More Adventures in Optical Communications

Bringing you up to date on the latest developments

PHOTO 1: The 3W optical beacon operated by the author.

MORE PROGRESS ON 630nm. Since the original Adventures in Optical Communications articles in early 2011, the maximum distance worked via 630nm red light was extended to 90km with astonishingly strong signals, then to almost 120km. Amateurs were active in the North East and further south in Sheffield, making incremental steps as conditions allowed. Barry, G8AGN and Gordon, G0EWN were first over the 100km mark. The longest two-way contact to date (117.6km) was achieved by Stuart, G8CYW, located near Alnwick, Northumberland working Rob, MODTS, at Danby Beacon near Whitby. This contact required help from atmospheric refraction as it was technically non-line-of-sight (NLOS). This time SSB was used due to the weak (but perfectly readable) signals. It is worth noting that this contact was completed well after midnight due to Rob's work pattern.

This was in April 2011, with the light nights encroaching on the time available for making contacts in the darkness.

INTO THE DAYLIGHT… Due to the light evenings, Stuart challenged all to try and make optical contacts during daytime hours. He thought that this would demand different techniques and had already developed a system using infra red (IR) LEDs for this. He used both 850nm and 940nm Golden Dragon LEDs, which perform the recently discovered feat of being usable on both receive and transmit.

A change of wavelength this turned out not to be necessary, as the Sheffield group, Barry and Gordon, carried out a series of lunchtime QSOs at increasing distances. Using red light totally invisible in the noontime sun, a distance over 40km was eventually worked on their baseband rigs, equipped with narrow band interference filters. This required extra precision in aiming, as powerful torches, beacons etc just were not visible.

The distance has recently been increased yet again, to almost 55km, with the use of more powerful 'Phlatlight' LEDs that run at a current of 5.9A.

The North East group had similar success over a 46km path using a red gel filter at Brian's (G8KPD) end and no filter at all at Stuart's end. In addition, lining up on each other was achieved by aiming telescope alone.

IR COMMUNICATIONS. On Tuesday evening, 26 April 2011, in full sunlight at 7.30pm BST, Stuart, G8CYW, and Brian, G8KPD/P, made their first two-way FM and SSB contacts on 940nm over the modest distance of 6.3km. Signals were 5/9+ both ways on both modes. For this contact, both stations went back to the earlier equipment described in the original articles, using 100mm glass lenses. Brian used separate transmit and receive heads connected to his optical transverter and FT-817. The transmit head red LED was replaced by an Osram Golden Dragon 940nm 2.2W device and the receive photo diode was replaced by an IR filtered version of the same device, a SFH2030F. Stuart used an IR version of his LED transceiver connected to his optical transverter and FT-817, both transmitting to Brian and receiving Brian's signal on the same 940nm LED.

The contact was witnessed at Brian's end by the farmer and his wife who had given him permission to use their farmyard, a nice level concrete surface. Brian had only to contend with an inquisitive horse, who stood exactly in the path of the beam – until encouraged away by the farmer with a little extra feed! Stuart's wife Christine witnessed the other end, taking photos.

Attention switched to 850nm after an internet search and enquires via the 'Optical Links' reflector revealed there might be less atmospheric attenuation at 850nm.

Some time later two contacts were made on the same day on 850nm. Stuart, G8CYW operated from Currock Hill, IO94BW93, some 800 feet ASL. Experiments started just before 3pm. The first contact was with Gordon, G8PNN using his rig located at IO95CA64, along with Peter, G8POG and Brian, G8KPD – who still had his IR rig stowed in his car. Such confidence! This was a 10km separation and Stuart lined up using his extreme beacon, itself co-aligned with a carrier on 850nm, bringing it to bear on to Gordon's location. The beacon was seen immediately. Gordon lined up his transceiver and FM signals were immediately exchanged, at end-stopping S-meter indications both ways.

Brian, Gordon and Peter then departed for IO95DC27, Saltwick, 21.5km distant and 340 feet ASL. This time both Brian and Gordon's (identical) rigs were deployed. Peter spotted Stuart's location and used his Fresnel-equipped Xenon strobe to mark the location for Stuart, who replied with the same extreme beacon and co-aligned 850nm signal. The same lining up procedure as used before rapidly brought about strong contacts for all stations on FM with all segments of the FT-817 S-meter illuminated. SSB signals were at S9+ as recorded by the HF rig. The FM signals were fully quieting, as would be expected. It seems odd that nothing visible

passes between stations once the beacon is turned off. The hardest thing was to find each other's location in the daylight!

It is interesting to note that even in the afternoon sunshine; the noise level on the FT-817 was S1 to 2 on SSB and S6 on FM. It seems that the 850nm LEDs used for both receive and transmit have the property of not responding much to the daylight – very handy.

Sometime later, Stuart, G8CYW, Brian G8KPD and Peter, G8POG, and Gordon G8PNN set out at noon to attempt to increase the distance worked on 850nm in the middle of the day. The intention was to be operating at 1307BST, which was the sun transit time (highest in the sky) for the day. The stations were both using LED transceivers and single optics.

This time there were to be no visual aids such as beacons or strobes. Instead, both stations had aligned their optics to a higher accuracy than ever before, hoping simply to beam accurately at each other. Stuart began radiating a 20kHz sub carrier on 850nm and almost immediately Brian picked up a carrier on LSB. This was confirmed by Stuart keying it on and off. Both rigs were then adjusted for aim and a QSO was made around two minutes later. This was the quickest set up time that had ever been managed. Signal reports were exchanged at 59 both ways on SSB. FM was also tried. Signals were strong but fluttering so much it made copy difficult. The wind, which was forecast to be at 10mph, was at least 30mph, making the gear vibrate and causing much turbulence in the atmosphere. This was another case where SSB gave a better result.

So, having dispensed with the visual aids and made contact despite the inclement conditions, the group moved on to the next trial. This was to use an iris plate attenuator to reduce the signal by a known amount. A 6dB attenuator (which reduced the area of the Fresnel lens by a factor of four, to roughly a rectangle 10cm by 14cm) reduced signals on SSB to 57 one way and 58 the other. This roughly simulates the signal level at twice the distance without taking account of the larger extinction coefficient at that distance.

The iris plate can also achieve a 12dB reduction in signal strength, which was duly tried next. This means operating through a silly little hole roughly 5cm by 7cm in a sheet of cardboard in front of the lens. Although Stuart clearly copied Brian with it in place, the wind ripped the cardboard attenuator off the front of the rig and hurled it across the road. We gave up with the attenuator at this point as it was felt that the result at 6dB alone was useful.

It was also noted that the received noise level due to daylight was around S3-4 using 850nm low-pass filters in the rigs. Removing the filter increased the noise to S6-7, so the use of a long-pass filter is a benefit, particularly as it had no effect on the wanted signal. The iris plate had exactly the predicted effect on the noise level as was expected, the 6dB aperture reducing the noise (and signal) by 2 S-points. The next trial planned is for a distance of 90km.

BEACONS. There are a growing number of beacons being operated at locations around the country. Bernie, G4HJW, has a 400mw 10 degree wide optical beacon at Wyton, co-located with the GB3CAM RF beacon north of Cambridge, beaming to the south east just north of Cambridge itself. You can find out more about this at www.earf.co.uk/light_beacon.htm. Stuart has a 3W beacon, 180 degrees wide by 10 degrees high, (photo) beaming a half-omnidirectional 16.6kHz signal everywhere from NW through north to SE from his home QTH. The half-omni directional LED system was a kind donation via Sam Jewell, G4DDK, who distributed four of these to various stations. Another NE beacon running a WJST mode modulator donated by Andy, G4JNT, is planned, and a possible Sheffield beacon has had a few outings using the same units.

YAHOO GROUP. Most active UK stations now have joined a dedicated Yahoo Group called UKNanowaves, which was started in summer 2011 by Barry, G8AGN. The term 'Nanowaves' first came to prominence at the Finningley Microwave Round Table Meeting in July 2011 when Peter, G3PHO used the term when adding optical contact distance records to microwave distance records in his talk. This term has since been adopted to describe what was otherwise variously referred to as 'optical' or 'light wave' activity.

If you are interested, it is a fairly simple matter to join the group, which has a growing band of international members. Also, we in the UK are becoming known as the ones who "construct the gear, then get out there and use it, not just appliance operators" as one American member put it.

CROSS-MODE CONTACTS. Many stations use baseband AM, but the North East group have all gone over to sub-carrier operation using the transverter described in the earlier articles. It has been proven that these two systems are compatible to some extent, by the simple expedient of the sub-carrier stations simply tuning down to zero beat on their own local oscillator signal, where the received baseband signal can be resolved as if it were LSB. Transmitting back on the same settings on the transverter rigs will use the local oscillator to re-insert a carrier on the LSB signal and convert it to a baseband optical AM signal.

This technique was tried first at the Finningley Microwave Round Table Meeting in July 2011 between Gordon, G0EWN and Stuart, G8CYW as a short range demonstration

PHOTO 2: Testing the low power beacon now co-located with GB3CAM at Wyton. The beacon DC input is 400mW.

on a sunny afternoon. It has subsequently been used by Bernie, G4HJW on a 33km contact when he was up in the NE on holiday, and on the longest (one-way) contact yet to date of around 120km, between Gordon, G0EWN and Rob, M0DTS.

SETTING UP A CONTACT. After using local knowledge of high spots likely to be useful, the web is a useful source of programs to work out whether a path is truly line of sight (LOS). A useful example is 'Heywhatsthat', with its 'visibility cloak' function that indicates all areas that are LOS from a given point. It also gives distance, elevation and bearing information as well.

After the planning stage and travel to the chosen site, there is then an opportunity to find out how inaccurate a magnetic compass is when used anywhere near a car! A powerful flashing light is useful, trained on the distant point (or where you think that point is!). A talkback channel is also a must. The NE group usually use 70cm and it is amazing just how far one of the current crop of handheld FM transceivers will go – over 100km in our case. The author uses the 'extreme beacon' from the earlier articles, firstly flashing at 2Hz and then, when spotted at the other end, switched to 27kHz to enable the distant receiver to be optimised. Since the NE group largely use LED transceivers, the rest is easy. Having received a signal of sorts, the far end then go on to transmit and the receiver at the near end is then adjusted for maximum signal. Apart from minor adjustments, that is it. Sub-carrier stations then generally use FM unless conditions are difficult with weak signals or scintillation. Under those conditions SSB is used.

NLOS CONTACTS. Looking into the future, several stations are preparing to go further beyond the visual horizon and attempting to make contacts by cloud bounce or atmospheric scatter, but that will be another story…