Walk into a bar and start talking about robots and law enforcement, and you are likely to get those special looks usually reserved for people who claim they were abducted by aliens.

Step outside, however, and the picture changes. If you frequent bars a bit too much, you might need to blow into a court-mandated device that measures blood alcohol levels. It decides whether you are sober enough to drive home. If you shoot through a red light, speed, or fail to pay a highway toll, automated cameras will photograph your car’s license plate and send you a ticket.

These devices enforce laws autonomously, with no human intervention.

If you live near a border, you might hear a drone flying overhead, searching for illegal entrants. The U.S. Customs and Border Protection agency is also testing AVATAR, a kiosk-based computer that interrogates people entering the country and analyzes involuntary responses (eye movement, voice constriction) for telltale signs of lying.

High Crime Rates
Further inland, small drones are taking to the skies. Right now, police use them to support police operations, monitor areas with high crime rates, and search for missing people.

Your town may own a ground robot similar to those used in Iraq and Afghanistan. Police use them to scope out dangerous situations, check suspicious packages, and disarm bombs. Equipped with a shotgun, they can blow open locked doors.

Today, humans operate drones and robots and act on any danger signals from AVATAR kiosks. These devices are likely to become more autonomous in the future.

If they do, they will be able to use today’s ubiquitous sensors as their eyes and ears. Many stores, hotels, airports and train stations have security cameras. Some cities, such as London, have placed them on the streets and subways. These cameras are increasingly networked.

Many police cars automatically record the license plates of passing motorists. Toll booths note where and when we ride on highways. The National Security Agency (NSA) collects phone call records. The post office images all mail. Phones signal our GPS location. Nearly all new cars have “black boxes” that store some details about our driving behavior.

Suspicious Activity
Today, this data receives only the barest of analysis. NSA looks at patterns of phone calls for suspicious activity. Police most often use license plate data to tag cars whose registrations or environmental permits have expired. Criminal investigators used postal images to trace poisonous letters sent to President Barack Obama and New York City Mayor Michael R. Bloomberg, MD A ’64.

Based on when and where cars enter and exit a turnpike, states could issue speeding tickets. How hard would it be to link other sensors to sophisticated software designed to enforce other traffic laws autonomously?

Today’s automated law enforcement is primitive when compared with what we are likely to see in the future. Engineers and computer scientists are achieving breakthrough after
breakthrough in sensors, robots, drones, and artificial intelligence. We are approaching a day when autonomous robotic law enforcement will become a real possibility.

That may sound creepy to some. Others see it as a way to enforce laws without bias. After all, a robot would ticket the town mayor and his janitor without worrying about political influence. Look a little closer, though, and we may wish for more, rather than less, application of human judgment.

**Boston**
The search for the criminals behind the Boston Marathon bombing shows how many of these capabilities can come together to aid law enforcement.

Immediately after the bombing, law enforcement agencies began collecting surveillance tapes from local stores and bystanders who took videos of the event.

Boston and the surrounding communities had only about 150 outdoor and 400 subway surveillance cameras, according to a 2010 survey by the American Civil Liberties Union. This is far fewer than the 3,000 networked government and private cameras in New York City’s financial district or the 400,000 cameras spread throughout London.

Several companies, such as IPVideo and ObjectVideo, have developed artificial intelligence software to scan crowds for suspicious behaviors. They might, for example, highlight when someone leaves a package or bag on the ground or lurks in the stairwell of a parking garage. They might have alerted police to the backpack bombs left in the street or provided clues to track down the suspects.

Instead, police went through the videos they collected, looking for known terrorists and suspicious behavior. They narrowed their search when a wounded bystander told the FBI that a young man in a baseball cap and sunglasses had placed a backpack on the ground and walked away. This narrowed the search, and police soon found videos of two men in baseball caps and backpacks walking away too casually from the blast.

The police tried identifying the suspects with facial recognition software. This failed, even though suspect Dzhokhar Tsarnaev had a driver’s license and his brother Tamerlan had been investigated by the FBI.

This suggests the technology did not work. In fact, facial recognition has long been oversold. Many airports installed systems following 9/11, only to remove them later because they were useless.

**Advanced Rapidly**
Yet in the past decade, the technology has advanced rapidly. In fact, the Boston investigators might have found a match if they used the right software.

Shortly after the bombing, Anil Jain and Josh Klontz of Michigan State University’s Pattern Recognition and Image Processing Laboratory tested three different commercial facial recognition programs. They seeded a database of 1.6 million images with pictures of the two Tsarnaevs. The software compared photos of the suspects released by the police with the database. NEC’s NeoFace found a strong match with Dzokhar but not Tamerlan, who was wearing sunglasses that obscured his face.
Remote-controlled robots sifted through trash bins, probed abandoned rubbish, and opened suspicious packages, said Charlie Dean, QinetiQ North America's director of business development for unmanned systems. The police used a Talon robot to check the brothers' car for explosives after the shootout and a truck-based robotic arm to pull away the tarp on the boat where Dzhokhar was hiding.

Dean guesses there were dozens of robots in Boston. “They are a great example of using unmanned systems to support human operations to investigate a crime,” he said.

Among the robots...
4,000 military robots that have taken out more than 30,000 improvised explosive devices (IEDs), Dean said.

Larger robots with manipulator arms use high pressure water cannons, called disruptors, to cut off the bombs’ triggers. Their operators use cameras on the robot to control them. They can use the robots to search a house or dig through a pile of junk to look for suspicious objects. Robots can also mount a shotgun and blow open a locked door, an extremely dangerous job for soldiers.

iRobot’s FirstLook and QinetiQ’s Dragon Runner are small treaded robots that weigh about five pounds. Instead of an arm, they mount cameras. Soldiers throw around corners, over walls, or into rooms to check for danger.

Police use robots in similar ways. FirstLook, for example, has four cameras and two-way audio. It not only withstands falls down staircases or 16-foot drops onto concrete, but automatically rights itself and starts moving.

“What’s the difference whether the drone is up in the air or on a building? You can’t keep the tide from coming in.”

—Michael R. Bloomberg, MD A ’64, Mayor, New York City

They provide a set of eyes and ears before the tactical team moves in,” Tom Phelps, iRobot robotics products director said.

According to Phelps, police bomb squads were the first to adapt robots, which enabled them to work at safer distances. Tactical (SWAT) teams soon followed, using robots to check situations without risking police officers.

Some first responders use robots to deal with hazardous materials. The robots carry sensors to identify the risk. They may even help bring the situation under control with their manipulator and disruptor.

**Suspicious Objects**

The Brazilian government recently contacted Phelps about using manipulator robots to investigate abandoned backpacks and other suspicious objects at the upcoming soccer World Cup and Olympics.

QinetiQ’s Dean believes the border patrol will eventually add fast moving autonomous ground vehicles for reconnaissance.

“If you have a large border and limited staff, technology can help you learn more than a pair of binoculars. Unmanned vehicles could cover the gaps where there are no people or sensors to report activity,” Dean said.

Today, large drones, such as the Predator, already cover those gaps. They use infrared sensors to spot people crossing illegally at night.

Drones have already helped police apprehend criminals. In 2010, for example, police used a drone helicopter to capture a car thief outside Liverpool, U.K. The three-foot-long helicopter used a thermal imaging camera to locate the suspect through dense fog.

Police departments want to use small drones, which cruise close to the ground and have limited range, to patrol high-crime areas, search for illegal drugs, survey crime scenes, and gather intelligence before officers open a gate or enter a house.

Yet drones have become a flashpoint for growing concerns about surveillance and civil liberties.

If there was any case that really set this off, it was the 2011 arrest of a North Dakota family of “sovereign citizens” who were charged with taking cows that had strayed onto their property. When the local sheriff went to investigate, the family met him with shotguns at the door. He borrowed a Predator B (now called a Reaper) drone. When operators determined the family was not carrying weapons, he swooped in to make an arrest.

Since then, the liberal American Civil Liberties Union and many conservative libertarian groups have come out against using drones to spy on citizens. When Houston police proposed using the aircraft to issue traffic citations, public anger scuttled the plan.

Other towns rallied against airborne monitoring of their shopping districts.

Deer Trail, a town of 550 people in Colorado, even considered paying a bounty to citizens who shot down drones. Yet even in Colorado, no one complained when the Mesa County Sheriff used a two-pound Draganflyer X6 to search a mile-long tract for a missing person. Ordinarily, sheriff deputies and volunteers would spend hours walking the site shoulder to shoulder. The drone completed the search in an hour.

In a world where London has 400,000 public cameras, arguing over surveillance drones may be a moot point. “What’s the difference whether the drone is up in the air or on a building,” said New York Mayor Bloomberg. “You can’t keep the tide from coming in.”

**Often Disturbing**

The implications of drones, robots, and AI systems are often disturbing, especially for people concerned about civil liberties. Yet today’s systems are essentially extensions of human beings. The pilot, driver, or software operator makes the real decisions.

What happens when robots begin making decisions on their own?

Autonomous robots are already on the way, according to Peter Singer, an expert on robotic warfare at Brookings Institution. He points to the new Reaper drone as an example. It can take off, land, fly mission waypoints, and analyze
sensor data, such as identifying depressions in the dirt as footprints from one mile high, without human intervention.

On the ground, robots can already right themselves if they fall over and retrace their route if they lose communication with their operator. They have improved their ability to navigate obstacles without human help, iRobot’s Phelps said.

**Shoot Enemies autonomously**

Meanwhile, militaries around the world are working on autonomous robots that can identify and shoot enemies autonomously. For example, South Korea patrols its northern border with armed robots built by Samsung Techwin. While humans are in control, the robots also have an automatic mode.

Israel already enforces its no-go zone near Gaza using stationary robots that autonomously combine sensor and drone data to identify targets. While the guns could fire autonomously, Israel currently requires a commander’s orders. Israel is also testing 10 autonomous vehicles along its borders. They could carry weapons in the future.

Autonomous killer robots make sense for militaries. They process information faster than humans, lack fear, make decisions without emotion, and insulate soldiers from risk. These arguments resonate with police departments.

They are given special credence because roboticists are making startling advances in autonomy. Improved statistical techniques and new software architectures that mimic the human mind have significantly boosted AI capabilities. This is especially true in pattern recognition. Just consider the dramatic improvements in Apple’s Siri and other speech recognition systems or the ability of Facebook to automatically tag pictures of our friends.

The real holdup has been shrinking the vast array of sensors robots need to move, avoid obstacles, assess threats, and make decisions. Right now, they are small enough for an autonomous vehicle like Google Car but too large for a Talon or PackBot.

Dean expects sensors will eventually shrink and robots will become more autonomous. Yet no one is rushing to give robots weapons.

“In my mind, the sensors don’t exist today that will allow a machine to make such deadly decisions. The sensors have...
to be more reliable. And in the end, the robots have to be able to determine the intent of a human being, and that is sometimes hard to determine,” Dean said. Yet many robots are already packing. Disruptors, which can cut through iron pipe bombs, are certainly weapons. So are the shotguns some robots use to blow open locked doors.

“They’re not engaging human threats,” Dean retorted. “They’re just getting through locks and doors. Otherwise, you have to put a human in front of the door, and that’s a hugely dangerous place for a police officer.”

Dean is right, of course. But such logic requires only a small step to go from opening a door to entering and clearing a building. From there, doesn’t it make sense for robots to return fire if they are attacked instead of risking a cop’s or sheriff’s life.

At least autonomous robots won’t react emotionally or shoot first out of fear. They may prove better at identifying a shooter in a fast changing situation.

Unbiased Law Enforcement
Perhaps we may be entering an era of safer, more unbiased law enforcement.

Or not. Autonomous robots are creatures of their software, and programmers cannot help embedding their biases and understanding (or lack of it) in what they write.

Last April at We, Robot, a conference on robots and the law held at Stanford University, a group of researchers from West Point and Cumberland School of Law ran a test to see how programmers might write code to enforce the law.

The researchers asked 52 experienced programmers to write software that would automatically ticket speeders. The researchers gave them speed zone information and a database of vehicle speed sampled three times per second.

The results varied wildly.

The problem was that programmers had to make value judgments about the letter of the law, the intent of the law, and how to implement the intent of the law within the design specification, said Greg Conti, an associate professor in electrical engineering and computer science at West Point.

They had to decide about tolerance, how much faster than the posted speed limit deserves a ticket, and also how long a vehicle should be allowed to drive at those speeds before it was ticketed.

This led to even more gray areas. “Tolerance is not necessarily one fixed value. It is different if you are doing 15 miles per hour in a 10 miles per hour school zone, and 75 miles per hour on a 65 miles per hour highway,” Conti said.

Programmers also had to grapple with the intent of law. Should they penalize every driver who goes over the speed limit? Just try to keep unsafe drivers off the road? Or encourage most people on the road to drive safer?

Allow Some Slack
Programmers came up with different ways to apply the law. Some issued tickets to any speeders. Others allow some slack. Still others warned speeders, then issued tickets. One assigned a small fine that kept growing unless the driver decelerated.

That last solution caught the attention of the conference because it solved the problem in a way a human policeman could not.

Oddly enough, something like it already exists.

Let’s go back to your hypothetical bar friends, who laughed off your concerns about robots and law enforcement. They may have driven home in cars that already report their driving behavior—speed, sudden stops, and sharp turns—not to the police, but to an insurance company that lowers their rates if they drive safely.

It is just another example of how the technology for autonomous law enforcement is quietly infiltrating our world. Given our rapid progress in AI and robotics, New York’s Bloomberg may be right. These technologies may be inevitable.

Yet we are not likely to arrive at any consensus on how to use them for many years to come.