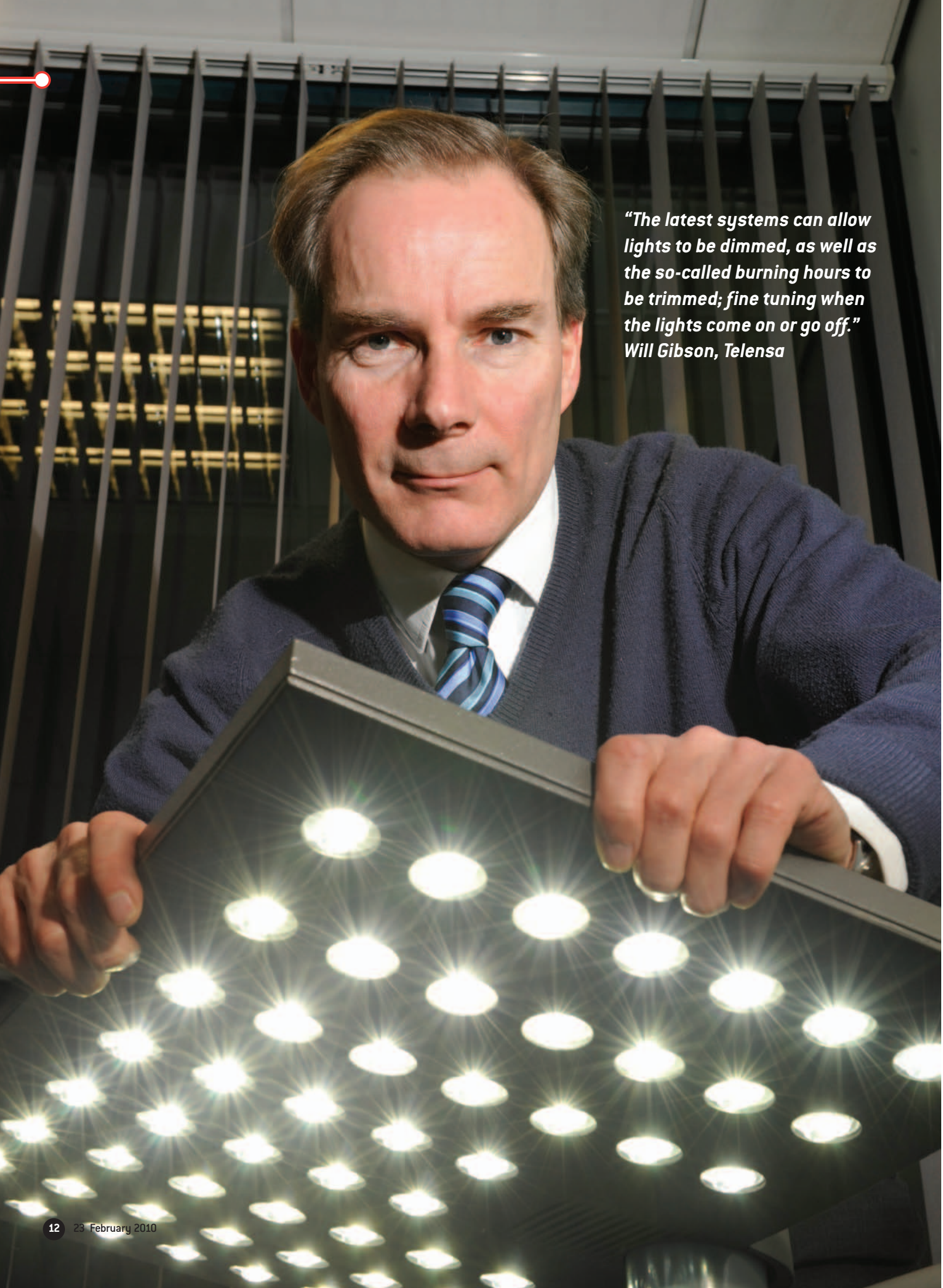

"The latest systems can allow lights to be dimmed, as well as the so-called burning hours to be trimmed; fine tuning when the lights come on or go off."
Will Gibson, Telensa

Turn off the lights!

Streetlights of the future will be anything but dumb. By **Graham Pitcher**.

The humble streetlight has remained basically unchanged since the advent of electrical power. The only nod to technology has been the addition of a photosensor to turn the light on or off. But climate change and the need for local authorities to save money has pushed streetlighting towards the top of the agenda.

The ten largest metropolitan areas in the US feature 4.4million streetlights and these consume something like 3billion kWhr of electricity per year, the generation of which produces 2.3million tonnes of CO_2. There is no reason to believe the situation in the UK – with some 8m streetlights – is any different.

Design consultant Plextek saw the opportunity to apply its ultra narrow band (UNB) radio telemetry technology to the problem and set up Telensa to focus on the intelligent streetlighting market.

Will Gibson, one of Telensa's directors, said: "All streetlights in the UK are owned by local authorities and there are 220 of them. A few years ago, their focus was clearly on the monitoring side, moving away from very old maintenance processes, such as scouting, where people went out at night to look for non functioning lights. That is a real cost. However, in the last five years, the climate change agenda has risen to the top of the pile and the concept of remote control and monitoring of streetlights has developed."

But Gibson said that, at first, he wasn't convinced there was the need for such an approach. "I was persuaded to call a local authority streetlighting manager. I asked him whether there was any mileage in a radio based system that could communicate with individual streetlights and he said they had been crying out for such a system for years."

But Telensa's radio telemetry approach is not alone in the market – plenty of other companies are developing streetlight control systems, with technologies ranging from gsm to mains signalling.

Echelon is a major supplier to the intelligent streetlighting market, using a combination of its Lonworks technology and mains signalling. Recently, it has installed a trial system in Milton Keynes. Adopting a similar approach to Telensa is Harvard Engineering, whose LeafNut system has been used in a number of UK and European cities.

Gibson says these moves are a direct response to demand from local authorities for systems that give them more control over their streetlighting. "The latest systems can allow lights to be dimmed, as well as the so-called burning hours to be trimmed; fine tuning when the lights come on or go off."

The systems available on the market are broadly similar in concept, Gibson said. "They will all have some kind of automatic device in the light, which allows communication in various ways with hubs or basestations deployed across an area."

In Telensa's PLANet – or Public Lighting Active Network – system, telecells (pictured below) are integrated into streetlights and these allow direct connection to a basestation. Basestations then connect into a central server.

Telecells contain a radio control processor, lighting control and monitoring circuitry, together with an electricity meter chip. The telecell is powered directly from the mains supply and consumes 0.5W. A dimming module interfaces with and applies control to an electronic dimmable ballast. The module uses short range, bidirectional communications over the mains wiring in the luminaire to receive dimming control instructions from the telecell.

The basestation consists of a radio box, a power supply, a light meter and an antenna. It can be installed either at the top of a column or on a rooftop and has a range of around 3km in urban environments and up to 8km across rural terrain. A PLANet basestation can connect up to 10,000 telecells, communicating using the 868MHz licence free band.

The radio box contains the ultra narrowband radio, a host processor, a UPS battery, ADSL modem and a 3G wireless modem for linking to the central server.

Gibson noted there is a trade off between capacity and data rate. "The underlying data rate is slow," he conceded, "but that works, because the amount of data traffic being sent to each telecell is small. What makes it work is that, while the links are slow, the system has a high overall capacity."

Despite PLANet being able to support up to 150,000 streetlamps, the system is capable of communicating with each lamp, accomplished by allocating each telecell a unique ID. Parameters can then be set for each lamp or group of lamps using a web based user interface.

Once a system is in place, streetlighting engineers have a range of control options and maintenance information to hand. "They can begin to think in ways they couldn't before," Gibson believes. "They can ask 'what lighting policies do I want?' and 'which policies should I apply to which group of lights?'. Lights could be grouped under headings such as traffic routes or residential areas."

Because the basestation features a light cell, engineers have the ability to set all the lights within a given basestation's area to come on or switch off at preset ambient light levels. If they want more accurate control, then on and off times can be set, as well as periods where the lamp's output can be dimmed and by how much.

Each telecell will also report back on the status of the light to which it's attached. As well as reporting if the lamp has failed, the telecell will send back information on instant and average power, current and power factor values, along with the active and cumulative energy consumption.

Everlight Electronics has recently introduced the SL-Dolphin Street Light series, available with a choice of 60, 90, 120 and 150W LED light engines. With short term projected efficiencies reaching up to 85 lm/W and energy savings of more than 40%, the lights provide improved brightness and higher uniformity when installed on 8m poles, than traditional street lights on 12m poles.

Everlight offers three kinds of light engine – Phoenix, Trex and Venus. Phoenix, with an asymmetric wide beam, and Trex, with an asymmetric short beam, are both suited to parking and road way applications. Venus has an asymmetric wide beam and is design for streets and pedestrian walkways.

Adopting a similar approach to that of Telensa is Harvard Engineering, with its LeafNut system. LeafNut has at its heart the TrunkNode central web server, which uses gsm communications to link with BranchNode control units, which are mounted in streetlights. In turn, each BranchNode is linked using wireless communications with up to 256 LeafNodes. These devices are connected directly to an electronic ballast in each street light.

The system manages the light output, allowing the dimming of street lights to match specific requirements of a location at different times of night and provides individual light management, as well as in groups or as a whole throughout the infrastructure. The system can also gather information on energy consumption and maintenance requirements. According to Harvard, if a BranchNode fails, its associated LeafNodes will continue to operate as previously.

Westminster City Council, which manages around 15,000 streetlights, has been trialling a LeafNut system as a part of its SMART Lights project. It believes the system could save up to £46 per street light per year, reducing CO_2 emissions by 100kg per street light per year. Total savings could reach£420,000 per year and carbon emissions could be cut by around 1.5m kg per year.

The solution also provides a daily maintenance report for each light. This not only identifies bulbs which have failed, but also ones which are about to fail. LeafNut avoids the need for 'scouting' as maintenance can be scheduled and managed via the web based interface.

Dave Franks, Westminster's public lighting manager, said: "With the introduction of the Climate Change Act 2008 and the Carbon Reduction Commitment, it is becoming increasingly important to identify ways of reducing the amount of electricity used, including street lighting. Some local authorities have made the decision to switch off street lights; in Westminster, we are looking to technology to help us achieve savings, reduce carbon emissions and minimise the energy wasted by overlighting the highway. The LeafNut system allows us to do this by reducing light levels at particular times, rather than switching lights off completely."

Milton Keynes City Council, meanwhile, has embarked on a test project which uses mains signalling to provide enhanced lighting control. The council has installed the technology in 400 new streetlights. Although the streetlights are of lower wattage, their light output is of a higher quality.

Smart electronic ballasts from SELC Ireland and enterprise monitoring software from Streetlight.Vision are combined with Echelon's LONWORKS technology. The ballast that identifies lamp and ballast failures; measures energy use, running hours, and voltage; and enables remote command through the power line network using Echelon's embedded power line transceivers.

Transceivers in the streetlight communicate with Echelon's i.LON 100 Internet Servers over a LONWORKS network. The servers, acting as segment controllers, communicate with a central computer equipped with Streetlight.Vision's Enterprise Monitoring Web software to record each lamp's energy use, status and failure information. Each i.LON Internet Server includes an astronomical clock that tracks changes in sunlight levels. This lets the lamps adjust their illumination accordingly from midnight until dawn; not only reducing energy costs, but also prolonging lamp life. Initial results show the system has cut energy consumption by 40%.

With accurate control systems, lighting engineers now have the ability to develop innovative systems. One potential system of the future might switch lights off completely in some areas, but provide the ability for them to be switched back on when needed.

One such example is in the northern German village of Dorentrup, where street lights are shut off at 9pm. However, by sending a text message to a control centre, identifying which road which needs to be illuminated, residents can have the lights restored for a short period.

Another potential application is to have 'pools of light' following pedestrians at night. Through the use of technology similar to passive infrared sensors, lights could switch on when they detect someone nearby, remain on for a given period, then shut off. "But this system can only work with instant lighting," Gibson pointed out. "The 'good old' sodium lamp takes too long to warm up."

Additional momentum for intelligent lighting systems will be provided by the Department for Transport, which is shortly to announce the winning bids in a £440m Private Finance Initiative. "We've got our eyes on this announcement," Gibson admitted. "It means that quite a few large scale projects will start and this will help the introduction of new technology."

While nothing changed for many years in the street lighting world, technology is now being applied. "Streetlights have moved from dumb to sophisticated," Gibson concluded, "and lighting engineers can now start using their imagination."