

Acrobat

Installation and planning Guide for Antennas



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1 Introduction

This Installation guide describes the proper planning and mounting of Acrobat antennas. The position is crucial for the performance of the system.

2 Ethernet Cabling

2.1 Cables and cable standards

In general CAT5e FTP cables are recommended for all CA-6 antennas. Wherever industrial manufactured cables can be used, they should be used. Handmade RJ45 connectors often do not achieve the same quality. The CAT cables should not be installed in parallel with power cables or other cables carrying a high amount of current. The EM field of the other cable might increase the bit error rate in the "ACROBAT" cable and causes malfunction.

All recommendations for Ethernet cabling are applicable for ACROBAT-Ethernet. Therefore the maximum length is limited to approx. 100mk (330ft) as well.

2.2 Synchronization

The ACROBAT system is internally synchronized via the Ethernet cable. This allows hand over between to cells and ensures that the cell controller gets data from the antennas in a timely structured way.

Therefore, one antenna is the Master antenna. The Master antenna can be assigned to any antenna in the system; it is not a special hardware. The number of calls should be reduced from 12 to 4 for the Master antenna.

The Master antenna sends a synchronization broadcast signal to all the other devices in the ACROBAT network via the network cable. Therefore a physically separated network or at least a separated VLAN should be set up.

All other ACROBAT devices (Slave antennas and the cell controller) sync to this signal. All network devices like switches, media converters shall fulfil the IEE1588 requirements.

2.3 Switches and hops

The number of switches (=hops) between the antennas and as well between the antennas and the cell controller is limited. This is due to the fact that every Ethernet device adds jitter and delay to the connection.

The maximum number between the Master antenna and the last Slave antenna must not exceed 3 hops.

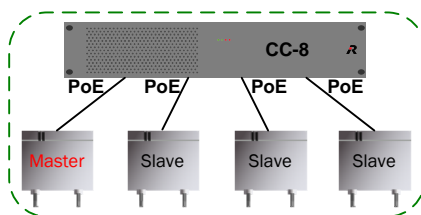
The number of hops between the master antenna and the cell controller must not exceed 3 hops as well.

There is a difference between an ACROBAT system with CC-8 and an ACROBAT system with CC-60 / 120 cell controllers. The CC-8 already contains an Ethernet switch that counts as a hop too. The internal switch in the CC-8 is designed to provide four PoE (Power over Ethernet) ports on the CC-8 for small and quick installations.

If more antennas are added to the system, the internal switch in the CC-8 should not be used but external switches with PoE.

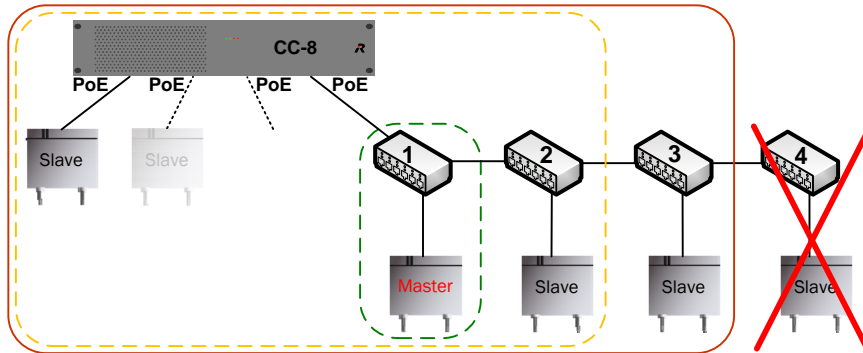
2.3.1 CC-8 Examples

- 1) Using a CC-8 with up to 4 antennas directly connected to the provided PoE ports of the CC-8:

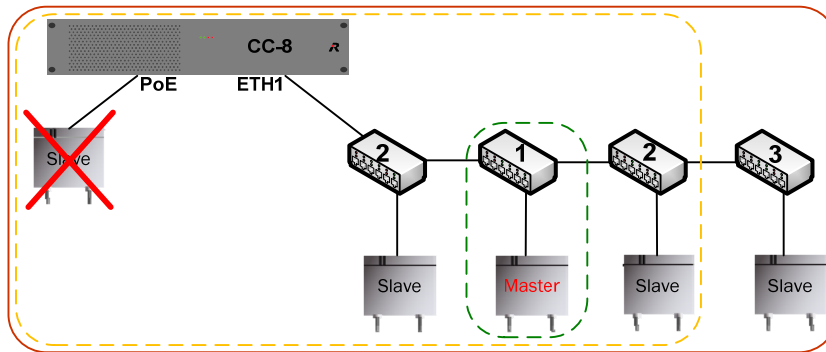


2) For more antennas, external switches will be used. There is a limitation of 3 hops (switches) between the Master antenna and the Slave antenna(s). The Master antenna should be connected to the external (manageable) switches.

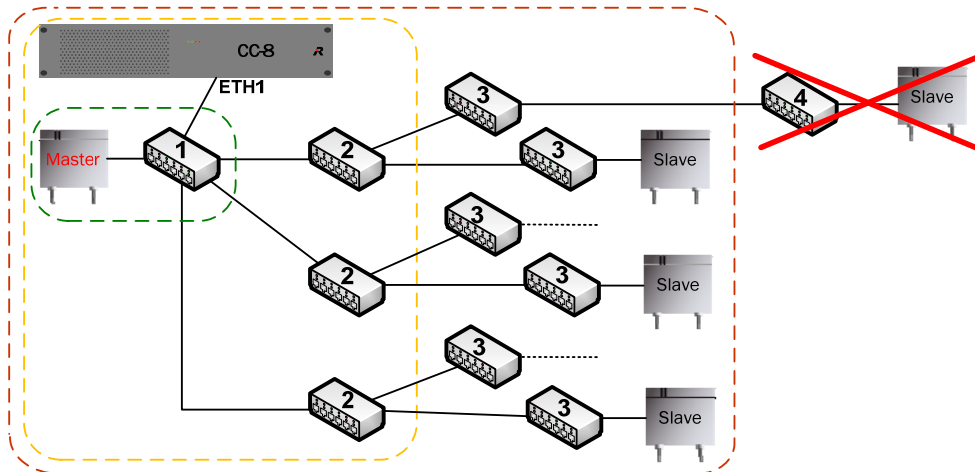
(1st Hop) (2nd Hop) (3rd Hop)



3) Ideally, the PoE ports of the CC-8 are not used in larger installations and the Master antenna is in the middle of the Ethernet structure.



4) Also tree structures are possible, the limit of max. three hops is still valid:

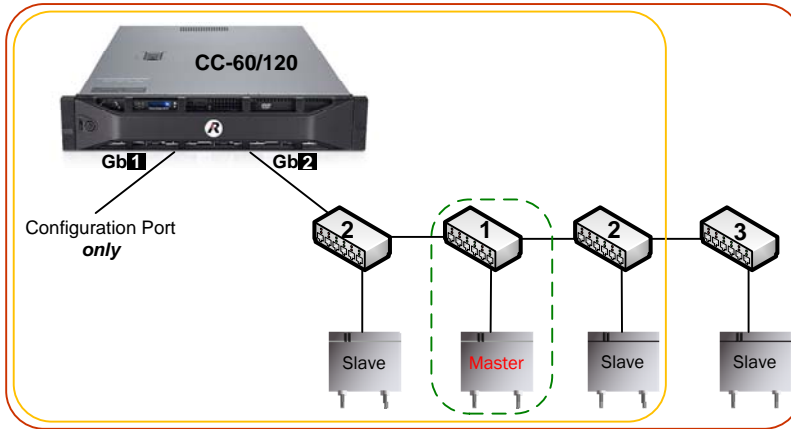


2.3.2 CC-60/120 Examples

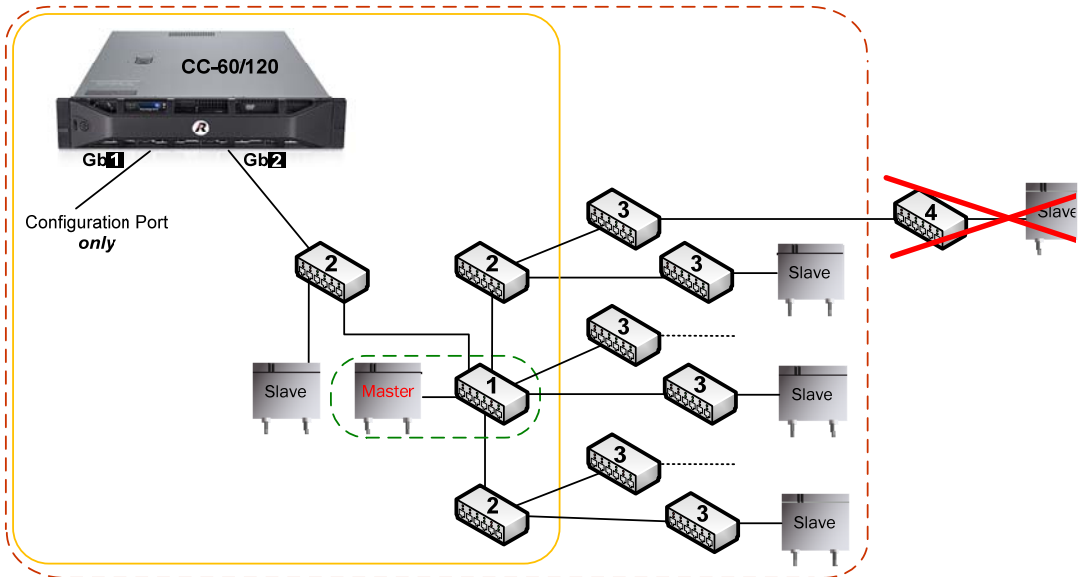
The 3-hop limit is also true for the CC-60 / CC-120.

As the CC-60 / CC-120 do not have an internal switch, there are *only* external switches. The DECT Ethernet network needs to be connected to Gb2 while the management LAN (Computer) should be connected to GB1 of the Cell Controller.

1) "simple" external structure



2) more complex setups are possible



In general, manageable switches are recommended. The switches must be set to simple Layer 2 mode. Any kind of filtering, firewall function or Layer 3 functionality is not supported and will cause delay, jitter and in the end malfunction of the system.

Also Layer 3 functionality will block the Sync signal as the sync signal is a broadcast.

All ports used by ACROBAT need to be set to 100Mbit/s full duplex.

2.4 List of tested switches:

- HP ProCurve 2626-PWR (J8164A)
- HP ProCurve 2650-PWR (J8165A)
- D-link DE-1228P
- D-link DES-3028
- D-link-DGS-1224TP
- Cisco SG300 28P
- Cisco SG500 28P
- Cisco Catalyst 3560
- Cisco Catalyst 2960-48PST-L (48 PoE ports)
- Cisco Small Business Pro ESW 500 (remark; all switch ports used for BSIPs were configured as "others")
- Enterasys Switch B3G124 (1Gbit)
- Enterasys Switch B5G124

Switches that are NOT recommended:

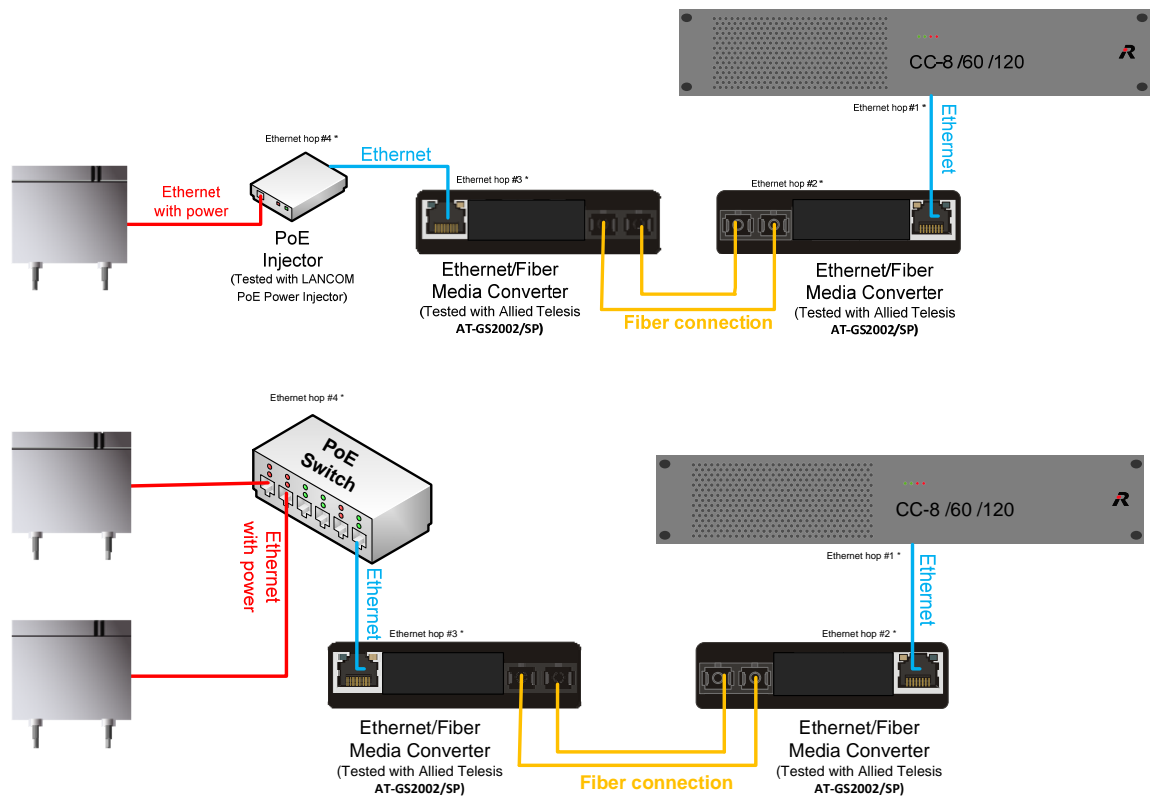
- Netgear FS1008
- Allnet

2.5 PoE

There are different PoE Standards available. ACROBATs' CA-6 antennas need PoE Class2, IEE802.3af (7W). Every CA-6 antenna needs an individual PoE port.

2.6 Extra long distances

In case the 100m (330ft) of copper connection between two switches or from one switch to an antenna does not reach out, media converters can be used.



In case the switch has fiber ports, those can be used as well.

3 Antenna Placement

There are some general rules for all antenna placements. In all cases, the antenna shall be installed with the two little antennas downwards, so that you can read the Riedel sticker.

3.1 Where antennas should be installed

- Free accessible for maintenance
- Near to the ceiling but with approx. 0,5m (2ft) distance
- Generally in the centre of the cell / area that shall be covered. In some practical situation this might not be possible.

3.2 Where antennas SHOULD NOT be installed

- On steel
- On concrete pylons, if coverage behind that construction element is desired
- In wall recesses, if coverage beside the recess is desired.

3.3 Where antennas MUST NOT be installed

- In special areas like intensive care stations in hospitals, areas behind fire blocking doors...
- On metal walls (keep minimum distance of 10cm (= 4inch))
- On high metal shelves (min. distance more than 3m (=10ft))
- In inserted ceilings, if the inserted ceiling is made with steel elements or conducting elements like carbon fibre
- In direct sunlight without the outdoor mounting kit
- In humid environments like washhouses
- Next to other RF equipment / antennas (minimum distance 3m (=10ft))
- Next to other electronically devices like microwaves, wired telephones, HiFi or other Audio equipment, Light control devices, fire detecting devices, Neon tubes, circuit boards, transformers.

4 Antenna Planning

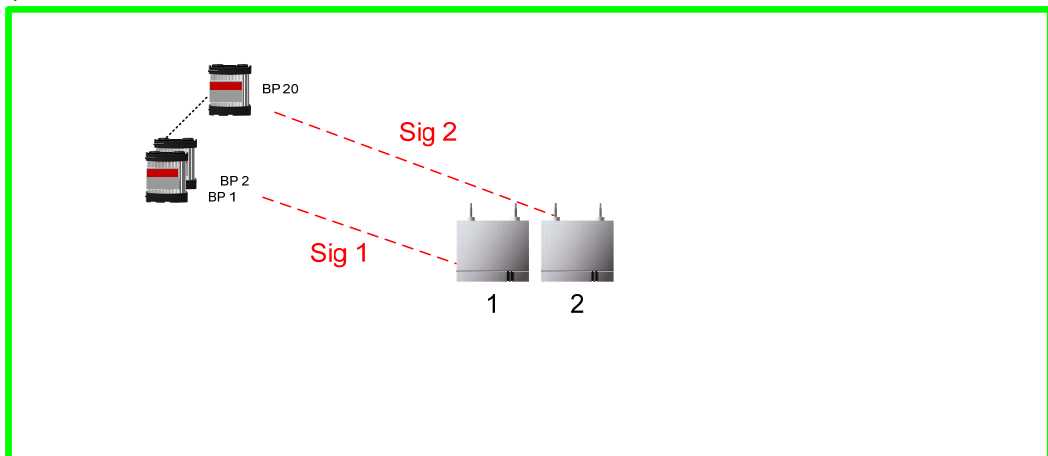
There are several environmental factors that determine the final positions of antennas.

4.1 Number of belt packs to serve

As one antenna can handle up to 12 belt packs, planning should be done with 10 belt packs per antenna. This allows the automatic intracell handover (change of frequency & timeslot) in case of RF distortion.

If the number of belt packs is higher than 10, a second antenna must be added. It is recommended that this second antenna is close to the first one to build up an antenna cluster.

Example: One room / Studio / office...



If the second antenna is far away from the first, all belt packs will try to log into the closer antenna while the BP 13 – 20 will receive a low signal from antenna 2.



4.2 RF radiation and attenuation

RF radiation works similar to light. Walls and other structures may absorb or reflect RF waves. The grade of reflexion and absorption depends on the individual material.

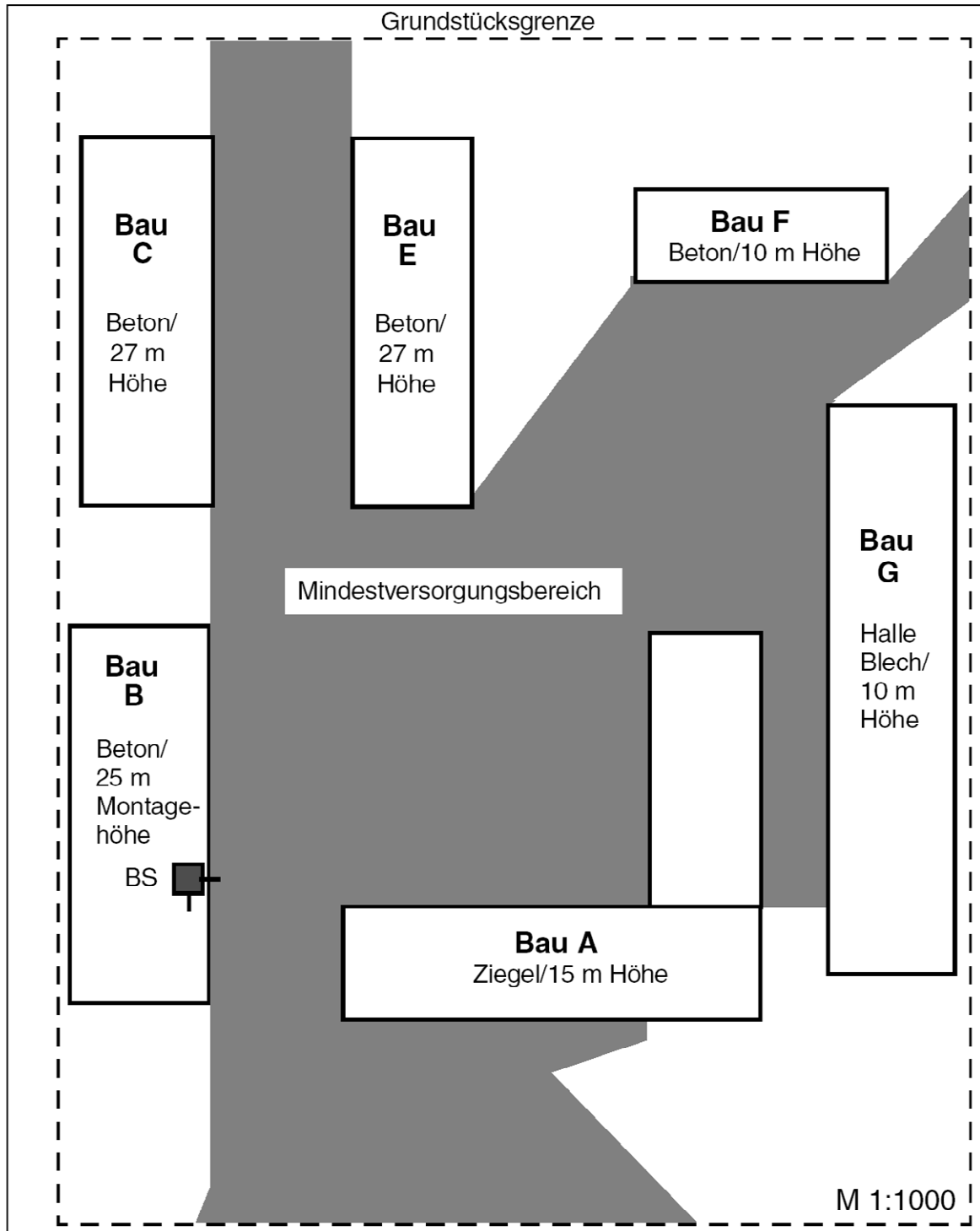
In general, metal like steel or copper reflects the RF radiation nearly completely while today's used lightweight materials like dry wood, hard plaster or plastics have only a low attenuation. Wet wood, particle boards or brick walls have an average attenuation. Security glass with wire inside, metal steamed glass or window sheds attenuate as well.

Material	a (dB)	Distance reduction in ~ %
Brick wall, 10-12 cm	2,5	43,5
Brick wall, 24 cm, small windows	4	~60
Hard plaster wall	4 – 4,5	26,5 - 41
Areated concrete	1,3 – 2,3	78
Glas wall	2	37
Concrete wall 10cm	6	75
Concrete wall, double 2x 20cm	17	97,5
Concrete wall 25-30cm	9,4 - 16	88-97,5
Security glass with wires	8	84
Concrete ceiling (apartment building)	6-9	75 - 87
Concrete ceiling (industrial building)	12-14	91 - 96
2 concrete ceilings (apartment building)	26	99,5
2 concrete ceilings (industrial building)	35 - 47	100
3 concrete buildings	46	100
concrete ceilings (industrial building)	42 - 53	100
Steel wall with security glass	6,5 - 10	75,5 - 100
Steel walls	31 - 41	100

In industrial buildings, the attenuation in the horizontal direction is similar to the one in vertical direction. The RF radiation is “tunnelled” by corridors and gets by reflexions into the separate offices. Normally, stairways and areas behind fire protection walls need extra antennas.

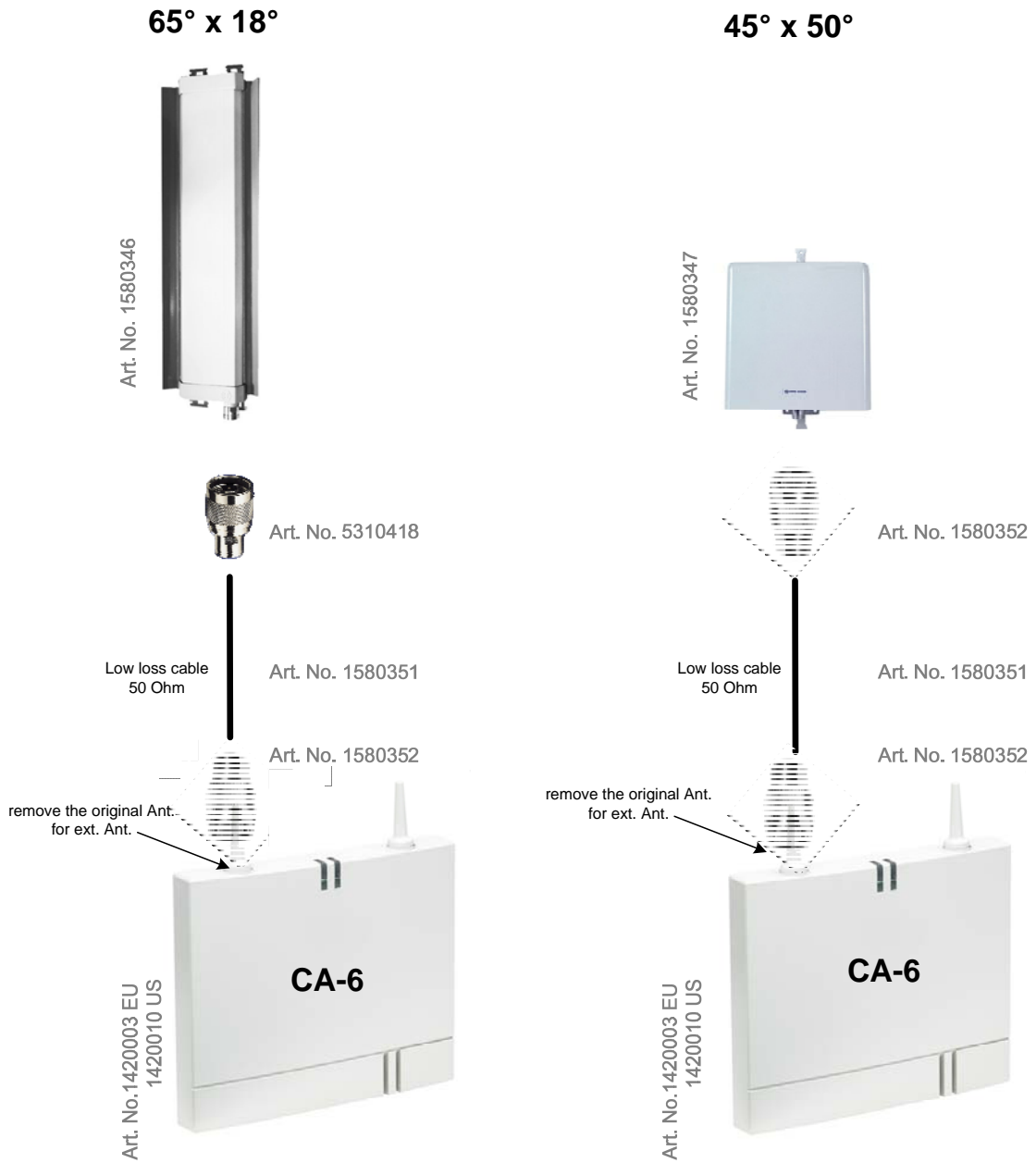
Big offices and studios or theatre halls need multiple antennas because of the number of belt packs and the area to be covered.

ACROBAT Antennas can be used outdoors with the ACROBAT Outdoor mounting kit. Keep in mind that overvoltage protection and lightning arrester is recommended.
 The line of sight can be up to 100m between antennas a belt pack. But in free field areas, the reflection from structures like walls etc. are missing. Therefore it makes a difference when the belt pack is at the users' belt and orientated to the antenna and an orientation to the opposite side. In the second case, the users' body will attenuate the RF signal and as the belt pack does not receive a reflected signal, it might loses connection.
 For free field conditions without reflections (soccer field, open air venue), antennas at the outer edges of the area to be covered are recommended.



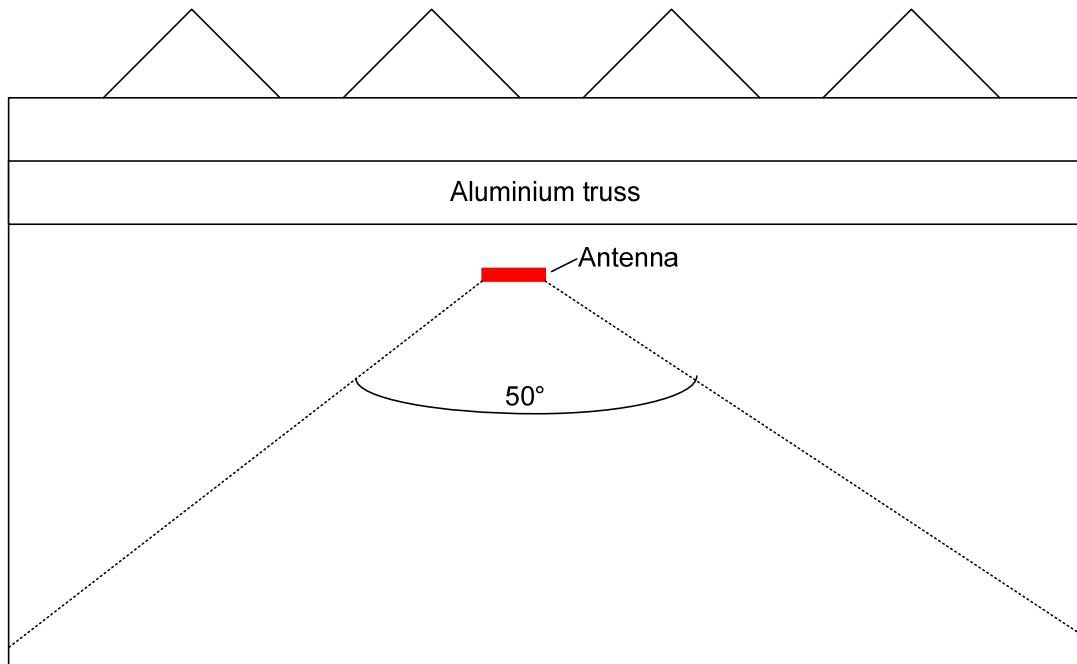
4.3 Reflections

In environments with a lot of steel, reflections are very common. To avoid those, the position of the antennas is once more crucial. In some cases orientated antennas might improve the situation. For those, the following parts are needed:

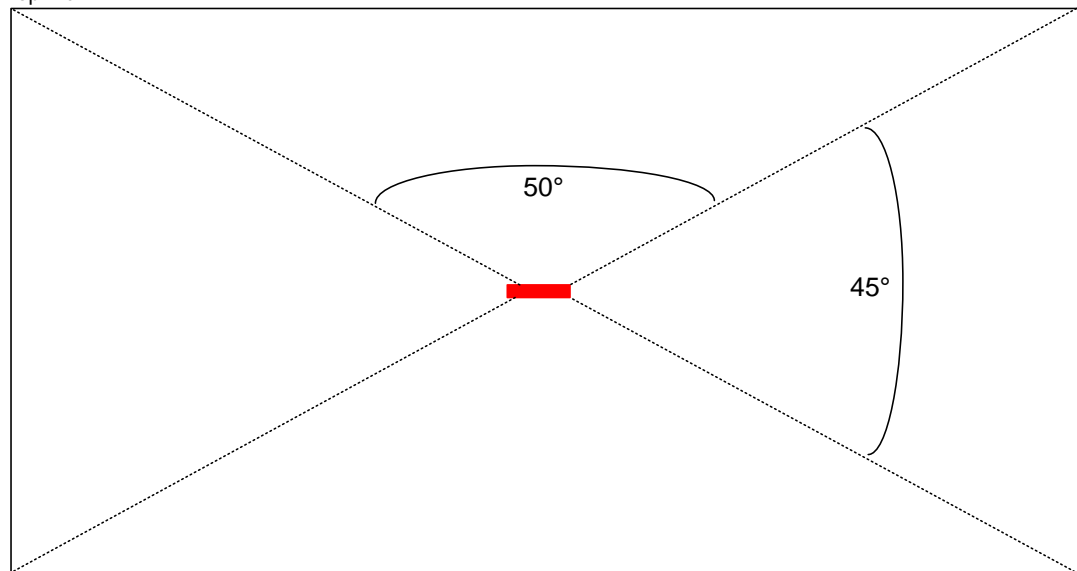


Mounting examples for orientated antennas:

Side view



Top View



5 Checklist

- Get floor plans from the area that shall be served by an ACROBAT system
- Mark the areas with 100% coverage request, 50% coverage request and 0% coverage request
- Determine the number of belt packs per area. Keep in mind that people change their location.
- Locate the antennas in the middle of the cell where you want to use it.
- Calculate with 1 antenna per 10 belt packs per cell. Add further antennas for more belt packs.
- Cells can become bigger (free field condition) or smaller (in house) depending on the attenuation.
- In case you are unsure, test the area with a real ACROBAT system (one or two antennas, one or two belt packs)
- Make the Ethernet planning (number and position of switches, cell controller) and keep in mind that a CAT5 cable must not exceed 100m (330ft) and reserve some spare cable at the end to change the final antenna position slightly.
- Install the System and feed an audio stream into the cell controller. Proof the functionality, coverage and seamless hand over by listening to the audio on the belt pack.
- Perform the same test with talking into the belt pack and listening at the controller side.
- Test communication between two belt packs.

6 Service

If you have any further questions, we offer comprehensive customer service options for this product including:

- Telephone service
- E-mail service
- Skype Service
- Fax service
- Configuration support
- Trainings
- Repairs

Your primary point of contact for any service issues is your local dealer.

In addition, Riedel Customer Service in Wuppertal, Germany is also available to assist you.

Telephone: +49 (0) 202 292 9400
(Monday - Friday, 8am – 5pm, Central European Time)

Fax: +49 (0) 202 292 9419

Skype: riedel.communications.service

Or use the contact form on our webpage: www.riedel.net

For repairs, please contact your local dealer. Your dealer will be able to help process your repair as fast as possible and/or arrange for the delivery of spare parts.

The address for repairs sent directly to Riedel Communications GmbH is:

Riedel Communications GmbH & Co KG
- Repairs -
Uellendahler Str. 353
D-42109 Wuppertal
Germany

Please add a completed repair form to all your repairs.
The form can be found at the Riedel website → download → forms

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