

The origin of the term NVIS

What's in a name? Abstruse terminology (or jargon) is very much part of our world these days and possibly never more so than in the field of electronics (which, I note, is not a word that's used as often as it once was).

It seems as if the abbreviation 'tech', as in hi-tech (and therefore, presumably, lo-tech) and its protagonists, the 'techies', have now replaced it. Anyone, it is assumed, with any familiarity with technical matters or, more accurately, with keyboards, touch screens and the like is apparently called a 'techy' these days, though 'teen' seemingly covers the user-group pretty well too!

Technical terminology

Technical terminology, even when sometimes turned into jargon, is important, particularly when certain words and phrases really catch on and enter the lexicon of daily life. One of these, at least within the world of radio communication, is the phrase 'near vertical incidence skywave', usually written simply as NVIS. It's the mode of propagation we all use, knowingly or not, whenever we operate over distances of more than just a few tens of miles, usually on the 40, 60 and 80 metre bands. The signals, from an appropriate antenna, propagate at a steep angle up to the ionosphere where they are reflected and are returned to earth over a region that extends, continuously, from the transmitting antenna out to a distance of at least 100 miles – and often a lot further. The complete absence of a skip zone is what makes NVIS so useful. To use it, however, requires rather more than the just the right sort of antenna. The ionosphere itself must cooperate and this means that the transmitting frequency must be somewhat lower than the critical frequency of the ionospheric region doing the reflecting from virtually above the transmitter. Usually this is the F2 layer during the day and the F layer at night, so NVIS propagation requires some attention to such technical details if it is to succeed. These matters have been discussed at length elsewhere, and over

many years, so won't be gone into here. Rather it's the origins of the *term* NVIS (and even the way one says it) that prompted this short article. Who used it first, and when?

NVIS history

To try to answer these questions I looked back into a rather bulky file of papers I have of the subject of NVIS, as well as at the many textbooks that now include the term. The search for the answers was fascinating.

It won't come as a surprise to note that this mode of propagation is almost as old as radio itself; it's just its rather catchy name that is of more recent vintage. The first document I uncovered that made specific mention of the need to radiate signals "nearly vertically" in order to achieve communications over distances "up to one or two hundred miles" was a report issued by the British Army Operational Research Group, the AORG, in September 1943. The document's title is *Simple Sky-wave Aerials for Wireless Communication over Short and Medium Distances*. The author, though not mentioned as such in the report, was more than likely E W B Gill who, with his much more famous colleague in post-war years, Hugh Trevor-Roper, broke the Abwehr cipher in the earliest days of the war before Bletchley Park really got into gear. Walter Gill subsequently became a key member of the AORG, responsible for solving all manner of radio-related problems affecting the army on the move.

His opening remarks in the above report are of much interest not only in terms of NVIS, yet to be so-named, but particularly because radio amateurs and their commercial counterparts are credited, equally, with pioneering "the evolution of the 'sky-wave' technique". However, as Gill pointed out, both amateurs and professionals were primarily concerned with propagation over long distances whereas the techniques for covering short and medium distances had "to a large extent been overlooked". His report addressed this specific problem both from the point of view of the best frequencies to use and the most appropriate antennas to achieve it.

Gill summarised the requirements to be met by an army sky-wave aerial as follows.

It should, he said (and these statements are taken directly from the AORG report):

- (a) Give good radiation upwards
- (b) Be flexible to considerable, and also to small, changes of frequency within the bands 2 to 8Mc/s
- (c) Be such that any type of mobile army set can "tune into" it
- (d) Be reasonably compact, easy to erect and simple.

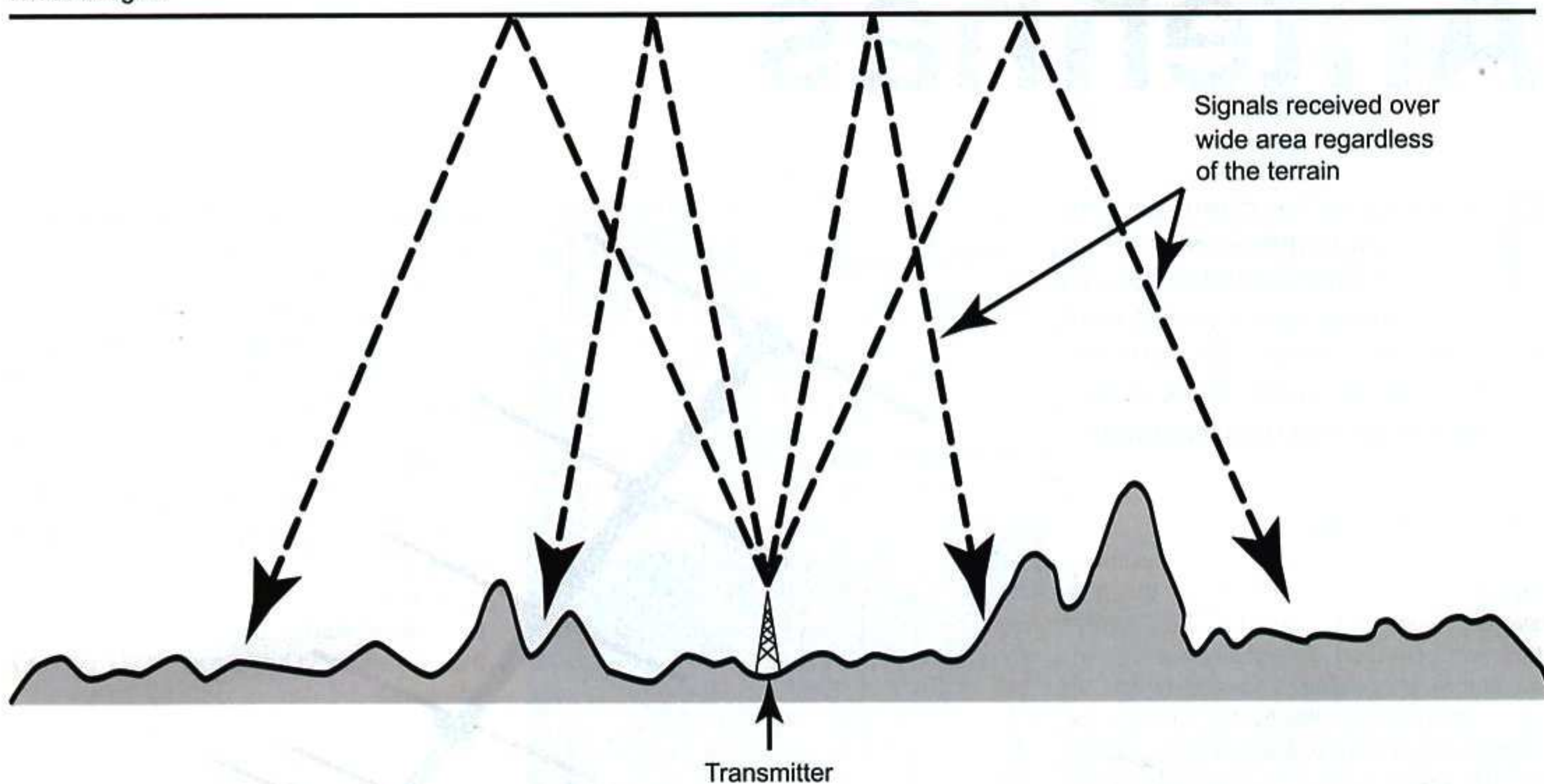
Viewed from our stand-point today no one would disagree that these requirements specify, most appropriately and precisely, what an NVIS system has to achieve.

The D-Day landings

Perhaps somewhat better known is what happened just before the so-called D-Day landings of 6 June 1944 on the coast of Normandy by the biggest military armada ever mounted. Effective radio communications were absolutely vital to the success of that mammoth operation and the American military certainly appreciated this. Dr Harold Beverage, well known as the inventor of the rather special antenna named after him, and a respected expert in the field, was appointed as a technical adviser on radio communications by the US Army. His crucial recommendation was that horizontally-polarised antennas should be used at the HQ station in Uxbridge and not the vertical whips that had previously been the standard antenna in use there. That recommendation, and the careful choice of the operating frequencies that accompanied it, ensured that the US Army's communications during the landings on the beach-head in France were most effective throughout this critical operation. But Beverage didn't give any particular name to the system he proposed, he just emphasised that high-angle radiation was vital to its success – and that required low, horizontal antennas at the HQ station in England and on the naval vessel, the USS *Ancon*, just off the Normandy coast, which acted as the command and control centre for all US military communications.

My search then moved forward some twenty years. Nothing, of which I'm aware, appeared in the technical literature during

Ionised region



Near-vertical incidence skywave gives propagation for a radius of 100 miles or more by reflecting signals more or less straight down from the ionosphere (as opposed to the small angles of reflection used for DX working).

the 1950s on this specific subject. But events in the world during the 1960s brought military communications back into sharp focus and none more so than the war in Vietnam.

Unfriendly environments

A considerable amount of research in the United States went into the problem of radio communications within a jungle environment so typical of parts of SE Asia. It was soon realised that the dense vegetation played havoc with signals at VHF, and even HF was compromised. The solution, therefore, lay in reducing the propagation path through the jungle canopy as much as possible and this required that signals should be transmitted almost vertically upwards at frequencies that would then be returned to earth by the ionosphere above. The man responsible for much of the pioneering research into the types of antennas best suited to such applications was George Hagn, an engineer employed at the Stanford Research Institute in Arlington, West Virginia.

In January 1966, Hagn and his colleagues wrote an internal company report that is apparently the first occasion on which the term near-vertical incidence appeared in the scientific literature. Given its importance in an age when NVIS is now almost taken for granted – even though

its origins are seldom considered – it's worth repeating the title here: *Ionospheric sounder measurements of relative gains and bandwidths of selected field-expedient antennas for skywave propagation at near-vertical incidence*".

Over the next decade and more Hagn was responsible for possibly the most thorough investigation of the NVIS communication problem ever undertaken until the flurry of interest shown in it, in various places, in recent years. The scientific literature published on the subject has now grown significantly with, at my last count, many more than a hundred papers and articles as well as chapters in books having appeared. Their authors are professionals, employed in universities and research institutes across the world, as well as radio amateurs in many countries. The topic has also been hot at international conferences devoted to HF communications and systems with special sessions devoted to NVIS being not uncommon. Current interest in this rather special mode of radio communications, within the military, the emergency communications sphere, in developing countries where cellular telephone systems have not yet taken hold, and amongst disaster-relief organisations as well as in the amateur radio community, of course, suggests that many more publications are yet to come as the underlying subtleties of NVIS are discovered.

Please say again, over

Now we come to the small issue of how to pronounce the abbreviation NVIS. There would appear to be two schools of thought on this matter.

One, particularly within the USA, calls it 'envis'. The other, usually encountered elsewhere, favours just spelling out the four initial letters, 'N V I S' (en vee eye ess).

Probably, like numerous other examples encountered when using the English language, it all depends where you come from. The important thing is that all who use it know that NVIS really works!

Conclusion

I must thank my many colleagues over the years, both practising engineers, radio amateurs and the many students who worked alongside me on unravelling some of the intricacies of NVIS, for their input and stimulation.

I'd also like to thank Bill Liles, NQ6Z who first asked me about the origins of the name NVIS. Trying to find the answer has been most interesting in itself.

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