Cambium Networks 60 GHz Deployment Guide and LATPC User Guide

Cambium Networks™

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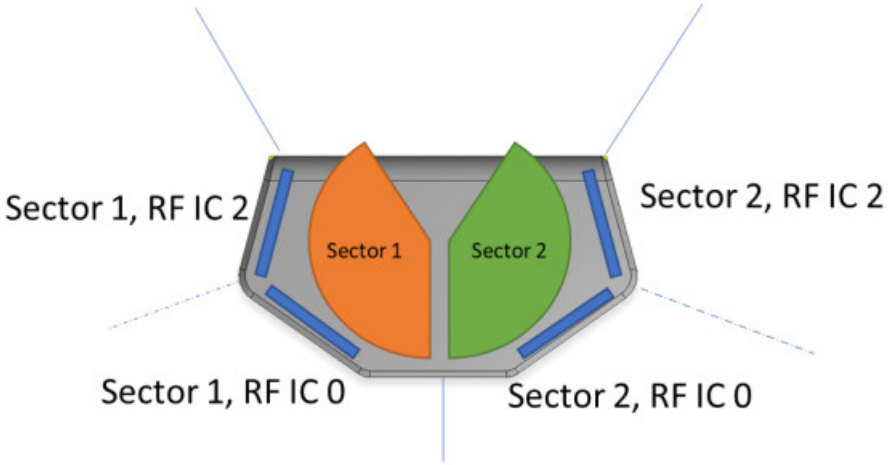
V5000 Sector And Antenna Guide

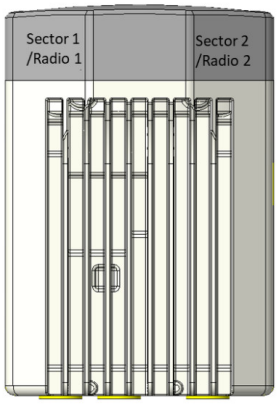
Contents

60 GHz Deployment Guide and LATPC

Each Sector is an independent Radio/Baseband unit.
Each Sector has 2 RF tiles connected to provide an extended azimuth scan range.



Please Avoid sticking any metallic labels on the radome
- The 60GHz antenna Tiles are located on the 4 marked faces.
- The GPS Antenna is located at the middle of the top face of the radome pointed to the sky.



Key Deployment Guidelines

- Mounting accuracy

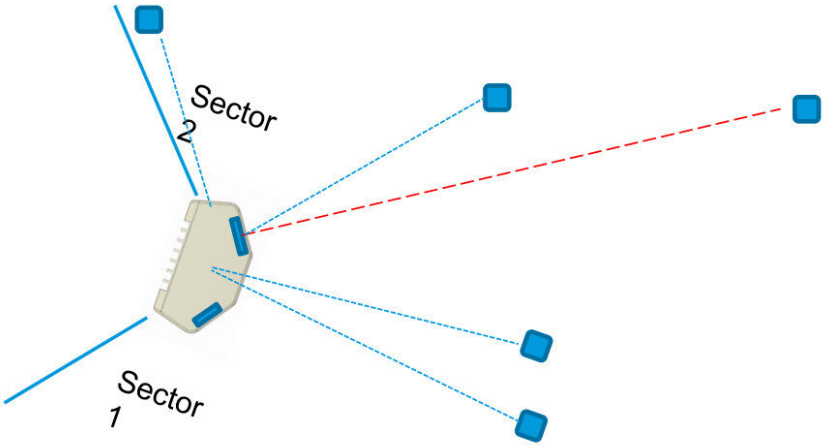
  – Cambium has 3 different SKUs, and these 3 have different requirements in terms of alignment coverage.

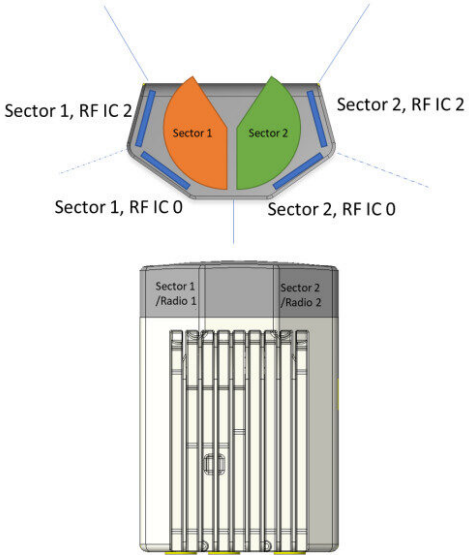
	Azimuth (deg)	Elevation (deg)
V5000	+/-70 per Sector	+/-20
V1000	+/-40	+/-20
V3000	+/-2	+/-1

- Typical minimum deployment distance based on maximum receive signal strength of -40dBm
  • 25 meters for V1000 and V5000
  • 150 meters for V3000
  • For deployments where the range will be less than this, a short-range/long-range check box is provided in the GUI to allow this.
- Deployment Frequency Range
  • Cambium CnWave 60GHz supports the use of CH1 to CH4.
  • Deployment in these channels depends on the allowed channels in that region.
  • Each channel is 2.16GHz wide and the raster frequencies are as below.
  • 58.32, 60.48, 62.64, 64.8 GHz

Alignment of V5K

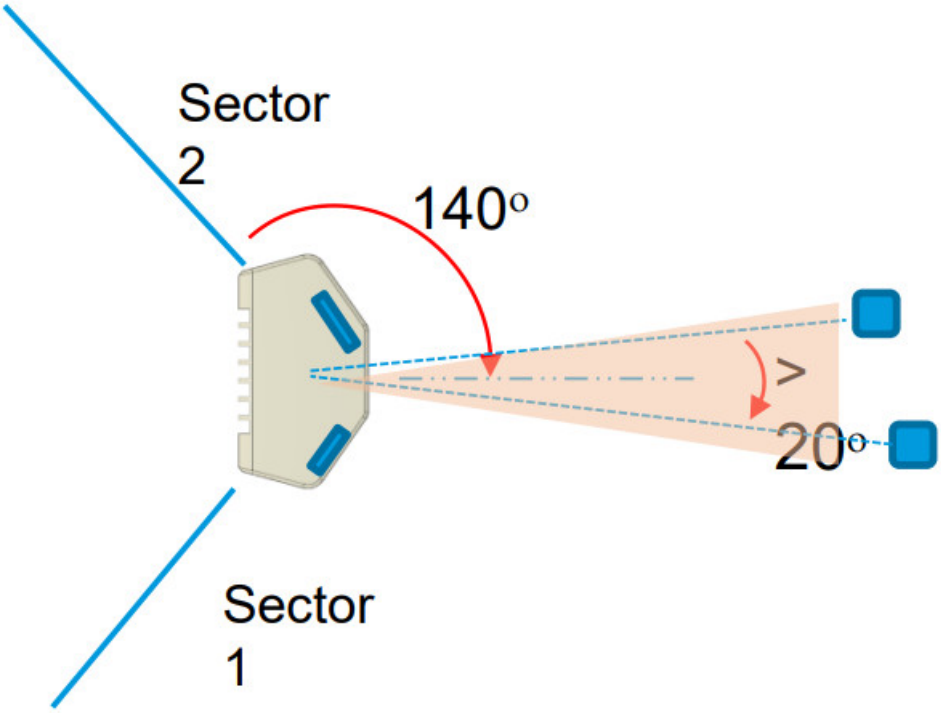
- Maximize pole/box height:
  – Reason: Minimizes ground bounce and avoids channel fluctuations, especially for links with long distances
  – Suggested height: >5m
- Orientation of a DN node in P2MP:
  – Orient the V5K to the boresight of the RF Tile to the longest link where possible
  – The optimal beam angle to achieve the maximum antenna gain is at the boresight of the active tile face (Red dotted line)





Minimum CN spacing at sector intersection

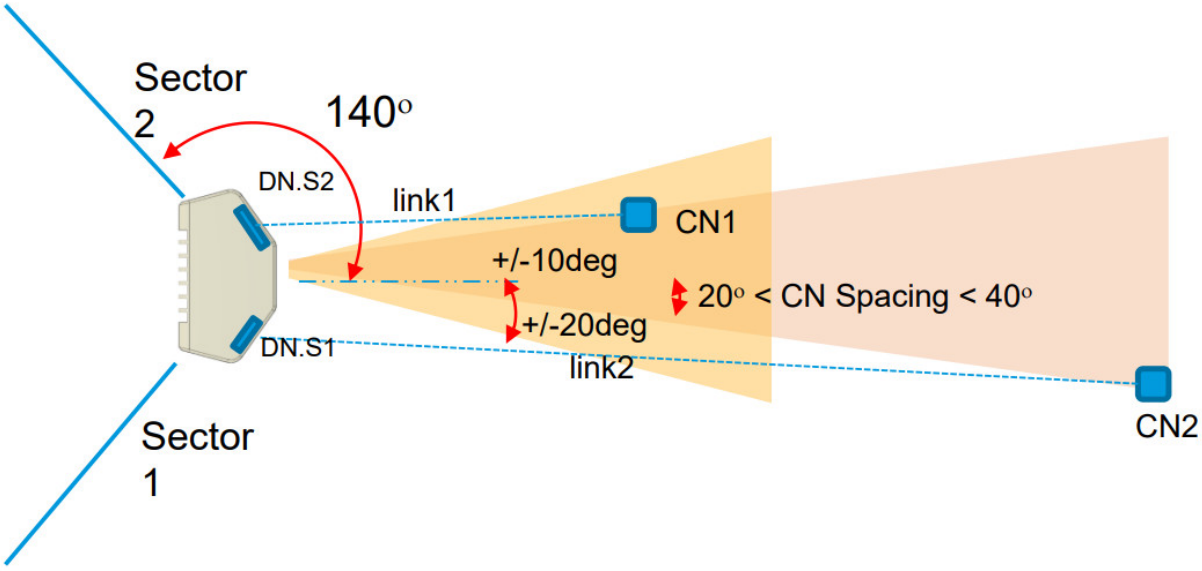
- Up to 15 CNs can be installed on a single sector. Due to TDMA, only one CN can talk at a given time.
- When CNs are installed on multiple sectors, more than one CN can be talking at a given time as the sectors have independent schedulers.
- Therefore, if CNs installed on different sectors are both located within the highlighted, 20degree range, configure the 2 sectors to be on different channels to avoid interference.



Near-Far Ratio

The near-far ratio for links from different sectors on the same pole

- Scenario:
  – One wireless link on DN sector 1 at long range, link2
  – One wireless link on DN sector 2 at short range, link1
  – Narrow angular separation between link1 and link2 (less than 20deg)
  – Configured for the same channel
- Problem
  – The TG system utilizes active Transmit Power control
  – The transmit powers for link1 would be automatically set to a low level.
  – The transmit powers for link2 would be automatically set to a high level.
  – Due to narrow angular separation, the sidelobes of link2 would interfere with link1.
  – As a result, the SNR of link1 could degrade and this itself causes the transmit power of link1 to be boosted to a much higher level.
  – This ends up in a cycle resulting in both links eventually transmitting at full power and hence causing network interference.
- Solution
  – Perform traffic test on one link at a time and then simultaneously
  – If the simultaneous traffic results show degradation along with transmitting power railed high to maximum, consider setting the 2 sectors on different channels or capping the maximum power of the short-range link.

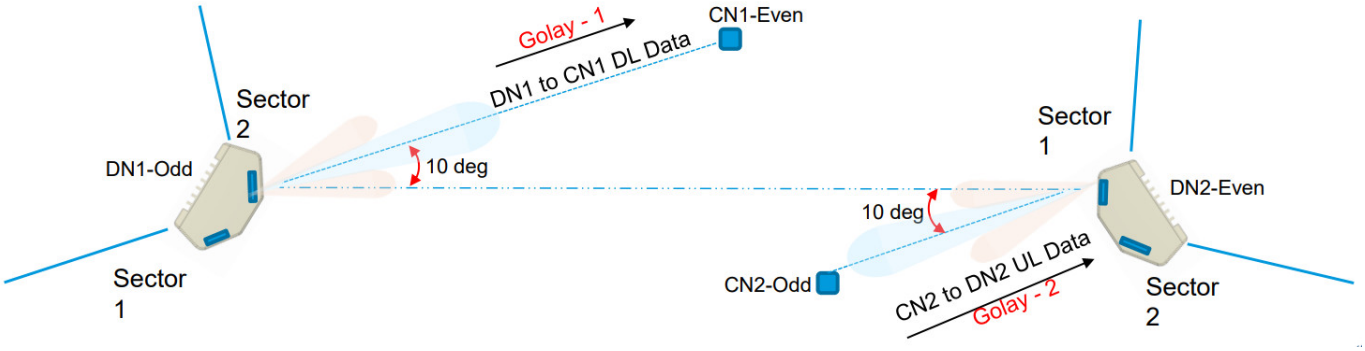


Early-Weak Interference

- Golay Codes in 802.11ad/ay
  – The 802.11ad/ay frame consists of a PHY preamble which consists of a short training frame (STF) and Channel Estimation Symbol (CES).
  – These STF and CES are made up of complementary Golay codes. Due to the repetition of the Golay codes, the signal can be correlated even with very low SNRs.
  – This preamble is used for frequency synchronization, timing synchronization, and Channel estimation.
- What is Early-Weak Interference?
  – Early-weak interference occurs when the receiver correlates to a preamble from an unwanted node, with the same Golay code as they wanted.
  – If the receiver starts decoding the preamble from the wrong node, it may be too late to recover the preamble from the correct node for that cycle.
  – Terragraph has 4 Golay codes to mitigate this.
  – The user can select Golay codes {1,2,3}.
  – Golay 0 is used for another purpose, hence avoid selecting this. (The use of Golay 0 has been deprecated in release 1.2)

Tight Angle deployment

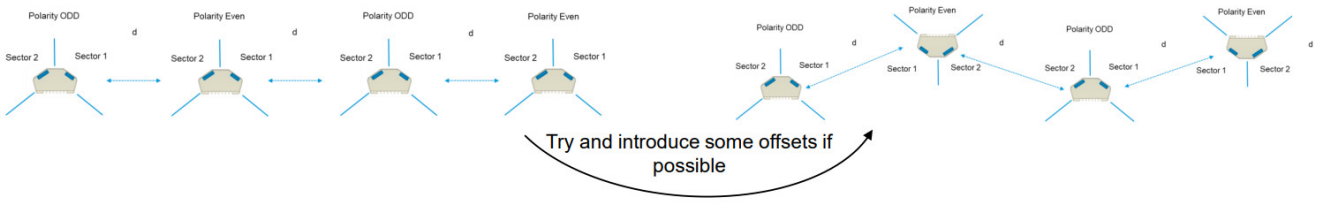
- Avoid tight P2MP angles
  – As an example, a Downlink data transmission from the DN1 to CN1 could interfere with the Uplink data reception at CN2 to DN2. This interference could be both down to the main lobe in very tight angles or sidelobes in up to 20 deg delta between 2 CNs.
  – The level of interference depends on the link distances between DN1 → CN1 vs DN1→ DN2 vs CN2 → DN2
  – In most cases, the main interference is due to early-weak interference.
- In order to mitigate this early weak interference, different Golay code assignments could be used.
  – This issue only relates to the 2 links transmitting at the same time in the same physical direction.



Straight line Interference

- Recommended: avoid straight-line interference

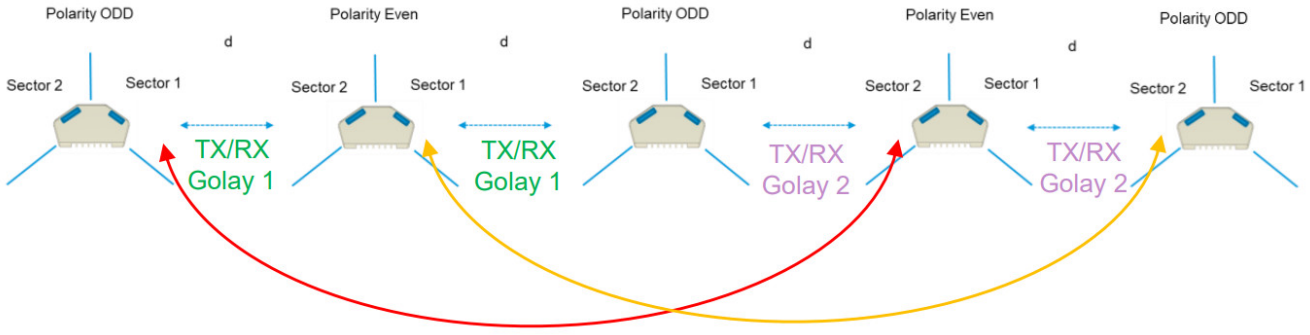
  – Reason: desired link and interference link angles are the same – no assistance from beamforming interference suppression.



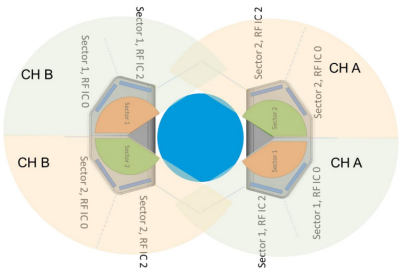
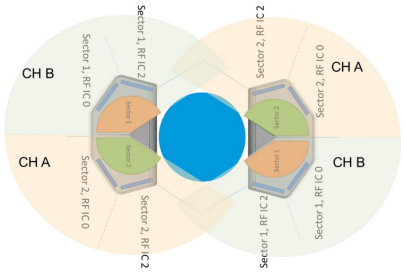
- Recommended: Assign Appropriate Golay Codes to mitigate early weak interference

  – The Red and Orange arrows show the possible weak interference.

  – Assignment should be in the form of 2-2-1-1 or 1-1-2-2, NOT 1-2-1-2

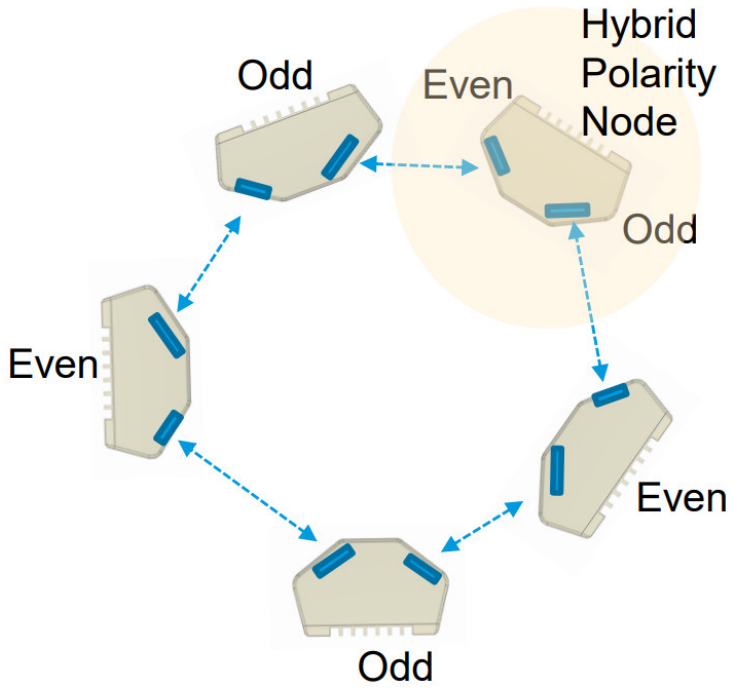


Co-located V5Ks on a Site

Option 1 	When Co-locating 2 V5Ks on the same site, it's recommended that one use s different channels on the 2 V5Ks to start with. Secondly, evaluate the issues raised earlier, with regard to near far, and tig ht angles. Following this consideration, one might have to configure 2 differ ent channels for the 2 sectors or consider option 2.
Option 2 	Where local regulations allow 4 channels of usage, it may be advisable to c hoose CHA and CHB such that they are 2 channels apart. Say CHA = 1 or 2 CHB = 3 or 4. The reason is, it may be easier to upgrade to Channel bond ing (CB2) in the future and still enjoy channel isolation.

Polarity

- CnWave uses Time-Division-Duplexing (TDD), which is synchronized across the network
- As one sector is in the transmit phase the neighbor is in receive phase.
- The transmit and receive phases of the sectors are defined by the 'EVEN' or 'ODD' polarity.
- In summary, all sectors with a common polarity in a network could be transmitting or receiving at the same time.
- Hybrid Polarity is when a node uses an 'EVEN' polarity on one sector and an 'ODD' on another sector.
  – Although this is possible through configuration. One should avoid this unless the installer is sure that the 2 links on the sectors will be orthogonal.



Link Adaptation and Transmit Power Control (LATPC) – 1

- The modulation and code rate (MCS) and transmit power are both adaptive values, and are set at the transmitter independently for every link and for both directions. The adaptive MCS selection procedure is referred to as link adaptation (LA), and the transmit power procedure as transmit power control (TPC). There are 2 versions of this adaptation, data traffic, and standby.
- When there is data traffic, adaptation is driven by the block error rate (BLER) reported every SF (1.6ms). A lower BLER causes the algorithm to adapt the transmit power / MCS.
- When there is no data traffic, the algorithm is driven by the STF(short training frame) SNR as reported by each mgmt packet. The SNR is compared to an MCS table and if the SNR > (<) table value, the transmit power / MCS will adapt accordingly.

Link Adaptation and Transmit Power Control (LATPC) – 2

- There is a max TX power per MCS mode. This is defined in the configuration.
- During the adaptation process, the transmit power is either increased or decreased first to either increase the power till the max per MCS power is reached or to reduce the power if there is enough headroom.
- If the maximum power for the MCS mode has been reached, the MCS mode is reduced.

Documents / Resources

	**Cambium Networks 60 GHz Deployment Guide and LATPC** [pdf] User Guide 60 GHz Deployment Guide and LATPC, 60 GHz LATPC, Deployment Guide and LATPC, Deployment Guide, LATPC