Company Develops Prototype of Equipment That Could Extend Moore's Law

A Dutch manufacturer says it could have a system ready by 2015 to provide a long-awaited photolithography technique that is seen as one of the few ways left to extend Moore's law.

ASML Holding, the world's largest supplier of photolithographic equipment, says it expects to have production-ready, commercial extreme-ultraviolet (EUV) lithography machinery ready in two years.

The equipment could enable the production of chips with smaller feature sizes than are possible today. This would enable manufacturers to continue increasing processors' performance in accordance with Moore's law, which states that the number of transistors on integrated circuits doubles about every two years.

Lithography limitations have threatened this trend. With photolithography, manufacturers coat the silicon wafer from which chips are produced with a light-sensitive layer. Light shines through a patterned mask onto the wafer, burning away the photoresist in the exposed areas, which are then etched away. This leaves the desired substrate.

To create smaller feature sizes on chips—which enable more transistors to be packed onto processors, thereby increasing performance—tinier mask patterns and shorter light wavelengths are necessary.

Current approaches use UV light with a 193-nm wavelength. However, to build chips in the near future with 10-nm feature sizes, EUV light with just a 13.5-nm wavelength will be necessary.

Chipmakers expressed confidence in the late 1990s that EUV equipment would soon be designed and built. However, companies experienced challenges in trying to do so.

For example, they had trouble developing mirrors for EUV equipment. The technique requires the use of mirrors because lenses, traditionally used in lithography equipment, absorb EUV light. In addition, generating EUV light proved difficult and costly.

ASML has dealt with enough of these obstacles to create a prototype EUV lithography machine, which uses lasers to produce the EUV light.

However, the light it generates isn't bright enough yet to produce chips fast enough for profitable commercial production. The dimmer the light, the longer wafers must be exposed to yield the desired feature patterns. ASML says it is working on these and other challenges.

## Prosecutors Charge Five Suspects in Largest US Financial Hack

Attorneys have charged five Eastern European men with running the largest financial hack in US history. The men—four from Russia and one from Ukraine—face charges of wire fraud and conspiracy for allegedly stealing 160 million credit and debit card numbers from major companies and causing hundreds of millions of dollars in losses.

The US Attorney General's office says this is the largest hacking scheme prosecuted in the US.

Between 2005 and 2012, the suspects allegedly exploited SQL vulnerabilities in login, password-reminder, and other pages on websites to penetrate the networks of institutions such as the NASDAQ stock exchange, Citibank, Dow Jones, Discover Bank, PNC Bank, Heartland Payment Systems, the 7-Eleven convenience store chain, the JCPenney department store chain, and the Hannaford supermarket chain. They also are suspected of downloading malware that gave them ongoing access to the networks.

Dutch authorities arrested two of the men in the Netherlands and have extradited one to the US. The other three suspects remain at large.

Authorities accuse the hackers of employing SQL-injection attacks, which have been used
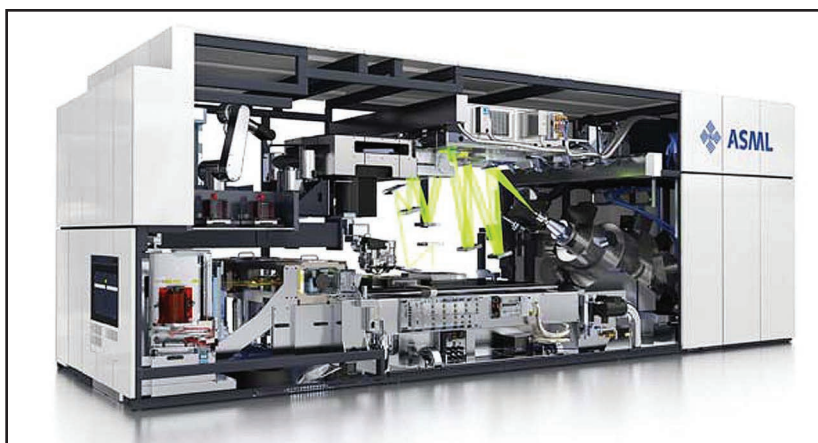
ASML Holding has produced this prototype extreme-ultraviolet lithography machine, which it plans to release commercially in 2015. EUV technology will be necessary to enable the production of more powerful chips with smaller feature sizes. Scientists have spent years trying to overcome the challenges of designing and building EUV equipment.

for years, to access encrypted financial information of customers of the victimized institutions.

These attacks take advantage of poorly coded e-commerce and other Web applications that don't filter or validate data that a user enters. A hacker could exploit this vulnerability to send malformed, malicious SQL queries to the application's database. This ultimately lets the attacker access the database and underlying network, and steal information such as credit and debit card numbers.

According to one of the indictments, the hackers sold European card numbers for up to $50 and US numbers for $10 each. The buyers encoded the stolen information onto fake credit and debit cards, which they used to buy merchandise or withdraw money from ATMs worldwide.

The US Attorney General's office says the operation was highly specialized, with different hackers having expertise in network penetration, the collection of sensitive data exposed via the attacks, Web hosting, and the sale of stolen credit and debit card numbers.

Faster, More Flexible Cellular Approaches Appear Ready for Prime Time

Emerging, advanced LTE 4G cellular technologies will become more popular during the next few years, in time to meet the demands that more users and data will place on mobile networks, according to a market analysis firm.

ABI Research said that by 2018, most LTE users will be on networks based on either TD (time division) LTE or LTE-Advanced technology, rather than the older and more common FD (frequency division) LTE.

FD-LTE uses separate, equal-sized bands for upstream and downstream traffic.

HIGH-TECH PEN CHECKS SPELLING WHILE USERS WRITE

A German start-up has developed a prototype pen that alerts users if they misspell a word while writing.

The Lernstift ("learning pen" in German) is a digital pen that contains a small Linux computer powered by AAA batteries.

It uses a calligraphy mode to vibrate when a user writes a letter incorrectly or illegibly, and an orthography mode to vibrate once for a misspelled word or twice to point out a grammatical error.

The Lernstift uses a patent-pending motion sensor to recognize specific movements and thus the shapes of letters and the words they form. The sensor works with a gyroscope to identify orientation, an accelerometer to determine movement speed, and a magnetometer to measure the strength of magnetic fields.

Wi-Fi capabilities let writers connect with smartphones, computers, or other pens in a network.

The first Lernstift pens will recognize only English and German, but later versions will work with other languages, the company says.

Lernstift officials say they designed their pen primarily as an educational tool that could, for example, help children with dyslexia.

The company recently began a Kickstarter crowdfunding campaign to raise $180,000 and intends to start tests in schools later this year.

Lernstift plans to offer pencils, fountain pens, and ballpoint pens initially costing $160 to $200 but perhaps falling to $60 over time, depending on sales volumes.

Lernstift founder Falk Wolksy noted that he got the idea for the new pen after seeing his son make mistakes on his homework and hearing his wife say there should be a pen that gives instant feedback when a mistake is made.

The Lernstift pen can recognize misspelled words and alert users while they write.

TD-LTE uses one band of frequencies to send traffic both upstream and downstream, but allocates different time slots for transmission and reception.

TD-LTE enables LTE use in countries that license one-band cellular technologies. In addition, proponents say, because it uses only one band, service providers could allocate that capacity to upstream or downstream traffic as needed, rather than being stuck with two equal-sized bands whose usage can't be changed.

Driving predictions of TD-LTE's bright future is China Mobile's planned huge nationwide deployment of the technology, which is awaiting governmental spectrum allocation. Service providers in Brazil, India, Japan, Russia, Saudi Arabia, Sweden, the US, and other countries are also preparing to implement TD-LTE.

In 2008, the 3rd Generation Partnership Project (3GPP), a

collaboration among six telecommunications standards organizations, adopted the International Mobile Telecommunications-Advanced (IMT-Advanced) requirements for the next generation of wireless technology.

In November 2010, the International Telecommunication Union ratified LTE-Advanced to comply with IMT-Advanced requirements. It was first deployed in Russia in October 2012.

LTE-Advanced offers more bandwidth via the aggregation of 20-MHz spectrum blocks into one big 100-MHz block. Advocates say it will also reduce signal interference and the number of dropped calls, and enable the use of more antennas in MIMO (multiple input, multiple output) systems. The use of multiple antennas enables higher throughput.

By 2018, ABI Research said, 34 percent of the predicted 1.5 billion LTE subscriptions worldwide will be on LTE-Advanced networks, 24 percent will be on TD-LTE networks, and 42 percent will be on FD-LTE networks.

New System Speeds Up Internet Communications

Two MIT researchers have developed software that generates TCP congestion-control algorithms that make IP networks operate faster and more efficiently.

Remy software—which professor Hari Balakrishnan and graduate student Keith Winstein designed—creates algorithms that carefully manage network communications, minimize congestion, and create new controls as needed to improve efficiency.

To utilize Remy, organizations input information such as a network's characteristics, the number of users, and the bandwidth required. They then provide metrics about how they want the network to perform.

Remy employs machine learning to examine multiple network configurations and automatically generate the best congestion-control algorithms—some with as many as 150 rules—to achieve the desired goals.

Examining all possible configurations could be highly time-consuming, but Balakrishnan and Winstein designed an algorithm that analyzes only configurations in which small changes to network conditions produce large performance improvements. This still requires four to 12 hours to yield results.

In tests, the researchers said, Remy substantially improved IP network performance compared to engineer-generated TCP protocols. Remy provided twice the improvement in a simulated high-speed wired network and up to 30 percent better performance in a simulated 4G wireless network. The researchers still need to test the system on live networks.

Remy's ability to automatically identify and generate congestion-control algorithms is a new approach. Over the years, engineers have manually developed improvements to TCP's congestion-control algorithms, creating dozens of versions of the protocol—such as Compound TCP—in the process.

According to Balakrishnan, humans can optimally configure a relatively simple network but a computerized system is needed to produce better results in more complicated networks with multiple connections and irregular traffic.

Referring to Remy, Winstein said, "It doesn't resemble anything in the 30-year history of TCP."

Smart Streetlights Promise to Save Energy

A Dutch company has developed a smart streetlamp system that turns on bright light only when it detects the presence of a person or vehicle. This would save large amounts of energy compared to traditional systems that stay bright all the time.

Tvilight BV is developing and commercializing Tvilight streetlamp technology, which director Chintan Shah invented while a student at Delft University of Technology in the Netherlands. It is currently in use in several European cities.

Shah said that he got the idea for Tvilight after noticing lamps lighting streets that were, at night, empty for long stretches of time.

In doing research, he found that European governments pay about $13 billion annually to power streetlights, accounting for a large part of their energy budgets and resulting in 40 million tons of carbon dioxide emissions annually.

Shah then created a system using his wireless plug-and-play CitySense sensors that detect the presence of a pedestrian or vehicle and tell nearby streetlamps to produce brighter light. The lamps stay dim when no one is around. The sensors can distinguish between people and smaller animals, like cats and mice, which keeps the lights from brightening unnecessarily.

His sensors can also alert a control center when service is necessary, thereby avoiding long outages.

Shah estimates Tvilight could cut energy costs and carbon dioxide emissions by up to 80 percent.

Currently, four Dutch cities and one Irish community are using the Tvilight system. Shah said his company has received queries about the system from countries including Australia, India, Israel, Japan, Turkey, and the US.

He entered his initial concept in a Delft University of Technology contest and won. The school then gave him facilities and funding to develop a product based on his design.