Application

of

DECT GAP Repeaters

in

a multi cell

Business Environment

ED.CHNO.:

EDITION: 1
SHEETS: 1

Contains

1. Introduction

A DECT-Repeater is a new building block, to be used in DECT-installations to extend the coverage. A DECT-Repeater is not a real base station, as a Repeater does not increase the number of DECT traffic channels, but can give a larger physical spreading of the traffic channels and hereby expand the radio service of the traffic channels, established with the real DECT-base stations.

The normal method of establishing DECT-multi-cell installations is to make pre-installation coverage tests to map out the coverage and hereby determine the necessary number of DECT-base stations. When the system is installed and tested, holes in the coverage may be found, or the customers may have new wishes as to the coverage, often in areas with a limited traffic, as e.g. basements, lofts or outdoor areas. To establish coverage the number of DECT-base stations must be increased demanding further installation. In such cases the DECT-Repeater is the ideal building element, as the installation and displacement of the DECT-Repeater is more simple than that of the real DECT-base stations.

The DECT-Repeater is not to be physically connected to the DECT-installation, and the DECT-Repeater can be programmed in a service workshop (however, this must know about the DECT-installation, where the DECT-Repeater is to be used). In principle the installation of the Repeater could be made by the customer, as the DECT-Repeater hereafter only must be mounted in the place wanted and be fitted with 220 V AC-net to function as a part of the DECT-installation, and no changes have to be made in the setting up of the DECT-system. In fact it is easier to install a Repeater in a system than to register a new DECT-handset.

Therefore the DECT-Repeater is a fine and easy tool to work with, when changes have to be made regarding coverage and traffic capacity in an installed multi-cell system.

2. Function of the DECT-Repeater

A DECT-Repeater can be considered as a DECT-unit, consisting of a DECT-handset and a DECT-base station, built together in one unit with the special construction that the Repeater (the hand set part of the Repeater) can handle more traffic channels (in principle 3 simul- taneously - in practice only two). The Repeater (the base station part) has the same coverage as a DECT-base station, however only with two active traffic channels (in special applications this can be increased to three).

A DECT-Repeater (the hand set part) must be placed within the coverage of the original DECT-installation, and therefore the DECT-Repeater (the base part) expands the coverage of the original base station by 50% (see fig. 1).

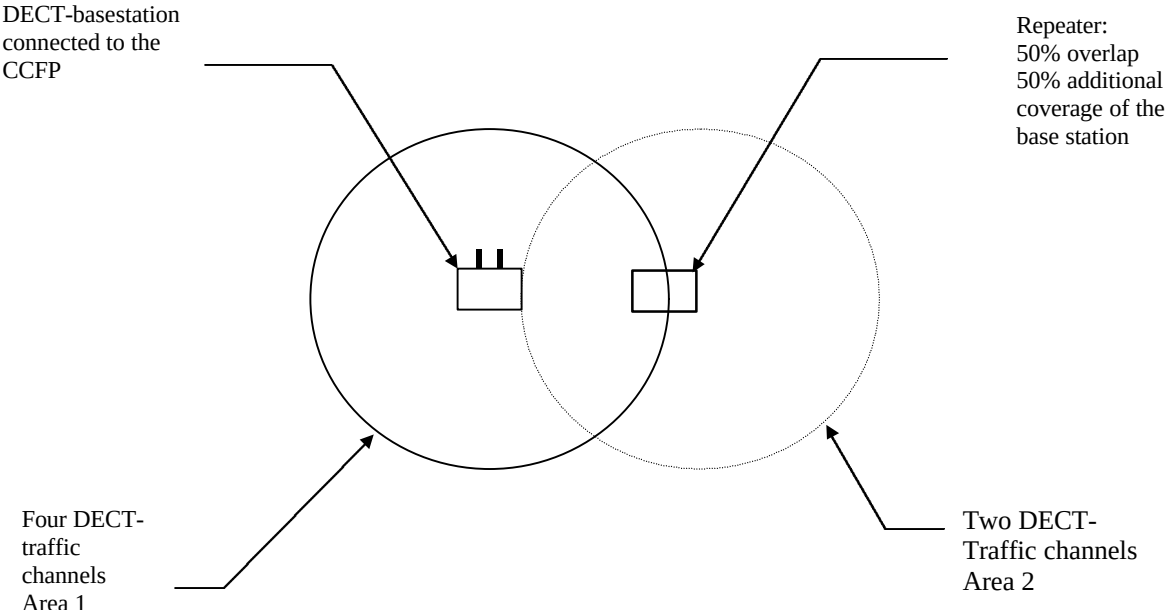


Fig. 1

The Repeater only takes traffic channels from the DECT-base, when there is active traffic on the DECT-Repeater. Thus the total number of traffic channels is neither increased nor reduced with the DECT-Repeater.

What happens physically, when an active DECT-hand set moves from area 1 to area 2 (see fig. 2) is, that the Repeater at handover takes over the active traffic channel, and therefore the hand set can be moved around in area 2 (the coverage of the Repeater), but seen from the DECT-base station the Repeater is now the active hand set fixed according to the DECT-base stations. When the active DECT-hand set is moved back to area 1 and outside the coverage of the Repeater, the Repeater lets go of the active traffic channel, gives this back to the DECT-base station, and thus there is full handover between the Repeater and the DECT-base station.

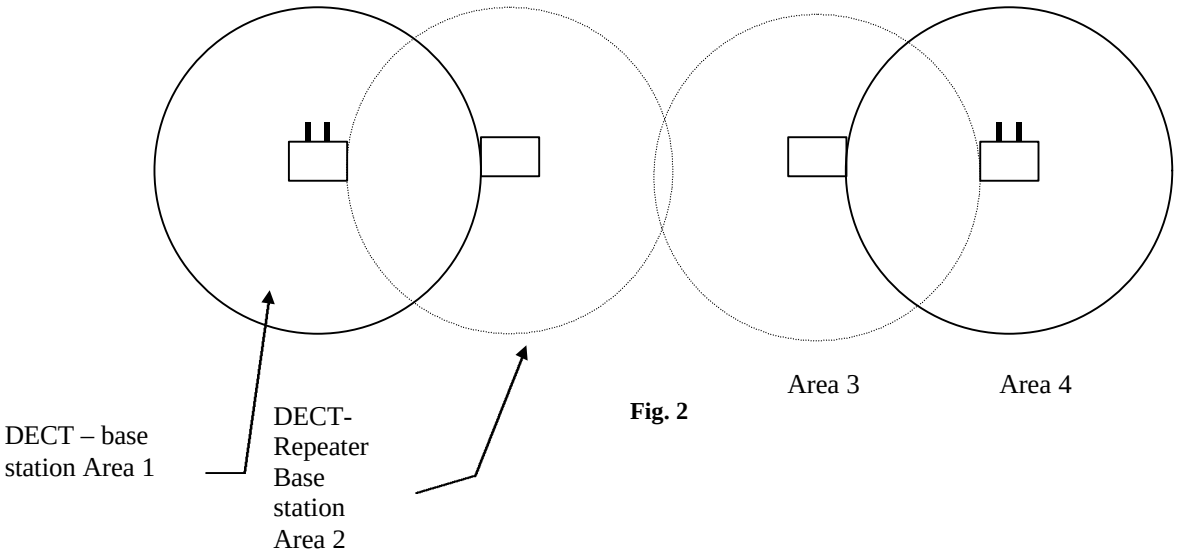


Fig. 2

In Figure 2 an installation with two Repeaters and two DECT-base stations is shown. An active DECT-hand set can be moved from area 1 to area 4 without losing the call, as handover is made from the DECT-base station in area 1 to the Repeater in area 2, handover from the Repeater in area 2 to the Repeater in area 3, and from the Repeater in area 3 to the DECT-base station in area 4.

This means that the installation gives a wider spread of the area of the traffic channels, and in this example a new possibility of connecting areas with radio coverage.

3. Repeater in multi-cell systems.

When installation of multi-cell DECT-systems is made two considerations determine the number of DECT-base systems.

1. Establishment of the necessary DECT-radio coverage.
2. The necessary number of DECT-traffic channels must be present to secure a good performance of the DECT-telephone traffic.

To fulfil point 2 the following hand rule has been laid down for KIRK Dect-z System 1500:
Under normal circumstances 1 base station should be installed per 10 DECT-hand sets.

This hand rule has been laid down for the following criterions:

In a busy hour the system shall be able to handle a traffic of 0.15E per DECT-subscription, or corresponding to the fact that the DECT-subscriber occupies the system for an average of 9 min./hour (approx. 5 calls per hour).

A fine quality of the call is determined by the probability that the system is occupied, and can thus perform no further traffic. This probability must be no more than 1% of the time.

In a normal office building this will be no problem, as the coverage area of a base station and the number of square metres per employee normally secure the necessary overlap, when rule 2 is observed.

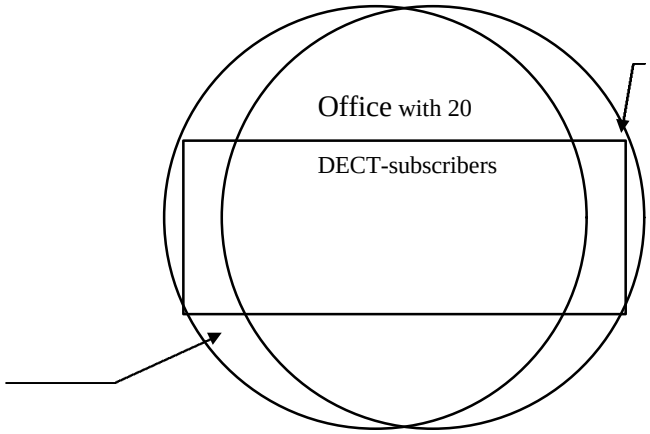


Fig. 4

If the building is a multi-storey building with an even distribution of employees the hand rule is sufficiant, as the physical coverage of the base stations secures the necessary DECT-overlap.

If the building is a factory building with a big physical spreading of the employees the Repeater can be used to establish the necessary radio coverage, but problems with the traffic capacity may arise.

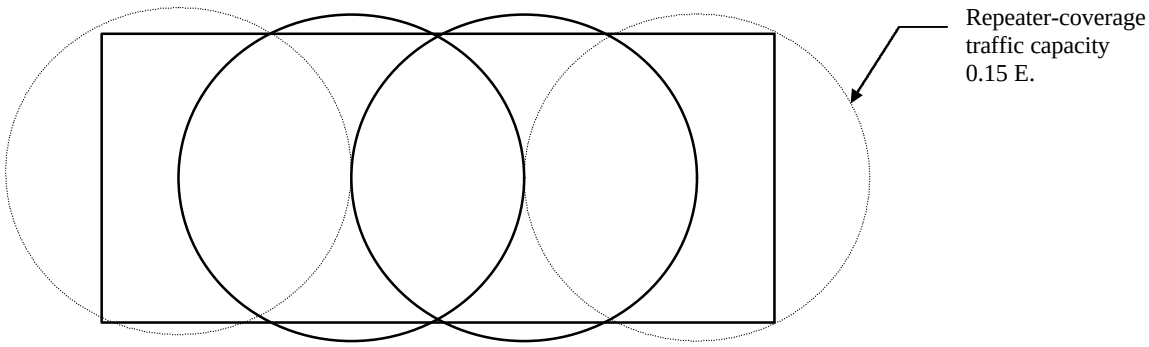


Fig 5

That the traffic capacity in the Repeater area is only 0.15E does not mean that there can be only one DECT-subscriber in the area. The Repeater can perform two traffic channels and hereby two calls simultaneously and the probability that the Repeater is engaged with traffic from two DECT-hand sets (0.15 + 0.15 = .30 E) is more than 1% (actually 3%), and therefore there will be no even distribution of the traffic capacity (see fig. 5).

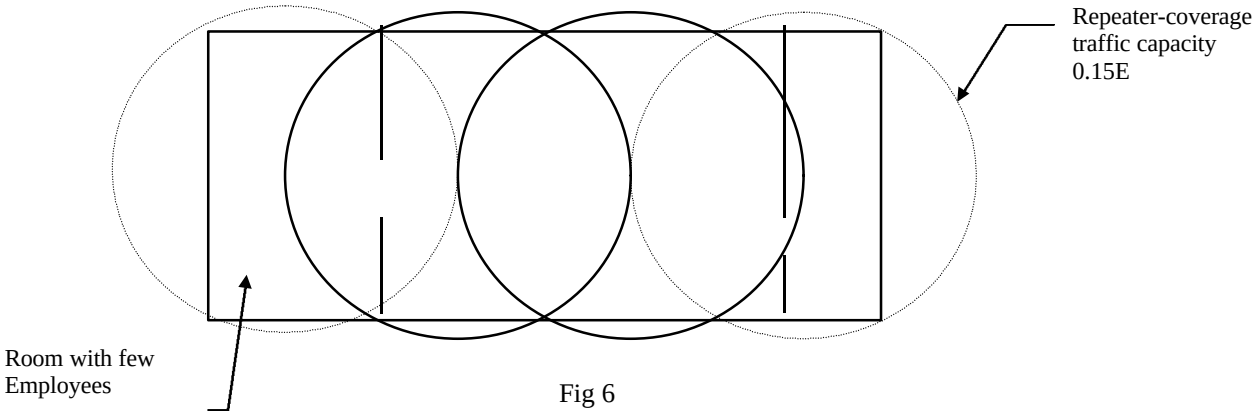


Fig 6

If the Repeater is used to obtain radio coverage in areas with low traffic, i.e. areas with few DECT-employees, the DECT-Repeater can be used as shown on fig. 6. Another possibility is to establish two Repeaters in the outer areas, giving an even distribution of the traffic capacity. However, such a solution will normally be more expensive than to establish coverage with original DECT-base stations, and DECT-bases give a better solution, as the traffic capacity is increased at the same time.

The Dect-Repeater can only to a limited extent be used as a substitution of the original DECT-base stations, as the DECT-Repeater does not increase the traffic capacity.
Therefore the correct installation of DECT-systems is to establish the sufficient coverage in the primary areas with original DECT-base stations and use the DECT-Repeater in areas where radio coverage is wanted, but where the traffic intensity is low.

4. Areas with low traffic intensity

The Repeater can be used to establish coverage in areas with low traffic intensity. This could be a passage between DECT-areas and establishment of coverage in outdoor areas.

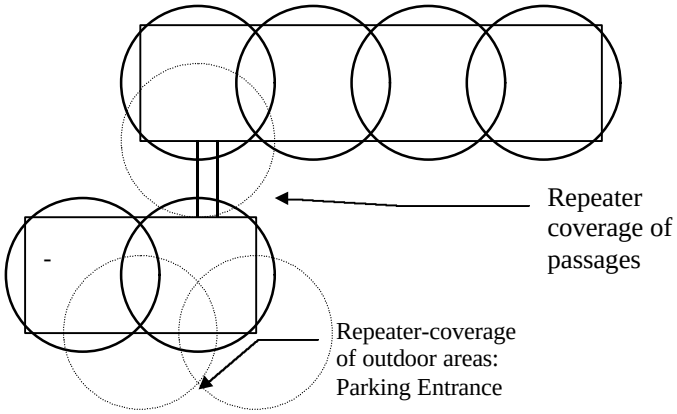


Fig. 7

There are installations with low traffic intensity, and where the primary job is to establish radio coverage. In such installations the Repeater can be used to establish radio coverage. This could be a hotel installation, where the system should create contact among the staff of the hotel.

Fig. 8 demonstrates a hotel installation, where radio coverage is established by registering two DECT-Repeaters on the same DECT-base station. The DECT-base stations are placed in the area, where the highest traffic intensity may occur, hereafter the traffic channels are distributed in the two room sections. This form of installation can be repeated for each floor in hotels and thus create radio coverage with a relatively small number of DECT-base-stations compared to the area of the building.

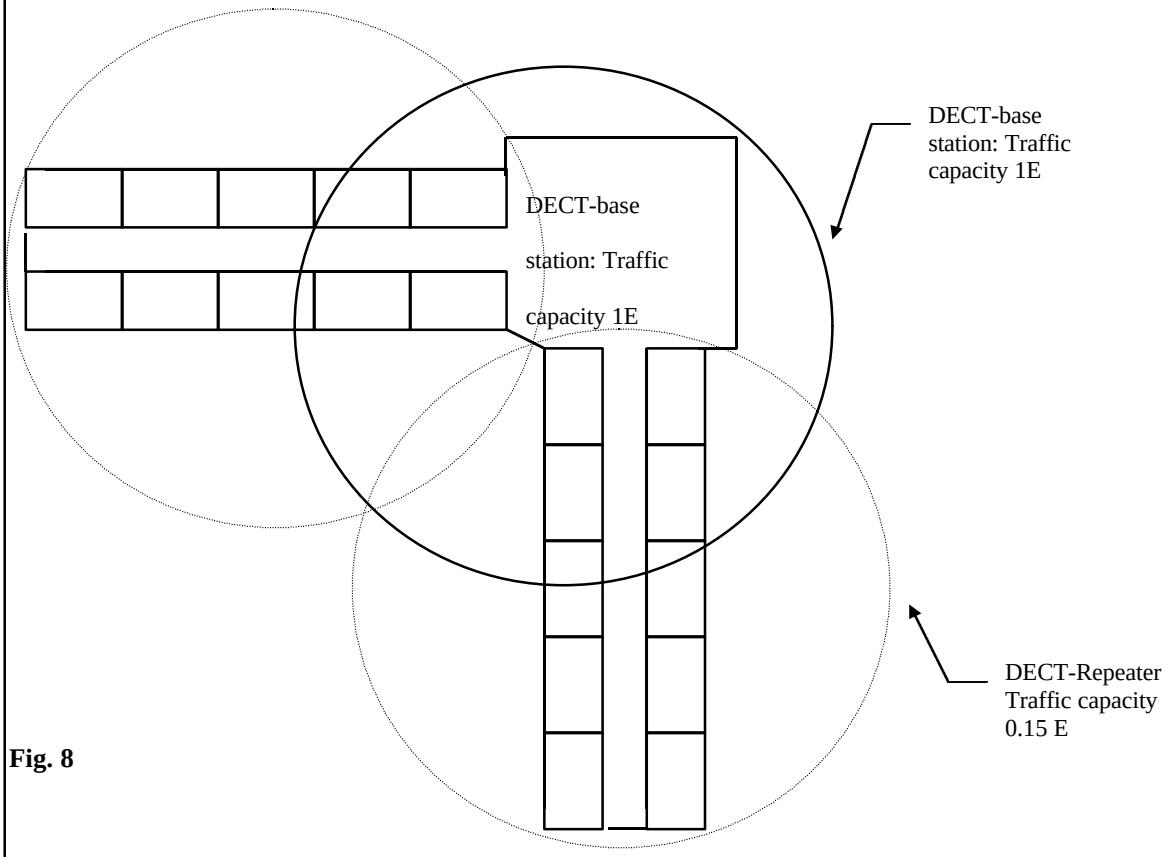
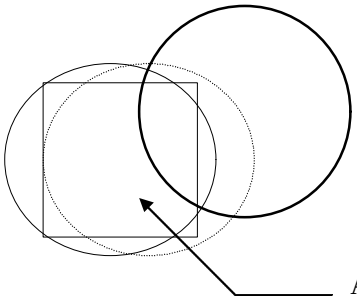


Fig. 8

By establishing multi-cell DECT-systems there are often areas with a low traffic intensity, but with wanted radio coverage, as it is important to establish contact to the maintenance personnel, and therefore loft and basement areas have to be radio covered. For this form of jobs the DECT-Repeater is an ideal problem solver.

5. Displacement of traffic capacity by means of DECT-Repeater

In multi-base DECT-installations it can be necessary to establish a high traffic capacity in certain areas, dependent on working conditions and movement pattern in the company. An example could be a meeting room, that is often used, or a canteen used for lunch and breaks. The task can be solved by establisching more DECT-base stations, covering the same area and hereby traffic channels. Another solution is to move traffic channels from the adjoining DECT-base stations, so that the necessary capacity is available when needed.



Area coved by a DECT-base station and a DECT-Repeater, totally 6 DECT-traffic channels

Fig. 9

	Number of traffic channels at disposal	Traffic capacity in the area of Erlang	Number of hand sets in the area (0.15 E)	Capacity increases in E	Increase of number of hand sets in the area
1. One DECT-Base system	4	1	7		
1.+ Repeater	4+2	2	13	1	6
2. Two base Stations with Overlap	8	3.2	21		
2. + Repeater	8+2	4.8	32	1.6	11

Table 1

As it appears from table 1, a Repeater can be used to displace traffic capacity to a certain area, and even if only two traffic channels can be moved, this means, in order to cover the area by a single DECT-base station, that the capacity of the DECT-hand set is increased by 86%.

6. Repeater used as problem solver in multi-cell systems.

The typical problems at establishing DECT multi-cell systems are:

1. Missing radio coverage

2. Missing traffic capacity in certain areas

One of the typical problem areas at establishing DECT-multi-cell systems is missing radio coverage, and this turns up even if a good measuring of radio coverage has taken place before the installation is made.

This is due to several circumstances: There is not always an unequivocal connection between coverage from a single DECT-base station used for coverage measuring, and a multi-cell system, as there may be radio interference among the cells. Another problem is that the physical placement of the DECT-base station used for radio coverage does not always have the same physical placement, as made in the final installation used during the measuring. Even a small change of the placement of the DECT-base station can give a big change in the coverage from the single DECT-base station, but also other things come into play. In storehouses the placement of the stored goods may influence on the radio coverage, and this means that the coverage is changed in connection with the composition of the stock.

The radio coverage is not the same all the year, as the coverage may depend on humidity or on building materials (in a wood-built house the coverage changes with the time of the year). **Therefore a DECT system must be established with a security in overlap between the coverage areas of the DECT-base stations,** but this often involves many DECT-base stations and hereby a more expensive system solution. With the present competition in the market this can mean that the DECT-quotation is not always the most economical solution.

The wishes of the DECT-customer as to radio coverage will often change, when the system is established, as the experiences from using the system create new wishes from the customer.

Therefore the DECT-Repeater is a fine tool to adjust a multi-cell installation, as the DECT-Repeater is easy to install and move not demanding cabling to the DECT-system. As well radio coverage and traffic capacity can be changed with the DECT-Repeater, exactly the problem areas arising at establishing the DECT-multi-cell systems.

7. Application of DECT Repeater with external directive antenna

The DECT-Repeater can be supplied with external directive antenna for establishing the connection between the Repeater and the existing DECT-installation (it is the hand set part of the Repeater that can be supplied with external antenna). This means that the Repeater can be used to create radio coverage in a remote area compared to the original DECT-installation and this without making cabling. This gives some new applications where cabling is impossible or very expensive to establish.

When the Repeater does not have to make handover to the existing installation (in principle there is no radio coverage between the DECT-installation and the Repeater-radio coverage), the DECT-repeater can be programmed to repeat the three DECT-traffic channels, i.e. a higher traffic capacity in the Repeater-area (from 0.15E to 0.5E).

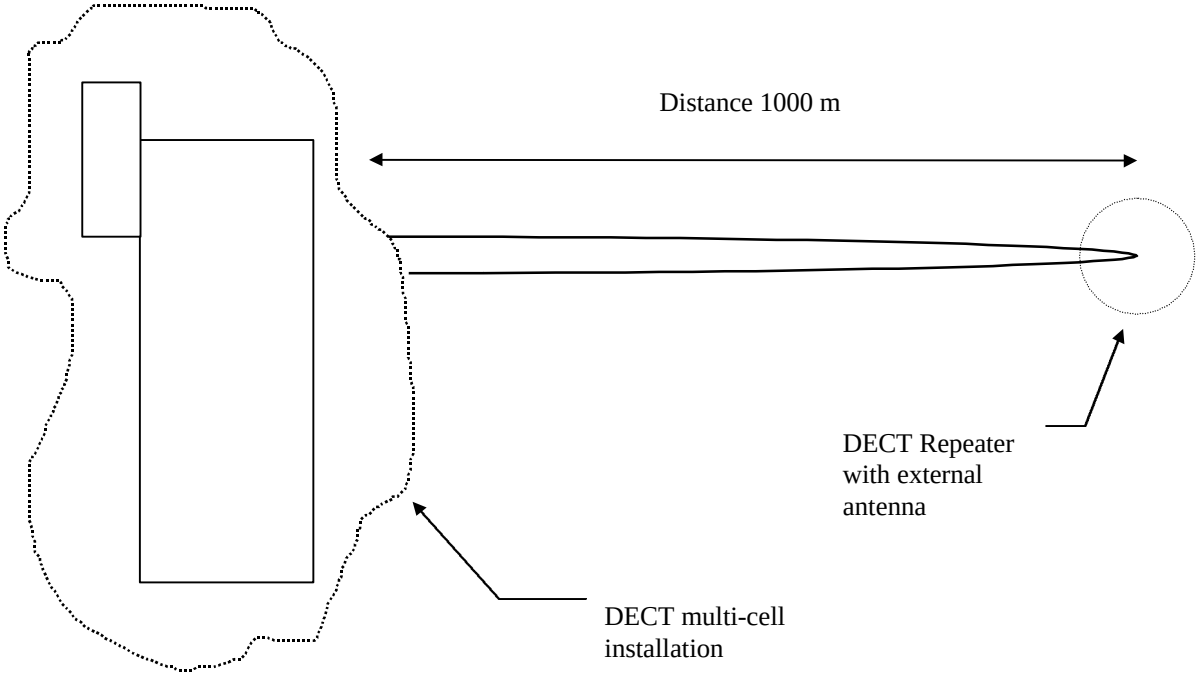


Fig. 10

The evident application of DECT-Repeater with external antenna is to establish radio coverage in a remote building from the original DECT-installation, and this without making real cabling between the systems. Another application is stores, which in summer displace parts of their shops to the parking place, and want to establish provisional radio coverage also in this area.

8. Coupling of Repeater (Repeater-jumps)

The DECT-Repeater can be coupled in a way, that the Repeaters are installed like pearls on a string, and there can be up to four Repeaters on "the string" (maximum three jumps). In this way a large DECT-area can be established, radio-covered only with DECT-Repeaters. On Fig. 11 a configuration with external antenna is shown (for the original DECT-installation) on the first Repeater on the "string".

The number of Traffic channels in the Repeater-covered area is two DECT-channels (there must be space for handover) and by this a traffic capacity for the whole area of 0.15 E.

This configuration can be used to expand the coverage area of a DECT-Repeater installation, but only in areas with demand for very low traffic capacity, as the total area will have to share totally two DECT-traffic channels. The coupling of the Repeaters can of course be used to give a DECT-installation a large physical extent and by this new possibilities to establish high radio coverage without making physical cabling.

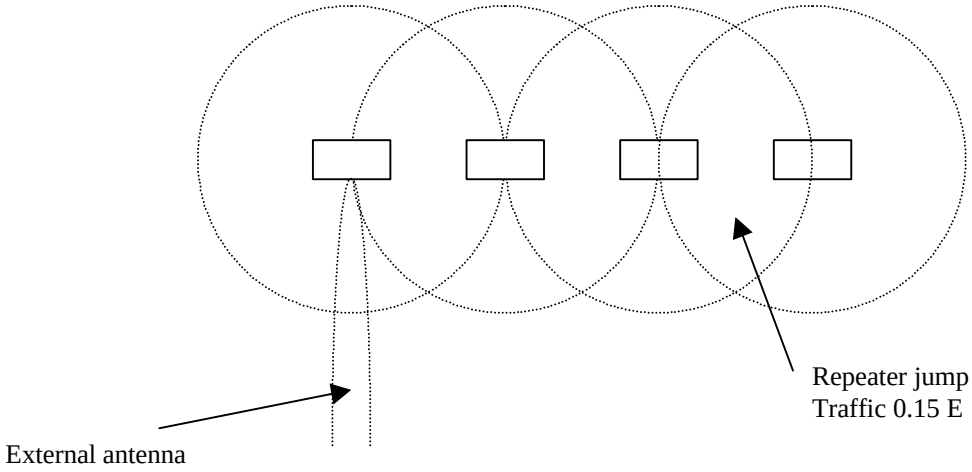


Fig. 11

9. Conclusion

The DECT-Repeater is a fine tool to adjust the radio coverage of a multi-cell system, and to displace the traffic capacity according to the application and demands of the customer.

A DECT-Repeater is easy to move and install. Therefore the DECT-Repeater is the ideal tool to test new possibilities of radio coverage and traffic without changing the already installed system. In many ways the DECT-Repeater will be able to solve the problems and the ways they are presented, arising when multi-cell Dect-systems are installed, and give us a better possibility **quickly to give the customer the multi-cell DECT-solution** suitable for the task given.

The DECT-Repeater is a new building block for DECT-multi-cell systems, to be used to solve radio coverage tasks, where there is low traffic intensity during new-installation.

The DECT-Repeater with external directive antenna opens a series of possibilities to establish radio coverage in areas where real cabling is impossible or difficult to establish.

Coupling of the DECT-Repeater in chain can be used to develop the coverage area of DECT-Repeater, but only in areas with demand for very low traffic capacity, as the total area must share two DECT-traffic channels. Coupling of Repeaters can be used to give a DECT-installation a wide physical extent and hereby new possibilities to establish high radio coverage without making physical cabling.