabit per second (1012 bits/sec) and computes one peta-op per second (1015 ops/sec).

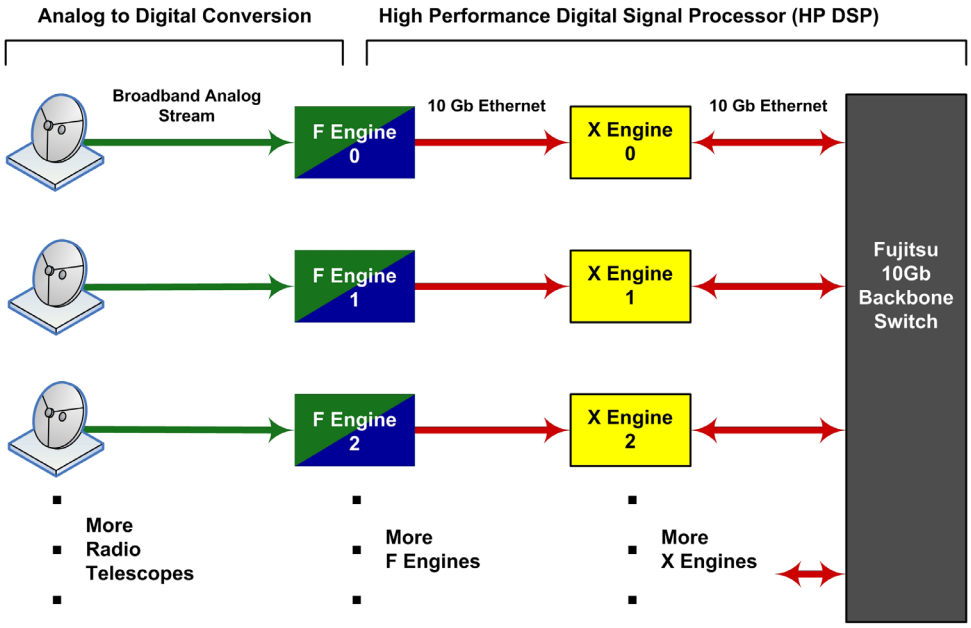
Each one of the ATA dishes churns out about a hundred gigabits per second. With 42 dishes in use, that's 4.2 terabits per second. Now the goal of the ATA is to have 350 of these dishes working simultaneously. That ends up being a huge amount of data. Small packets

come in from many antennas and flow every which way, from port to port. This places enormous signal processing demands on UC Berkeley's computing systems.

"Our switch requirements are extremely demanding," says Werthimer. "We needed a high bandwidth switch that could handle short packets at full line rates."

Enter the Fujitsu XG2000 series of 10Gb Ethernet switches. The XG2000 series features Layer 2 10Gb Ethernet switching, and is powered by a robust 20-port 10Gb Ethernet switch chip. Highly integrated, flexible and extremely fast, this switch offers industry-leading performance with ultra-low latency and a compact form factor, creating the ideal environment for processing data in the search for E.T.

"The XG2000C is working perfectly," says Werthimer. "It handles 300Gb per second data rates continuously, and helps produce spectacular images of our galaxy and beyond."



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The Fujitsu XG2000C model features the cost-effectiveness of a CX4 device while allowing for optical connections to departments from up to 10km away, exactly the kind of technology and speed SETI researchers need.

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When sending data every which way from port to port at full rates, packets occasionally falter and fall through the cracks using competitive products. For SETI researchers, dropped packets mean lost data, and a missed opportunity for a significant scientific discovery. Fortunately, the Fujitsu switches support up to 16KB jumbo frames with latency of 300 ns and a large 3MB buffer so the chances of lost frames are minimal. That means the SETI researchers can go to sleep at night without worrying about losing data and thus missing an important discovery because of a technology limitation.

"When the data packets come in, they get routed to a bunch of different places," explains Werthimer. "This is quite demanding on a switch. So obviously there's a lot of very rapid switching going on to route our data between all of the ports. And the Fujitsu switches handle this problem effortlessly."

Fujitsu helps enable a new revolution of super computing

This new 10-gigabit Ethernet technology makes it possible for SETI to build radio telescopes such as the ATA and analyze data from these dishes. And Fujitsu technology has helped revolutionize the way these cutting-edge telescopes are built.

"Nobody has built this kind of thing before, because the computing and the data routing was such a nightmare, says Werthimer. "Nobody's been able to do it. Now we can have tens or hundreds

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of receivers and connect them all up together through the Fujitsu switches. It's quite an achievement."

The high speed data processing currently being utilized by SETI is not unique to astronomy applications. In fact, other industries such as weather forecasting and climate study, genomics and molecular modeling, and high volume financial trading applications have similar technology requirements. Each of these industries requires high speed, low latency networks that cannot afford to drop packets. UC Berkeley has been a pioneer in solving these technology challenges with low latency 10 GbE switches from Fujitsu.

"With Fujitsu switches, we're solving a problem not just for astronomy, but for very high performance computing," says Werthimer. "I can see Fujitsu switches fitting nicely for other HPC applications, not just for our astronomy project. All the basic building blocks for a low-latency, high-performance network are available for others to take advantage of."

Bringing Fujitsu technology and innovation down to earth

With an expanding universe of data just waiting to be discovered, SETI is counting on companies like Fujitsu to be at the forefront of innovation.

"The capabilities are growing because of companies like Fujitsu," says Werthimer. "It's not as if we in the SETI community are getting smarter or more clever. We're counting on other technology companies to solve this problem of innovation for us. So if we ever find E.T., it will be thanks to Fujitsu. We'll probably have to share the Nobel Prize with them."

To Learn More:

Fujitsu 10GB Ethernet Switches:
http://us.fujitsu.com/ethernet

The Fujitsu XG series of switches offer high-performance 10Gb Ethernet Layer 2 switching. Featuring ultra-low latency, flexible interfaces and compact form factors, the switches are ideal for enterprise and video server/storage applications, high-performance computing, and the Internet SCSI (iSCSI) and Networked Attached Storage (NAS) markets.

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