along with your callback number and the details and location of the tower that processed your call. Those coordinates are fed to the mapping system at the 9-1-1 center and your position is displayed on a map. 9-1-1 knows where you are and can send help.

While this scenario is the goal, a variety of factors limit 9-1-1's ability to do just that.

Traditional Enhanced 9-1-1, before the advent of mobile phones and the ability to locate them with technology, relied on civic addresses for caller location. Enhanced 9-1-1 delivered these civic addresses automatically. Landline phone numbers were linked to street addresses in a database maintained by the 9-1-1 database provider, standardized with the Master Street Addressing Guide—the MSAG. The MSAG also provides a code—the ESN or Emergency Service Number—for the specific fire, law and EMS agencies that respond to that location. With the help of the database of accurate street addresses (MSAG), E9-1-1 technology allowed landline calls to be selectively routed to a specific public safety answering point (PSAP) by address.With the MSAG, basic 9-1-1 with default routing—sending an entire telephone exchange to a single PSAP regardless of political or PSAP boundary—moved from the forefront of 9-1-1 to a backup plan for unaddressed or underserved areas.

The FCC standards, which have been updated as technology improves, are currently fairly lenient. However, it is our experience that few 9-1-1 personnel fully understand them and thus may use mapping applications incorrectly in pinpointing emergency locations.

But it was back to the drawing board with mobile location, as mobile phone technology didn't dovetail with the established 9-1-1 system. Mobile phones could not be associated with MSAG-valid physical addresses and did not adhere to traditional exchange and switching rules. Early mobile phones were used primarily in vehicles, and drivers expected to be able to use them to reach 9-1-1 during vehicular emergencies. Each tower, tower face or antenna was assigned to a PSAP. When a 9-1-1 call was handled by a tower, the call was forwarded to a designated PSAP's administrative line. Carrier and PSAP equipment upgrades were required before these calls could travel through the 9-1-1 system with their attendant ANI/ALI data and reach 9-1-1 dispatchers.

But even as those upgrades were made, and wireless calls began hitting the 9-1-1 system on 9-1-1 trunk lines, location information was limited and might have included cellular company name and phone number, a call-back number for the caller, and perhaps tower address. Wireless call routing was, and often still is, an all-or-nothing proposition—the location of the caller could not determine wireless call routing. In the 9-1-1 systems available for most Americans, calls handled by a specific directional antenna on a cell tower must all route to the same PSAP, even if those calls were placed from individuals in different PSAP response areas.

Thus, if Poplar Bluff, Missouri, and its home county of Butler have their own 9-1-1 systems, landline calls can be routed according to address. Next door neighbors, one inside the city limits and one just outside, reach two different PSAPs. Those same callers would almost certainly reach the *same* PSAP when dialing 9-1-1 from their cell phones because both calls are likely to be picked up by the same cell tower face.

Before cellular phones became GPS devices, able to package latitude/longitude coordinates and transmit them along with a 9-1-1 voice call, the need still existed to locate callers. The network solution, still used in some places today, locates callers by using radiolocation; the towers themselves locate the caller but good location calculations require three closely-spaced towers. This system, often called triangulation, offers a quick location determination with less accuracy than GPS. This method is especially weak in rural areas where there aren't enough towers to pinpoint the caller accurately.

As cell phones became ever smarter and the consumer market developed more applications that utilized GPS positioning, consumers' expectations of their 9-1-1 systems rose as well. If vacationers can call Uber and expect a car to pull up in five minutes, why would a 9-1-1 operator ask them—as a victim, injured, sick, lost, panicking—where they were? Why didn't the operator already know?

The answer is complex. But it includes the legacy equipment and systems already in place; the prohibitive expense of replacing and upgrading these systems to keep up with changing technology, especially given how 9-1-1 has historically been funded; the information overload a dispatcher already experiences; and the privacy and security requirements of the industry.

Because 9-1-1 is regulated by the Federal Communications Commission (FCC) as part of the telecommunications industry, the agency set about creating and updating standards for positional accuracy of 9-1-1 cell phone calls. Determining location of 9-1-1 calls placed from traditional wireline phones relies on attendant databases derived from addressing data overlaid with zones depicting responder and community designations. The caller's landline telephone number is tied to an address. That address is queried in these databases and the corresponding responder codes derived and transmitted in a text string to the answering PSAP. All of this text data—account holder, call back number, physical address and appropriate fire, law and ambulance responders, or ALI (Automated Location Identification)—can be parsed out by applications at the PSAP to enhance call taking, CAD, mapping and even voice recording. Standards for this data are created and maintained by industry organizations such as NENA and APCO, supplemented by local exchange carriers, the United States Post Office and other entities.

But the location of a wireless 9-1-1 caller, as previously described, is derived from the equipment used by the caller to place a 9-1-1 call or from the telecommunications systems themselves (i.e. the cellular networks). The