What would London be like without power? Saul Wordsworth looks at the worst-case traffic scenarios, and then discovers the new technology that, as it becomes more widespread, is making such risks more remote.

Photography: Alphaspirit

Britain. Winter. 2016. Freezing fog blankets the Southeast. The National Grid has warned that the risk of blackouts is at its highest for years. The closure of power stations leaves spare capacity on the system at just 1.2%, the lowest in over a decade. One morning the capital is hit by a power failure the likes of which it hasn’t suffered since the 1970s. All power is lost, including overhead lighting and traffic signals. The roads are plunged into total chaos.

“The result would be instant gridlock,” says Nick Hounsell, professor of highways and traffic, the University of Southampton. “Drivers would be hesitant at every junction, where previously they weren’t. The queuing would be horrendous.”

The myth that traffic lights somehow cause congestion would quickly be dispelled, particularly in a city where SCOOT (Split Cycle Offset Optimisation Technique) is widely in operation. With cars bumper-to-bumper, emotions would...
be heightened and tempers would inevitably fray.

“Traffic signals are a safety net for pedestrians as well as vehicles,” says Hounsell. “With no movement at all, pedestrians would likely be OK, but in a slightly free flowing environment the risk suddenly escalates enormously.” A woman trying to cross the road is knocked down. How will the emergency services reach her? Very quickly the city takes on the sheen of anarchy.

The worst conditions would be reserved for complex junctions. Under normal circumstances they provide a safety function as well as synchronizing traffic. Large junctions could prove extremely hazardous, particularly for those drivers attempting to negotiate them for the first time. Without traffic signals to assist, two drivers trying to complete the same maneuver in conflict could easily collide.

Opinion is divided on exactly how a city like London would react to a total collapse of its traffic signal system. Perhaps the doomsday scenario is overly dramatic and there may be a more harmonious outcome.

“We might actually be pleasantly surprised at how well some junctions perform when all the drivers approach knowing they have to give way,” says John Parkin, professor of Transport Engineering at the University of the West of England, who suggests a social spirit may prevail. “Spontaneous collaboration may ensue and the capacity may not be as severely limited as we think.”

“Operations might revert back to major-minor type junctions, in which case the major roads will keep going and the massive queues will be on the minor roads,” ventures Hounsell. “If lights were down for a long period it would be interesting to see how drivers would react. I imagine everyone would slow right down and be cautious at junctions, and that would cause delays. People would quickly realize they couldn’t get from A to B by car in a reasonable time. The outcome would be that business people would work from home.”

Back ing up
It is only in the past 50 years that we have seen the growth of the major signalised junction, and only in the past 15 that anyone has considered protecting them. Some of the first backup systems were installed at the turn of the millennium as California reacted to power shortages and rolling blackouts. Soon after, agencies across the USA began installing backups in response to power outages and line disturbances such as sags and swells. Other reasons for signal breakdown include power failure at substations, cable failure and miscreants deliberately cutting through cables. It was only as a result of the Northeast Blackout of 2003 (see World’s worst blackouts) that New York first considered signal backup.

“After 2003 we installed battery backup systems (BBS) for the traffic signals at over 600 locations,” says Mohamad Talas, deputy director, system engineering, NYCDOT Traffic Operation and Planning. “We continue to add extra BBS as we go along. The BBS kick in the instant there is power loss and run for up to eight hours, or until a traffic agent is present or the problem is fixed. You can’t assume that all intersections are going to have backup. That’s a challenge and a problem.”

Even where BBS systems are in place, batteries can sometimes fail prematurely. Agencies need to check them periodically to make sure the
systems are fully functional. What helps greatly is to have a BBS with a self-test feature. Such setups automatically run a system in backup mode once a month and the agency will be automatically notified of any issues.

Meanwhile, because of storms and there being some areas susceptible to power loss, intermittent problems remain in New York. “These things happen,” says Talas.

**New developments**

With junctions growing in size and complexity, the risk to motorists if signals fail remains greater than ever, particularly at high-speed intersections. As such, there is a worldwide move toward BBSs, particularly at hamburger junctions, where a main road passes through a roundabout.

Virtually all uninterruptible power supplies (UPSs) rely on a battery or bank of batteries to provide power. When customers invest in a UPS, more often than not they are purchasing an office-based solution originally designed for indoor, computer power backup.

**WORLD’S WORST BLACKOUTS**

**Brazil, 1999**

In March 1999, 97 million people – most southern Brazilian cities – are affected when lightning strikes an electricity substation in São Paulo. More than 60,000 people are stranded in the Rio subway. 1,200 police deployed to prevent looting.

**Itaipu Dam, 2009**

In November 2009, Itaipu hydroelectric dam, bordering Brazil and Paraguay, grinds to a halt. Suggestions it was the work of hackers are never proved. But, as a result, the power system is now voice-activated.

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John Parkin, professor of transport engineering at the University of the West of England, UK

These generally use lead-acid batteries, which have limited temperature tolerance, which means they’re not optimally suited for static outdoor use. In addition, most solutions are ‘online’, whereby the UPS provides constant power to the load. This isn’t necessary since all traffic control systems are able to tolerate short breaks in the mains power. What’s more, an online UPS solution that operates all the time overheats and wears out more quickly.

“At Junction 11 of the M4 into Reading we have eight controllers,” says Lyndon George, traffic signal engineer for Reading Borough Council. “Originally we had a set of very large containers for air flow to cool the batteries. I referred to them as bicycle sheds because they were that kind of size. That isn’t really practical in an urban environment. One day an accident took out one of the cabinets. That gave us the chance to look at what was on market.”

What Reading Council plumped for was a new UPS solution from Siemens designed specifically for traffic signal applications. Instead of lead acid, the new system employed lead crystal batteries for a longer life (six to 12 years versus two to four) and for a much wider operating temperature range. The latter meant the housing units no longer needed to act like air-conditioning cabinets, and could be smaller.

“Whereas the older system gave us five to seven hours of continued use after power loss, the newer one is closer to 10 hours,” says George.
“This allows us time to get traffic management into place or an engineer to investigate. Unlike online solutions, it is only when the mains power fails or falls outside certain defined limits that the UPS switches on. This helps prolong the life of components that make up the controller itself. Spiked voltages tend to make things heat up, cool and heat up again, causing components to break. The newer units improve the life of the controller.”

The solution is not there to provide backup power, merely to provide backup power for long enough for a local authority to decide what steps it wishes to take. In the event that the power failure is long-lasting, there is a ‘comet’ socket built in for a generator. So, if the batteries run out, the site can be kept running for weeks if necessary.

“We have our UPS configured so that it generates output into urban traffic control and in turn our fault-management system automatically signals a fault to an engineer,” says George. “There have been cases where the power has failed for a few minutes but we have seen no indication and the lights continue working safely.”

Backup to the future
It is clear that purpose-built solutions are already proving valuable to the market. At intersections where the cost of signal and enforcement hardware may rise above US$500,000, further investment to keep that technology running makes economic sense. George for one believes that backup, whatever form it takes, is essential, because, however polite we think we might be to other road users, if there was a massive power outage and all signals suddenly stopped functioning – as in the doomsday London scenario imagined earlier – safety would be compromised.

“You need to look at everything from a safety perspective,” he says. “Technically you’re only supposed to proceed through a junction if it is clear to do so, and only then with extreme caution. You must give way to others unless you can see them giving way to you. Sadly, in my experience, people don’t do that.”

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Lyndon George, traffic signal engineer, Reading Borough Council, UK