



Cellular network with capacity transfer



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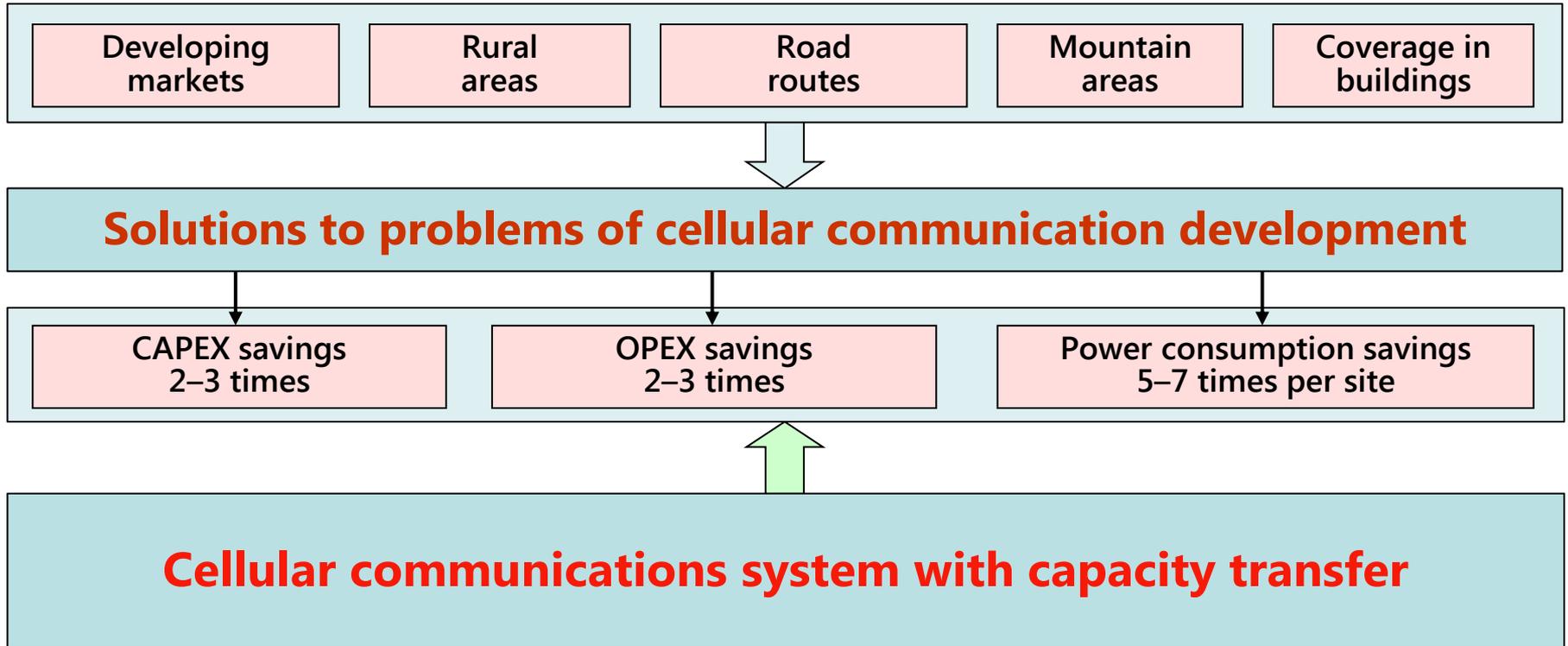
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Problem areas of cellular communication development: high CAPEX/OPEX, large power consumption of sites

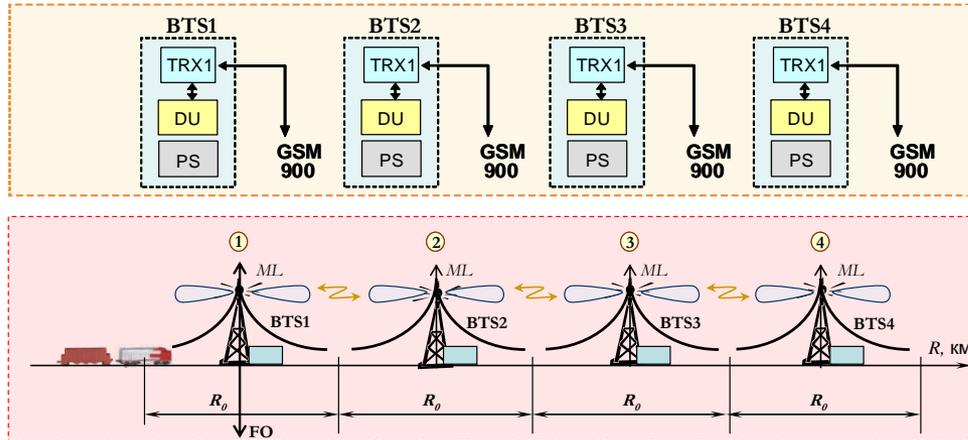


The cellular communications system with capacity transfer is based on changing of the network topology without changing the generally accepted standards of cellular communications (GSM, UMTS, LTE, 5G, etc.), using standard subscriber stations and terminals.

Principles of cellular communications system with capacity transfer

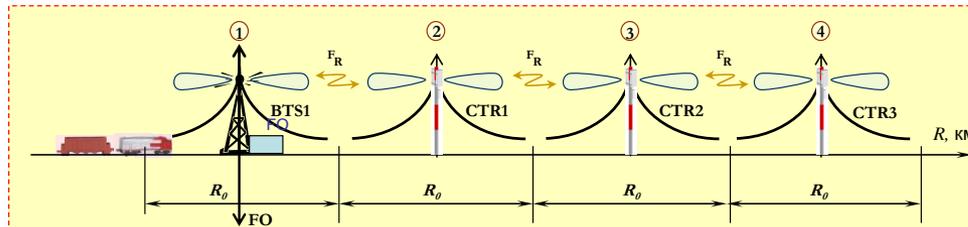
Cellular communications linear scheme

Standard cellular communications system

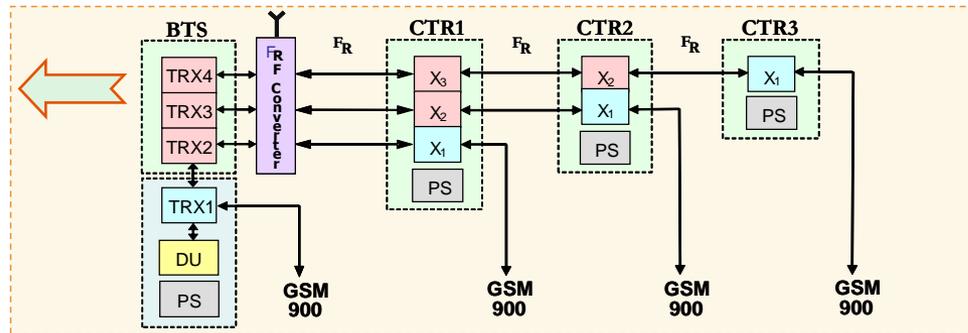


4 base stations (BTS)

Cellular communications system with capacity transfer

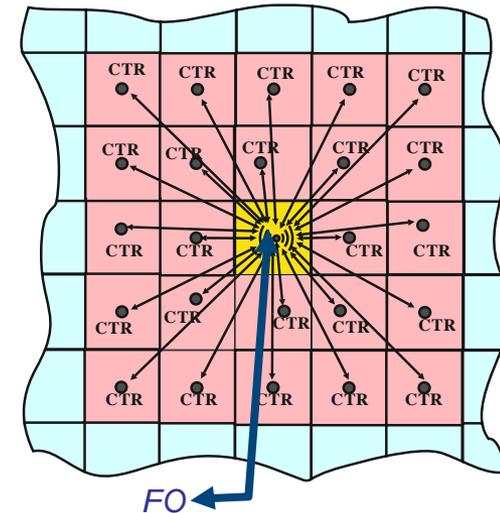
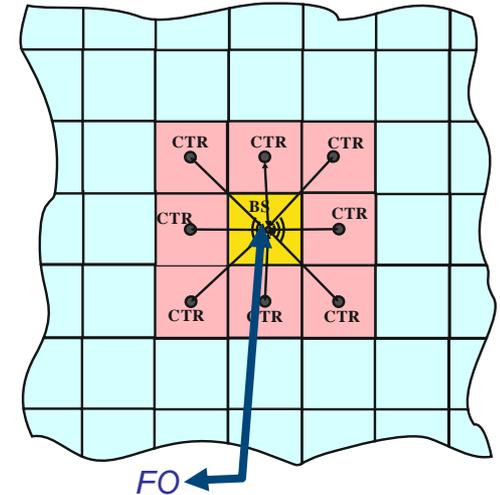


1 base station and 3 CTR



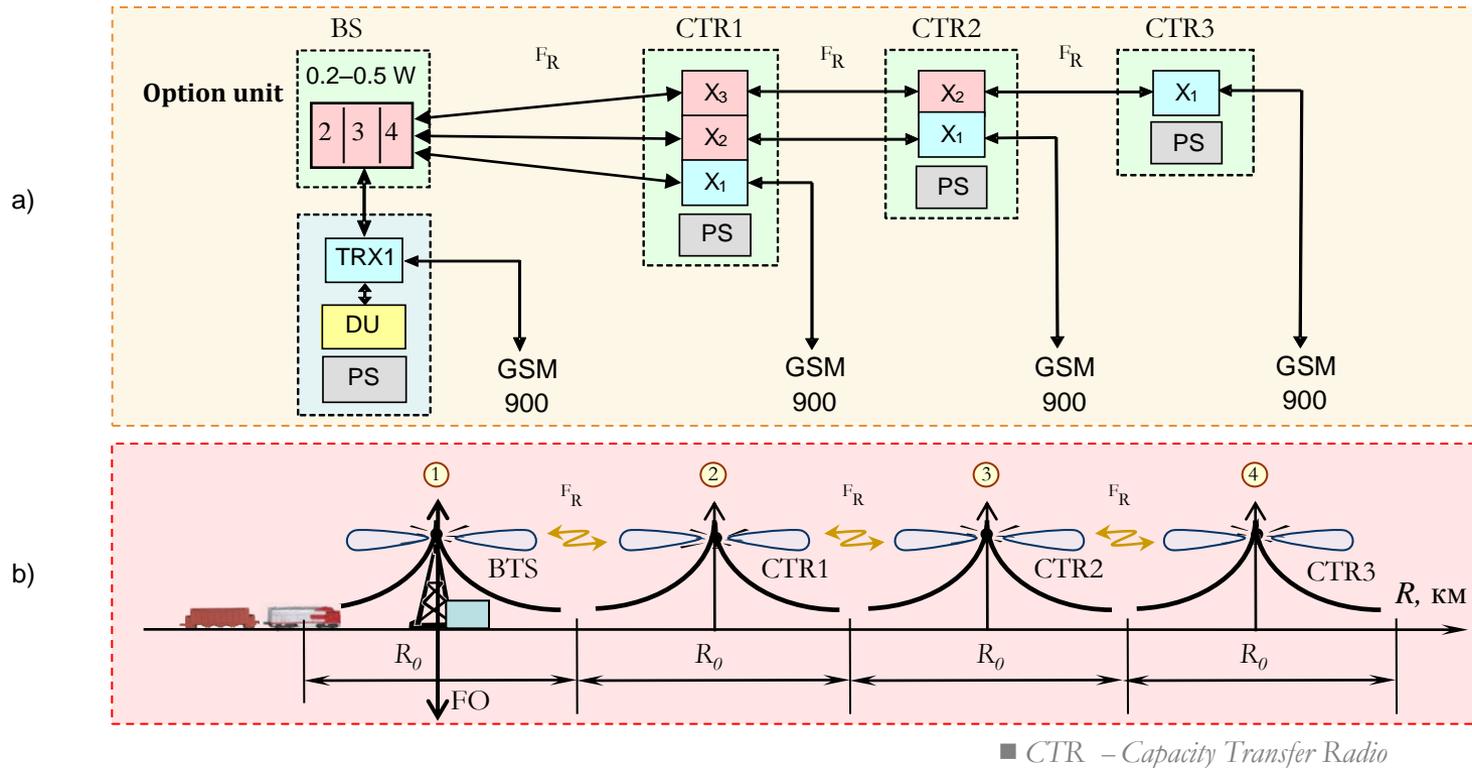
- CTR - Capacity Transfer Radio
- FO - Fiber-Optic (BOAC)
- RC - RF convertor

Cellular communications system schemes for small towns



The capacity transfer scheme is applicable for any cellular communication standards (GSM, UMTS, LTE, 5G, etc.). The cellular communication systems with capacity transfer equipment (CTR) are compatible with base stations of any vendor (Ericsson, Nokia, Huawei, ZTE etc.)

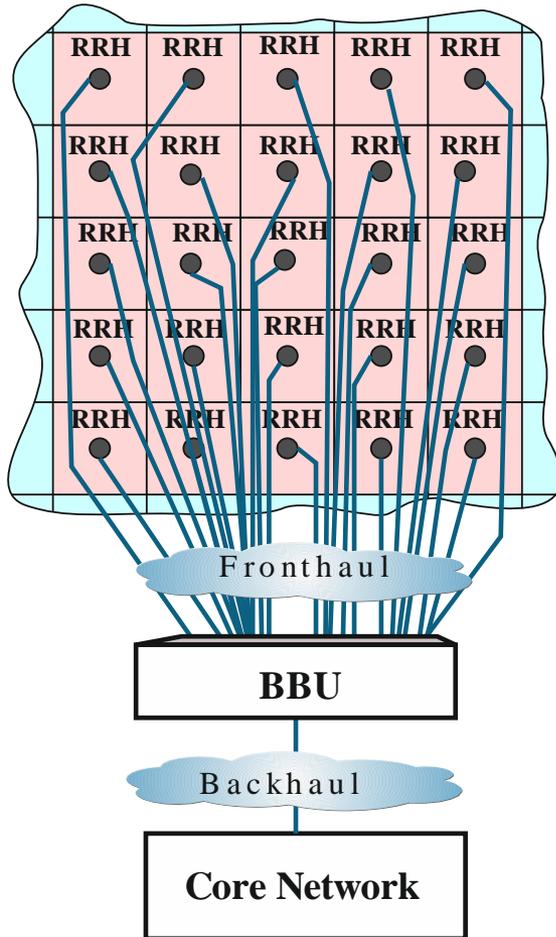
Cellular communication system with capacity transfer and option unit at the base station



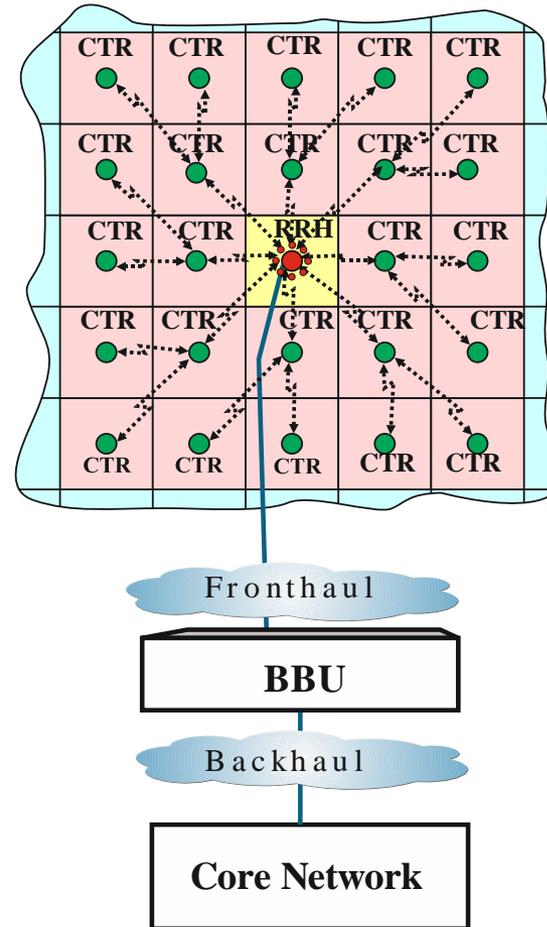
The option unit at the bearing base station replaces high-power (20-40 W) transceivers of the standard base station (TRX), with low-power (0.2-0.5 W). The use of the option unit eliminates the need for the use of a radio frequency converter RC and a microwave link (ML), since it generates a cellular signal at relay frequencies (for example, 6-20 GHz). As a result, the cost of a bearing base station with an option unit and its power consumption is significantly lower compared to the previous version of the capacity transfer scheme using a standard base station with standard transceivers with a power of 20-40 W.

C-RAN Cellular communications system with capacity transfer

Standard cellular communications system



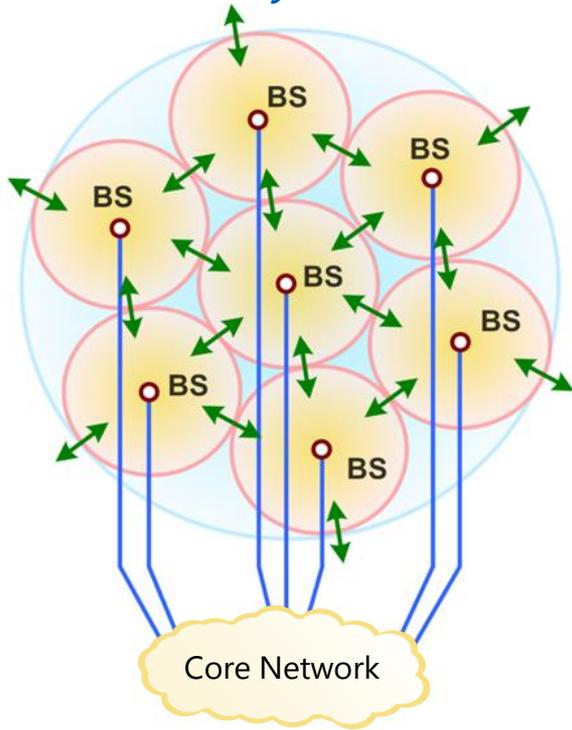
Cellular communications system with capacity transfer (CTR)



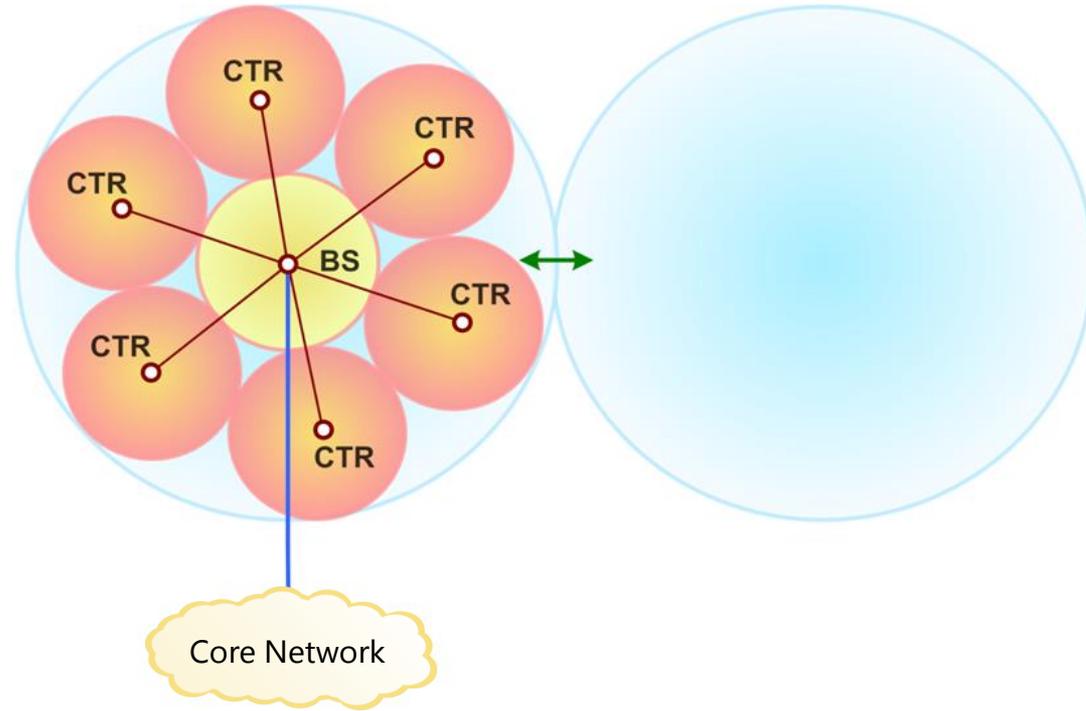
The number of Fronthaul fiber-optic (FO) lines is reduced by N times, where N is the number of sites in the communication scheme (25 times in the presented case).

The reduction of the number of inter-cell handover and transport channels (FO, ML) in the city

Standard cellular communications system



Cellular communications system with capacity transfer (CTR)

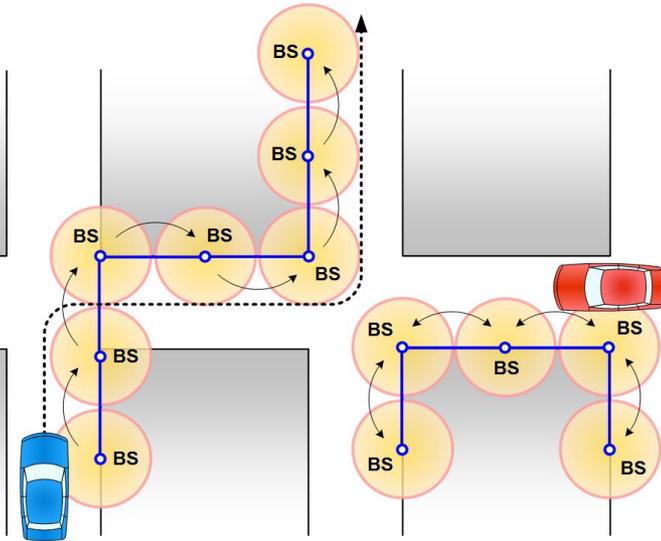


In a city, where the radius of the cell is 100-400 m, the quality of the communications determined largely by the number of handovers. Use of the technology of capacity transfer in the presented scheme with CTR reduces the number of inter-cell handover by 18 times, the area of the handover zone is reduced by 36 times.

Topology of cellular communications system with capacity transfer (1/2)

Standard cellular communications system

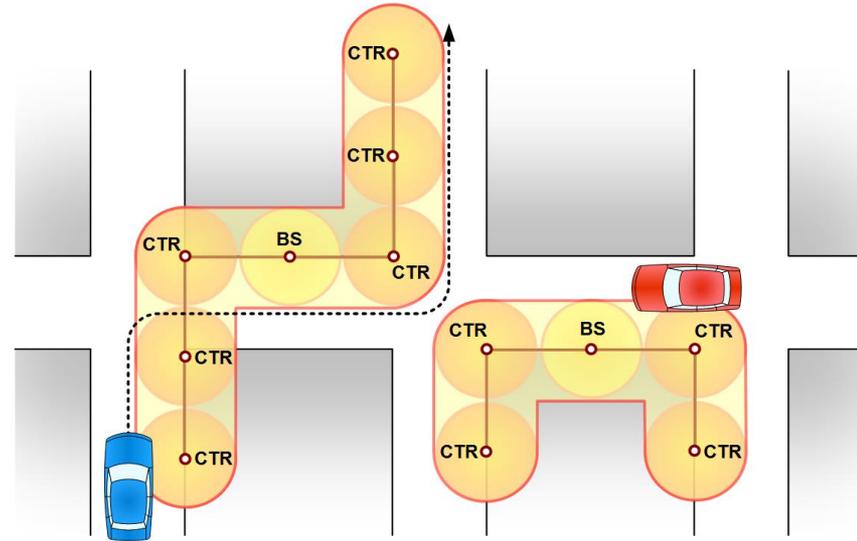
7 base stations (BS)



5 base stations (BS)

Cellular communications system with capacity transfer

1 base station (BS) + 6 CTR

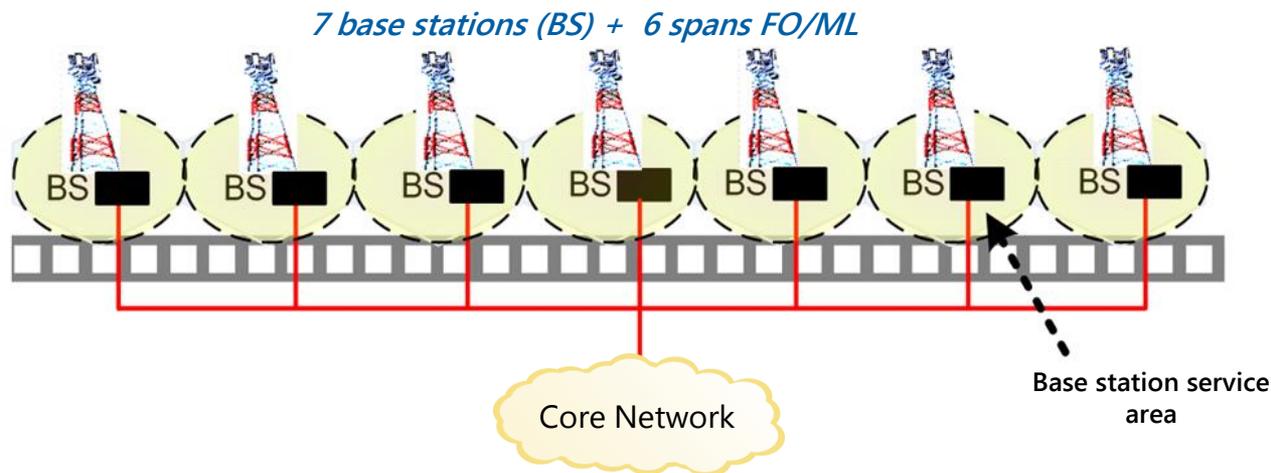


1 base station (BS) + 4 CTR

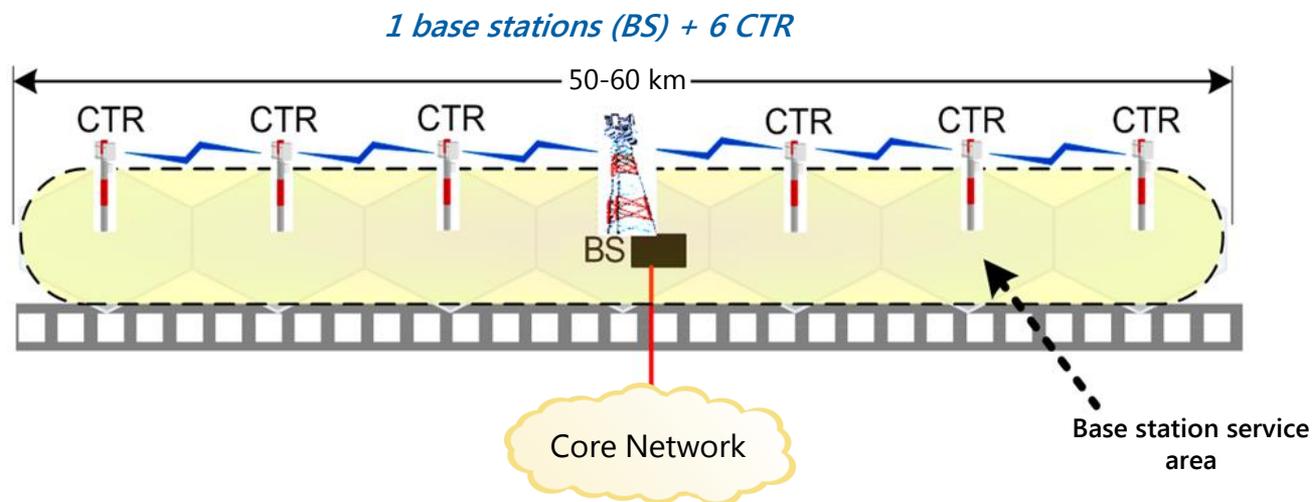
The cellular communications system with capacity transfer opens the possibility of use a flexible network topology on the basis of the possibility of a chain connection of the CTR with each other and with the base station, provides a reduction in communication disruptions, improved quality of service, providing coverage in buildings, as well as in subways and underground premises without a handover with above-ground network.

Topology of cellular communications system with capacity transfer (2/2)

Standard cellular communications system

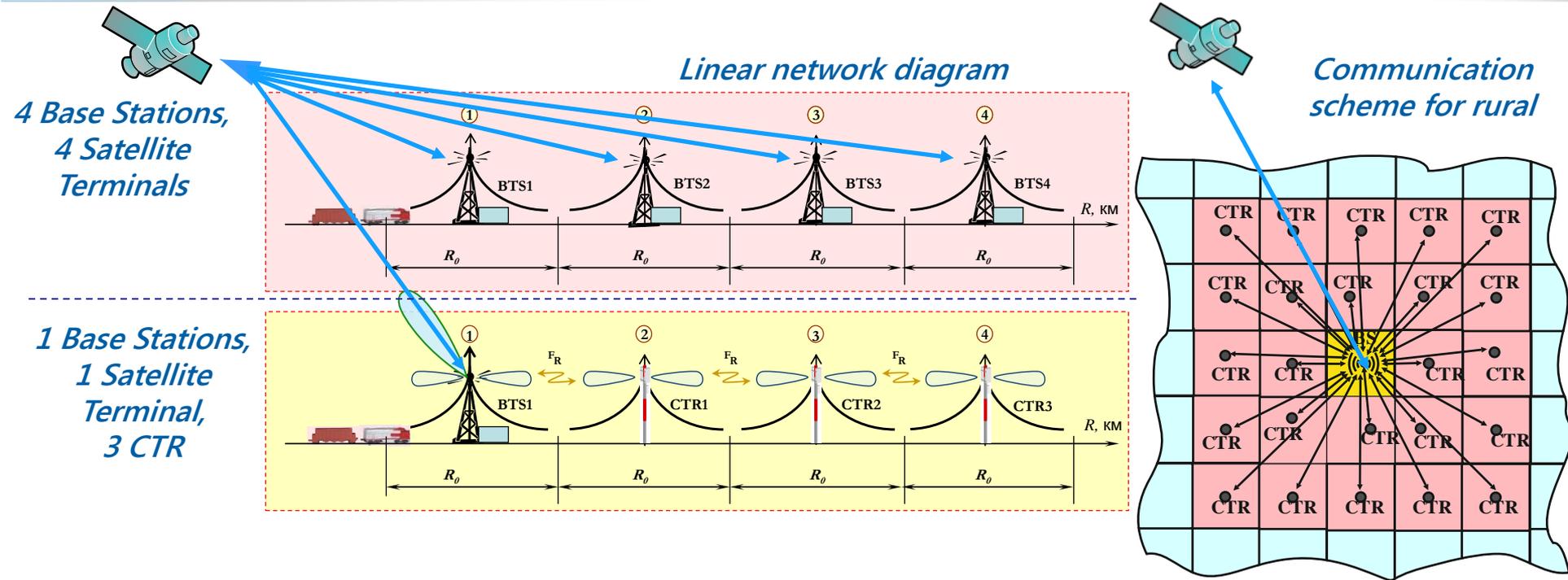


Cellular communications system with capacity transfer



The replacement of the standard connection of each base station to the Core Network via fiber optic link with the CTR communication scheme – connection of the bearing base station to CTR via the relay channel, significantly reduces the number of inter-cell handovers, increasing the reliability and quality of communications.

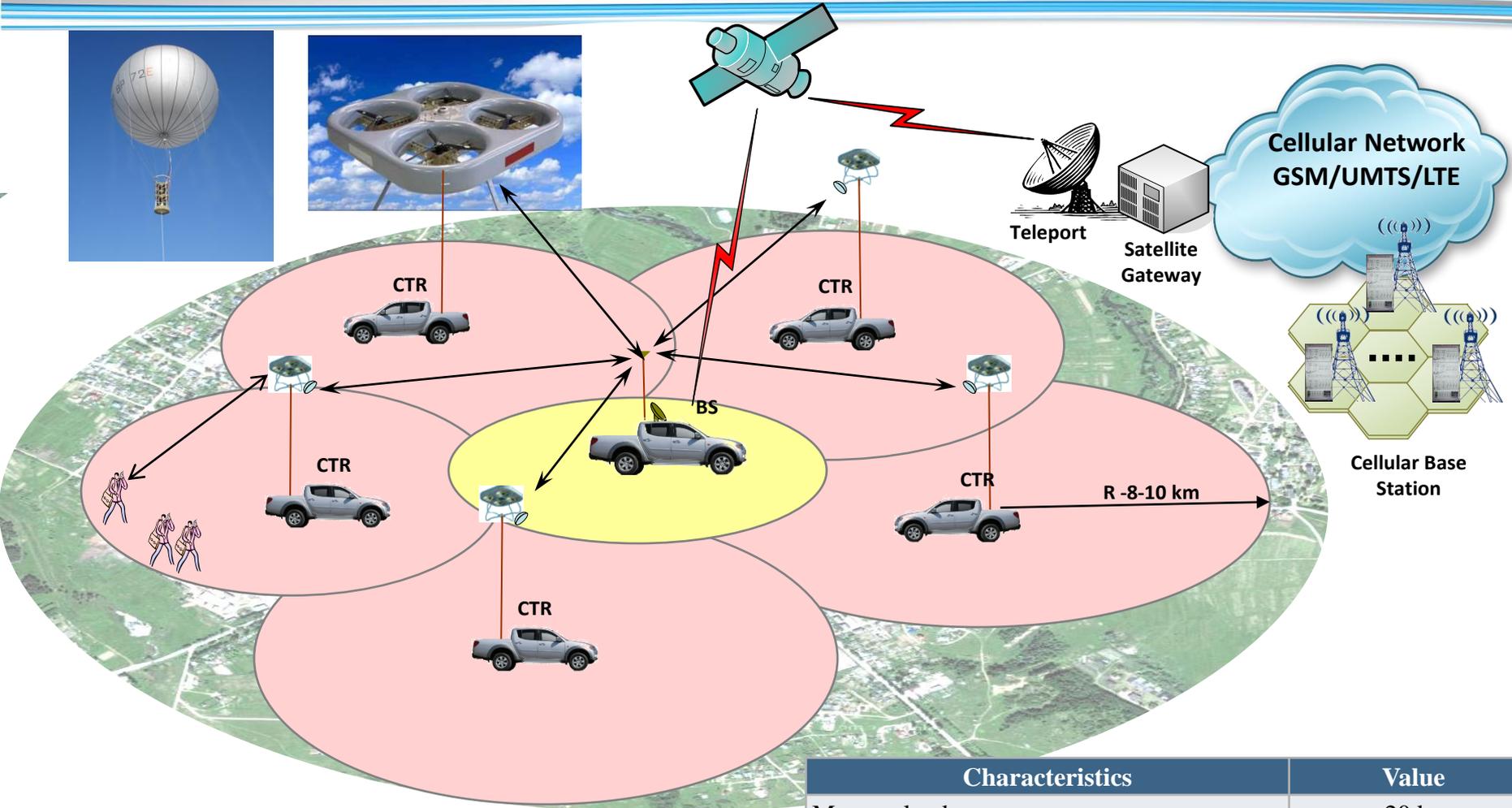
Integrated system of satellite and cellular communication with capacity transfer



The integrated system allows to significantly reduce the requirements for on-board equipment of the satellite communication system due to the use of ground tracking antenna systems with a narrow beam pattern (high gain) combined with a bearing base station of cellular communication system with capacity transfer.

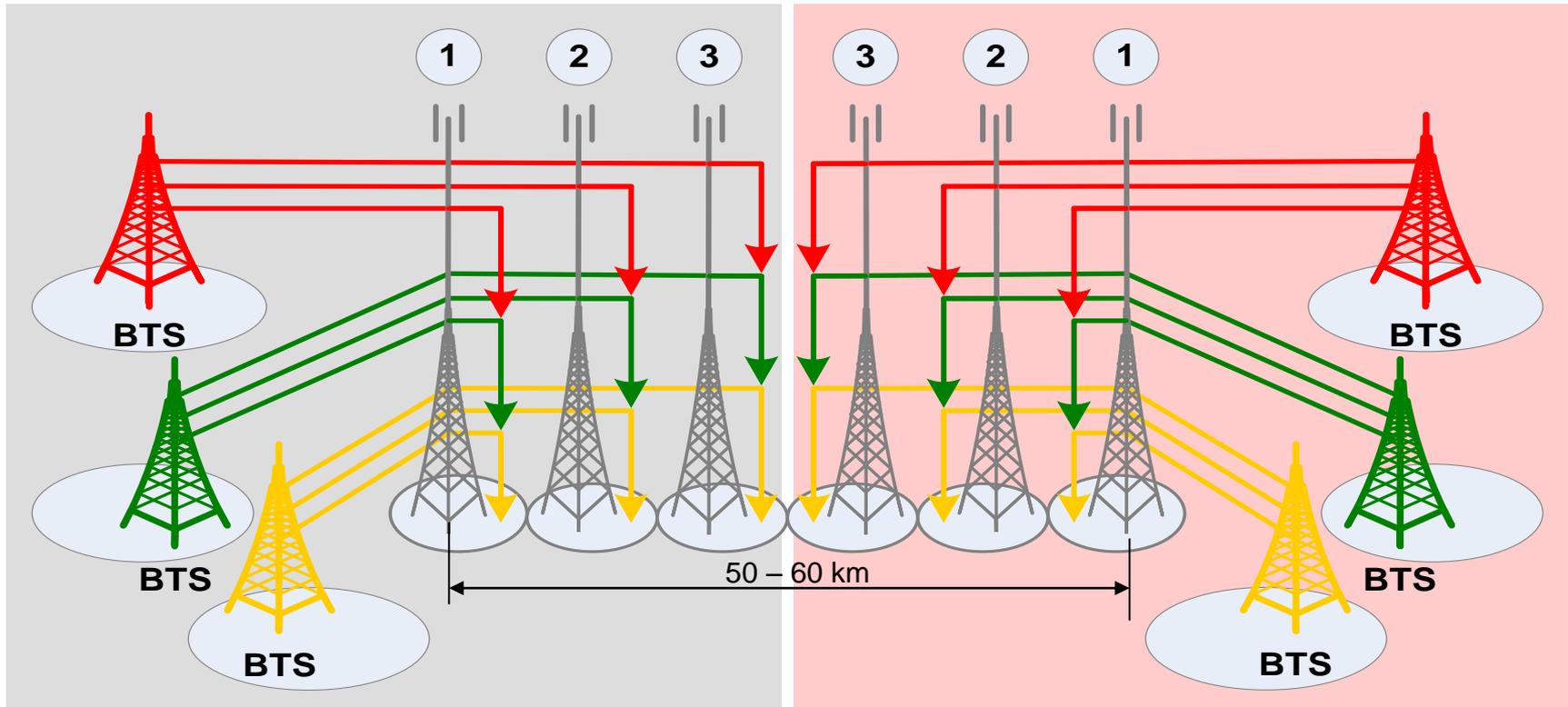
- Provides communication with mobile subscribers in buildings,
- Local traffic from mobile subscribers remains in the cluster of the bearing cellular base station,
- Cheap cellular terminals might be used.

Cellular communication systems with capacity transfer for creating of local zones in emergency situations



Characteristics	Value
Max payload	20 kg
Max. Lifting height	100 m
Lifting time to a height of 100 m	30 s
Dimensions (length * width * height)	1,6*1,6*0,2 m
Flight time	Unlimited

The use of the cellular communication system with capacity transfer simultaneously by several operators (RAN Sharing)



The ability of CTR to work with base stations of any vendor allows to implement a communication scheme with capacity transfer simultaneously for several operators.

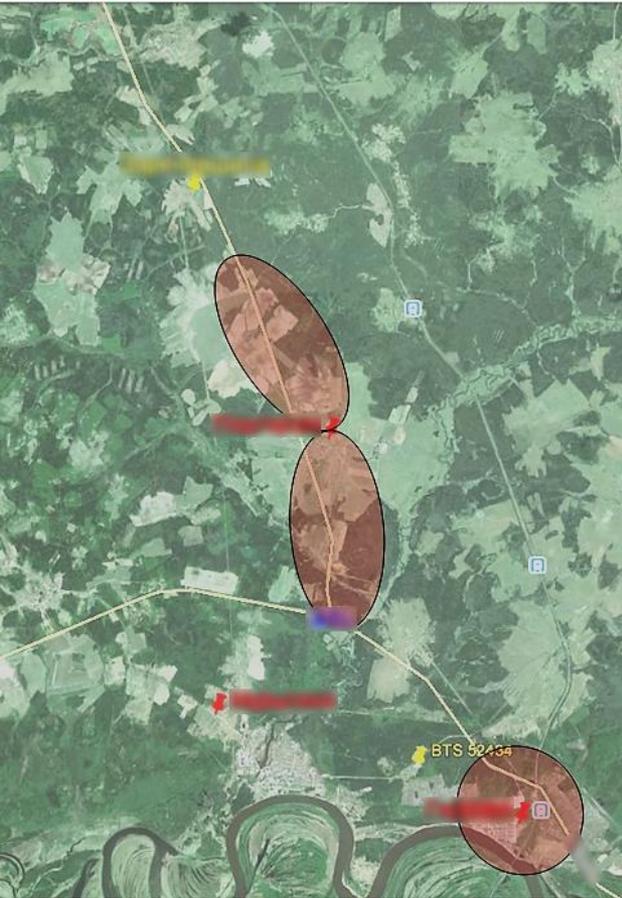
For each of the 3 operators provides:

- 6 base stations of cellular communication and 6 microwave links (ML) replaced with 6 shared CTRs;
- the number of towers and sites reduced 3 times;
- energy consumption per the site reduced 5-7 times;
- light masts used;
- significantly accelerated the construction of the network.

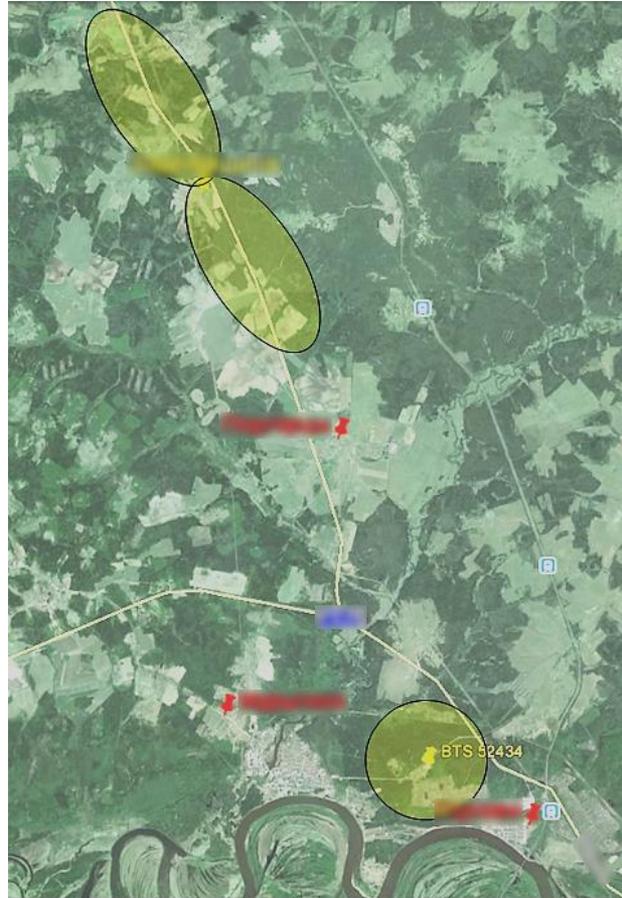
Scheme of the joint RAN Sharing test zone (Operators «A» and «B»)

The use of CTR to provide continuous coverage of the road route for 2 operators

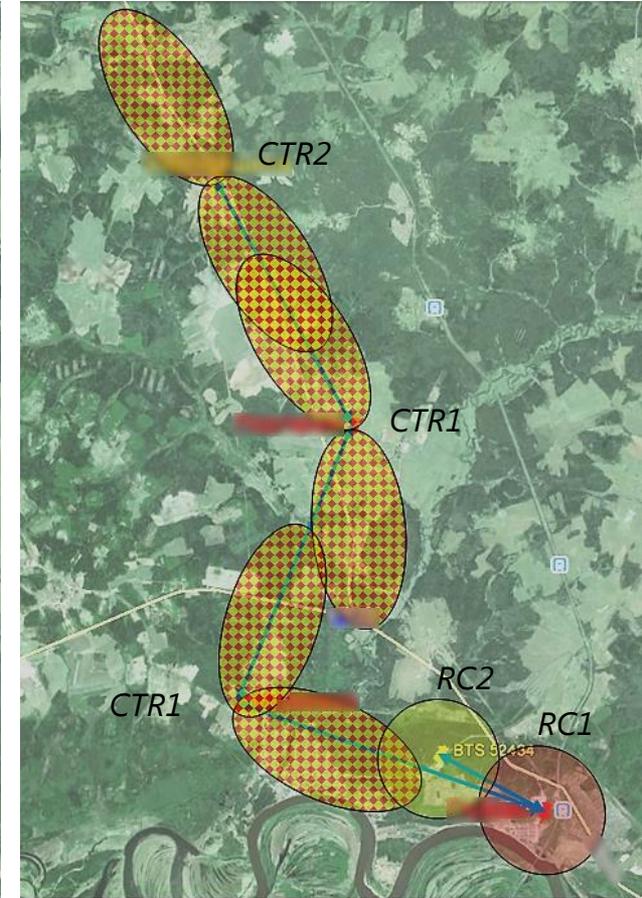
Operator «A»



Operator «B»



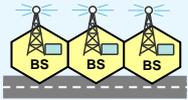
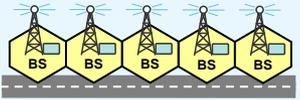
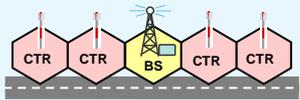
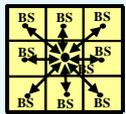
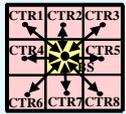
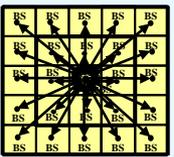
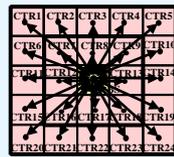
RAN Sharing



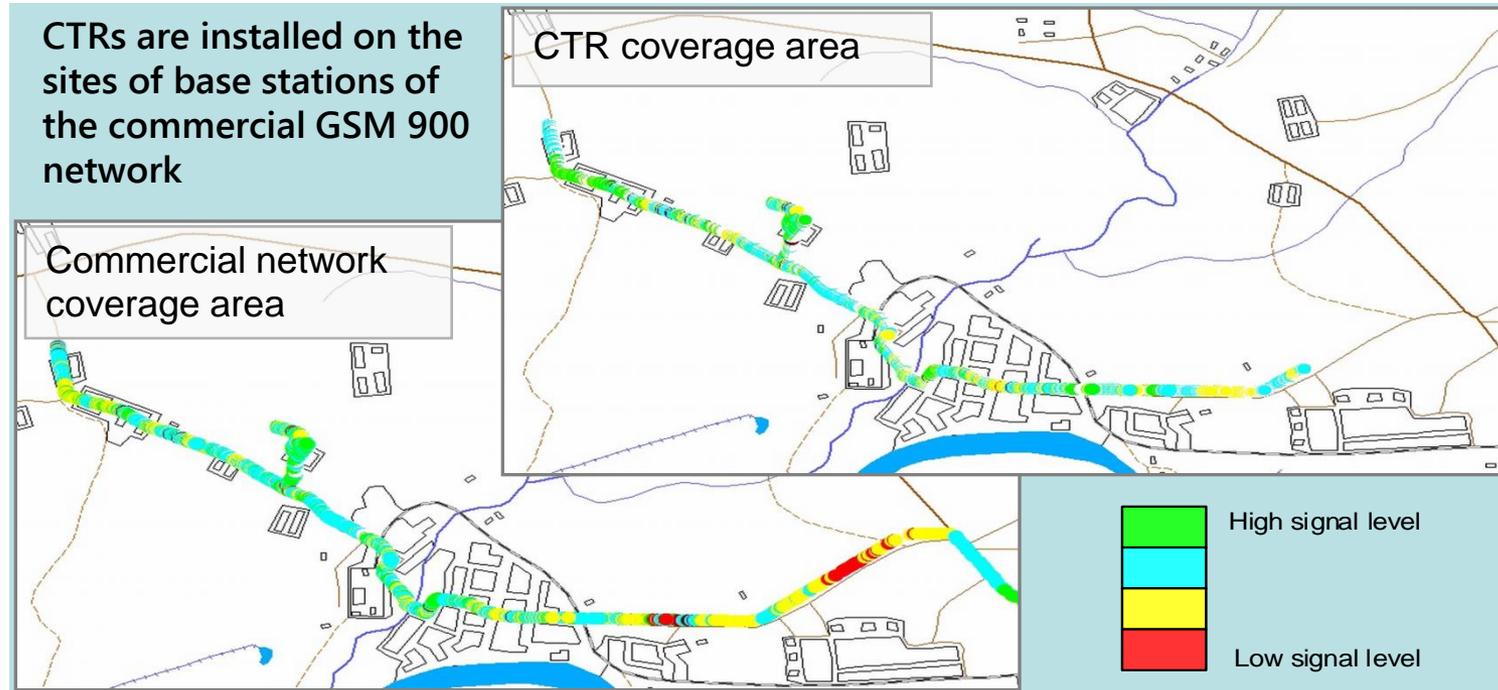
The installation of CTR, shared by 2 operators, using common towers for all operators, allows to reduce the use of standard base stations and to provide multiple expansion of coverage areas and capacity of the network.

■ RC – Radiofrequency Converter

Effectiveness of cellular communications system with capacity transfer use for different communication schemes

Communication scheme		Cost reduction (BS / CTR) for network fragment		RAN Sharing operators	Cost reduction (BS / CTR) for network fragment, for each operator	
BS based	CTR based	Equipment	Electricity		Equipment	Electricity
Linear 3 sites  		2,0	2,3	2	3,4	2,6
				3	3,8	2,6
Linear 5 sites  		2,4	3,1	2	4,1	3,6
				3	4,5	3,6
Linear 7 sites  		2,6	3,6	2	4,4	4,2
				3	4,8	4,2
Rectangular 9 sites  		2,2	4,0	2	5,0	5,1
				3	5,5	5,1
Rectangular 25 sites  		2,4	5,2	2	5,6	7,0
				3	6,1	7,0

Results of GSM 900 cellular communications system with capacity transfer tests at commercial network of operator «A»



The tests showed that the characteristics of the GSM network fragment built on the basis of CTR are not inferior to the characteristics of the network fragment built on the basis of standard base stations, both in measures of the created coverage and quality of service.

The power consumption of the radiofrequency converter RC is not more than **100 W**, and the power consumption of the CTR in the maximum configuration (6 frequency channels) is not higher than **320 W**.

GSM 900 cellular communications system with capacity transfer tests

Six-channel CTR on mast of operator «A» at Kirov town



power consumption 320 W

power consumption 180 W



GSM 900 6 channels CTR



*3x sector UMTS or
LTE CTR*



*General view of BTS site
power consumption around 5 kW*



*General view of CTR site
power consumption up to 320 W*

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L.1700

(06/2016)

SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

Requirements and framework for low-cost sustainable telecommunications infrastructure for rural communications in developing countries

Recommendation ITU-T L.1700 Supplement 30 and invention patents

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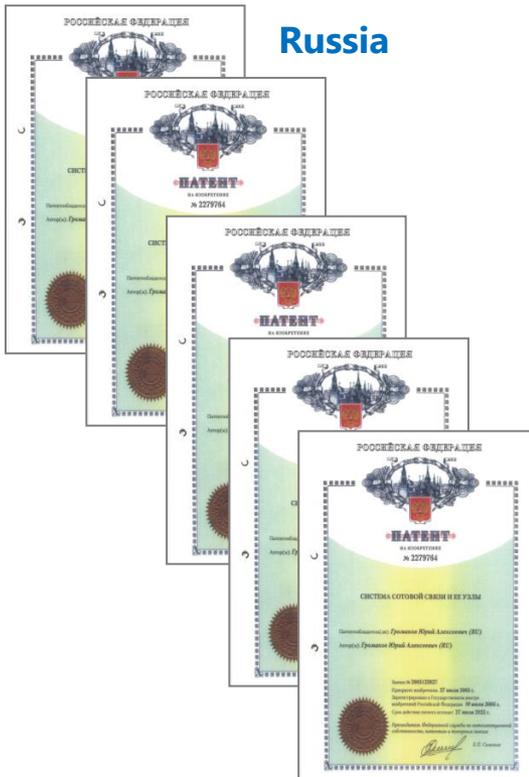
SERIES L: ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

ITU-T L.1700 – Setting up a low-cost sustainable telecommunication network for rural communications in developing countries using cellular network with capacity transfer

ITU-T L-series Recommendations – Supplement 30



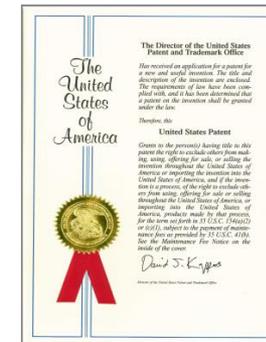
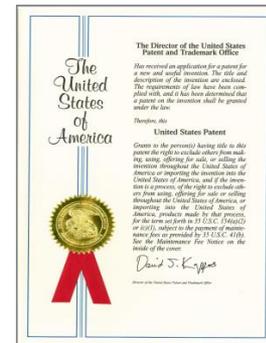
Russia



Europe



USA



India



China



Ukraine

