WHITE PAPER

Headwinds for DAS deployment

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Headwinds for DAS deployment

As DAS use is expanding, particularly infill DAS applications etc, the main operating environments are moving from the original intended indoor locations to external use.

While office, campus and stadia environments tend to be working close to the DAS equipment specifier's relatively constant 25^{o}C and low Relative Humidity, external installations must withstand many years of widely varying environmental conditions with current European temperatures ranging from -10^{o}C to perhaps +40^{o}C.

Average temperatures in the 21stC are expected to rise ranging from 1.3 °C to 5.1 °C in summer, and 0.6 °C to 3.8 °C in winter[1]. Significant extremes well in excess of these averages are already evident.

For rainfall, the expected *average* changes range from -45% to +5% in summer, and -3% to +39% in winter and future climate change is projected to bring about a change in the seasonality of extremes. UKCP Local (2.2km) projects an extension of the convective season from summer into autumn, with significant increases in heavy hourly rainfall intensity in the autumn.

The strongest ever winds in the UK [2] have been recorded on mountains, and the strongest ever gust was 150.3 knots (173 mph) recorded at Cairngorm Summit on 20 March 1986. However, some very strong gusts have been recorded at low levels too, mostly along exposed coastal areas.

These include:

123.4 knots (142 mph)	13 February 1989 at Fraserburgh in Aberdeenshire
107.8 knots (124 mph)	12 January 1974 at Kilkeel in County Down
102.5 knots (118 mph)	15 December 1979 at Gwennap Head in Cornwall

Clearly, these operating environments are substantially more challenging for externally installed DAS infrastructure compared to benign office and stadia-type environments.

The net result of current and projected worsening ranges of environmental conditions is that the robustness of externally installed systems infrastructure must be substantially improved.

Radio equipment and Antenna notwithstanding, the cable types used in DAS to date are vulnerable to such problems as:

- excessive heat causing dielectric performance issues affecting PIM and impedance
- excessive cold temperatures making external sheaths and dielectrics more brittle and less flexible
- electrical noise and PIM created by vibration which causes abrasion on braided and double-screened cables
- high-level noise sources nearby to DAS antennae (which operate at lower power levels)

Moreover, the large minimum bend radii of larger (higher power) corrugated cables used in wider area networks offer poor flexibility, making installation in the often smaller infill DAS locations very difficult**

Many of these problems are exacerbated by thermal cycling and the extreme variations in the expected worsening of environmental conditions found in outdoor environments.

** Not only more problematical to bend and fit into smaller spaces but bending, particularly overbending changes coaxial conformity, thereby changing the impedance and performance of cable. In addition, overbending in the vicinity of connections increases the stressing of solder joints and connection systems.

Additional issues expected to become more evident are:

- Moisture ingress due to higher and more extreme rainfall and RH
- Shrinkage and expansion of cables through thermal cycling (wider and faster temperature variations)
- Extremes of localised weather patterns requiring installations to be more tailored to remain efficient over time.
- DAS and higher frequencies have smaller ranges so as we move into mmWave, antennae numbers (with 4x these numbers of interconnects) will grow exponentially

DAS is already prone to several sources of noise and PIM due to the distributed nature of the systems, with ca 4 x the number of connections compared to antennae count, including:

- External – impinging electromagnetic noise from peripheral devices
- Internal – from the electronic devices employed on the systems itself– up to 9th order
- Internal – induced PIM from residual higher power level environments
- Internal – cable and connector systems – PIM/harmonics due to cable/connector design/construction and errors in manufacture plus environmental issues like vibration, overheating humidity, or corrosion through water ingress.
- Internal – connector PIM failings due to historic design.

DAS/4G+LTE/5G wavelengths are reducing as more bandwidth is required for the expected exponential growth in data transfer with mmWave well on its way to reality. The higher frequencies naturally bring about more potential harmonics/PIM interference that can lead to frequency blocking of swathes of bandwidth which in turn creates the need to resend corrupted data (error correction) adding to the general noise and dead bandwidth caused by the harmonic interference. The deleterious cycle causes data loss, lower frequency transmission/reduced data speeds and lower system efficiency.

These problems are eminently resolvable, indeed certain products do exist which, though not necessarily mainstream, when deployed correctly can mitigate some of these difficulties. But there is no magic bullet, in passive installation, ‘it’s the details that matter’, and manufacturers, installers and suppliers must come together to increase inter-discipline knowledge to design better products that can put GB incorporated ahead of the international race to full exploitation of mmWave and beyond.

1 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-wind_march21.pdf

2 https://www.metoffice.gov.uk/weather/learn-about/weather/types-of-weather/wind/windiest-place-in-uk