

City-1

TV/IP broadcasting system

December, 2003

- **432 TV-programs of broadcasting quality**
- **3.24 Gbps per cell sector**
- **DVB-S standard**
- **L-band interface**



City-1 equipment was designed for wideband TV and/or IP broadcasting in urban areas. City-1 operates in mm-wave frequencies, from 40.5 to 95 GHz.

Operation principle

In City-1 DVB-S standard is used, as in satellite TV/IP broadcasting. The only difference is a frequency range.

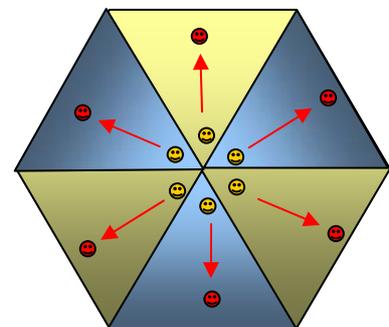
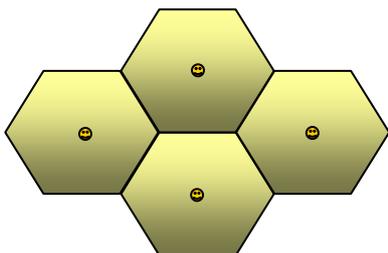
For full compatibility to satellite equipment, City-1 transmitter and receiver have L-band interface (IF = 950 to 2150 MHz). This allows using any satellite equipment both at base station and receiver side.



Network topology

City-1 transmitter can be deployed on TV tower or any eminent building. Transmitter range is up to 10 km, depending on a rain statistic in an area.

TRx is equipped with 30, 45, 60, or 90° sector antenna. To cover all directions, the cell topology is used. Depending on antenna pattern, the cell can be formed from 4, 6, 8, or 12 sectors.



To cover larger territory, multiple cell can be deployed.

An example of frequency allocation plan

Let 40.5-43.5 GHz band is split in 39 MHz bands, like in Satellite broadcasting. We will have 72 bands of vertical polarization and 72 bands of horizontal polarization. Each 39 MHz band is equivalent to satellite "transponder", i.e. can carry 6 TV-channels of broadcasting quality or 45 Mbps data stream.

Operator can use from 1 to 72 bands in any sector, according to his needs. It is important that due to quasi-optical propagation in 40 GHz, the same frequencies can be used in all cell sectors and in all cells. To avoid interference at sector margins, it is enough to use different polarization in adjacent sectors.

Capacity

As fixed polarization can be used in any cell sector, the sector capacity is $72 \times 6 = 432$ TV channels or $72 \times 45 = 3240$ Mbps. The capacity of 12-sector cell is more than 5000 TV-channels or 40.000 Mbps. The total capacity of the system depends on cell quantity.

Transmitter

City-1 Transmitter is a low-noise up-converter from 1500 MHz to 40.5-43.5 GHz band.

Transmitter can transmit up to 4 DVB-S streams. But it should be mentioned that increasing carrier number leads to decreasing of cell radius (due to decreasing of power/carrier ratio and a crosstalk). So if you need to maximize the cell radius, it is better to use separate transmitter for each DVB-S stream.

Transmitter is supplied with horn antenna of 30, 45, 60 or 90 degrees beamwidth. Transmitter powered with 48-60 VDC, 2A.



Multi-channel transmitter

Multi-channel transmitter is to provide the maximum cell radius transmitting multiple DVB-S streams. It consists of multiple single-channel transmitters mounted in single case.

Receiver

City-1 Receiver is a down-converter from 40.5-43.5 GHz band to L-band (950-2150 MHz). It has completely the same interface as Satellite converter (except it operates in fixed polarization). Receiver can be connected to any standard Satellite STB or receiver card with a coax cable. It consumes 18 VDC over a coax.

Receiver is supplied with 30, 45 or 60 cm reflector-type antenna.



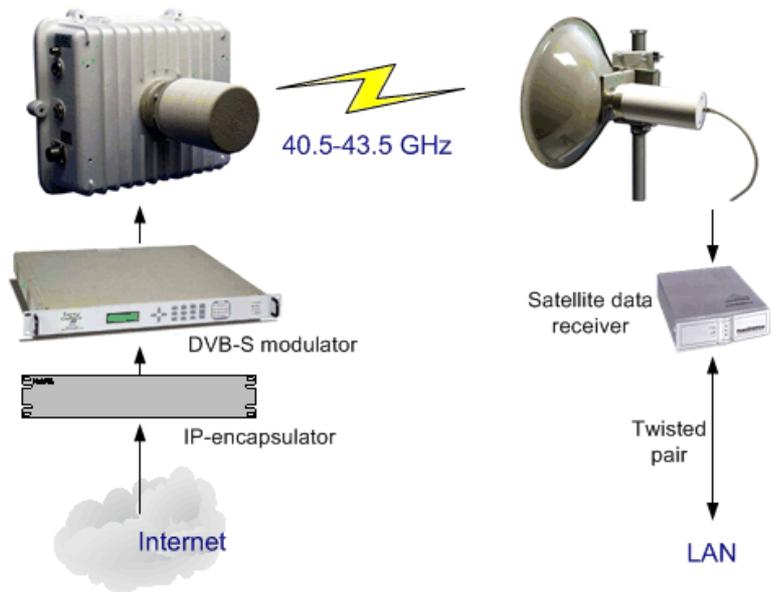
IP-broadcasting

DVB-S standard is used in City-1 for IP broadcasting.

To create DVB/IP stream, IP-encapsulator and DVB-S modulator should be used at the base station.

To receive DVB/IP stream, any satellite data receiver can be used. For example, DVB-router, that has L-band input and Fast Ethernet output. It can be connected to LAN directly.

A return channel to Internet in City-1 can be organized in any alternative manner.



TV-broadcasting: Choice 1

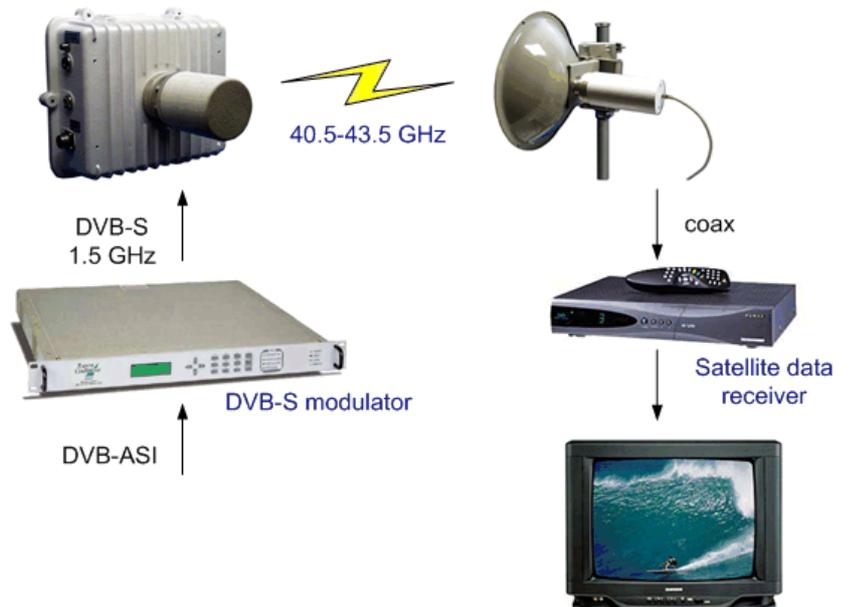
An operator can use 2 different ways to broadcast TV in City-1. The simplest one is TV over DVB, like in satellite TV.

To retransmit a Satellite transponder you can take it from any standard satellite converter, single out one transponder with, for example, ALCAD converter, and forward it directly to City-1 transmitter.

To receive DVB stream, a customer can use any standard satellite TV-receiver. To connect it to City-1 receiver, a coax cable with 2 GHz band should be used. To use existing narrow-band coax, QPSK/QAM or QPSK/PAL transmodulators should be installed at receiver side.



To broadcast DVB-ASI/SPI stream, DVB-S modulator should be used.



TV broadcasting. Choice 2.

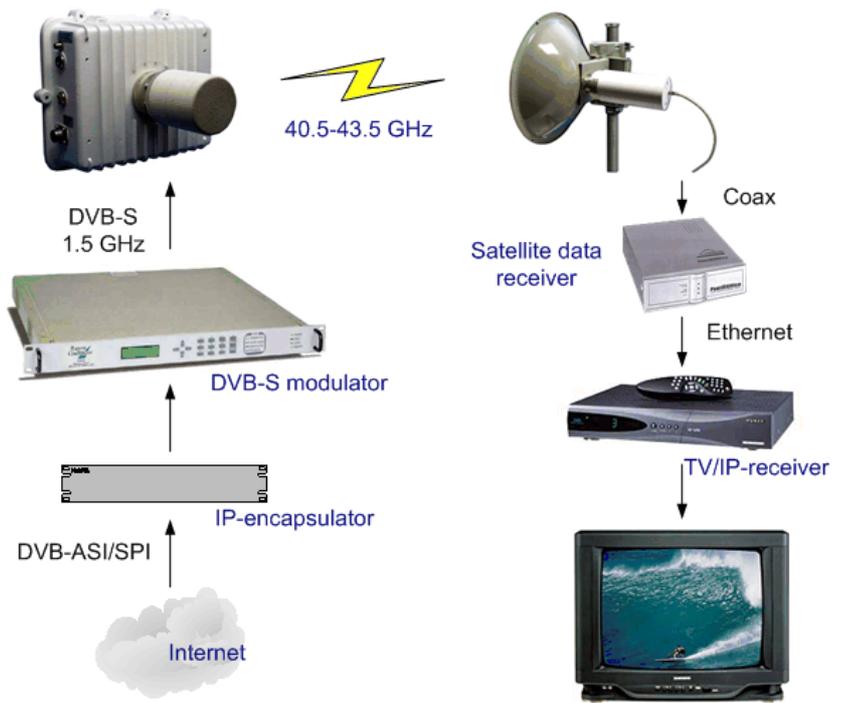
An alternative way of TV-broadcasting is TV over IP over DVB. In this case TV is transmitted like other data.

If digital TV to broadcast is available in Internet, IP-encapsulator and DVB-S modulator should be installed at the base station.

At a customer side any standard Satellite data receiver can be used to extract TV/IP stream from DVB and forward it to LAN.

Customers should use TV/IP receivers to view a TV on their TV-sets.

This way simplifies a house distribution system. The simplest Fast Ethernet network provides both data and TV distribution.

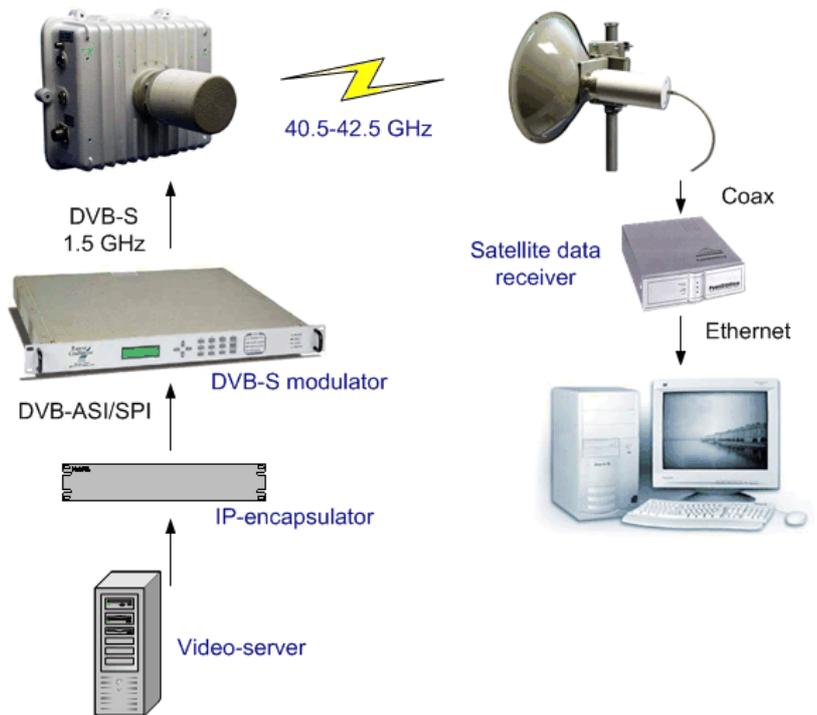


Video on demand

VoD transmission is completely the same as TV over IP broadcasting.

Video can be stored on a disk array. After IP-encapsulation and DVB-S modulation, Video forwards to a City-1 transmitter.

At customer side video converts to an IP-stream, that can be viewed on a computer or with a help of TV/IP receiver.



Performances

General

Frequency range	40.5-43.5 GHz 92-95 GHz
Bandwidth	39 MHz * channels number
TV-channels	Up to 432 per a cell sector
Data capacity	3240 Mbps per a cell sector
Sectors in cell	4, 6, 8, or 12
Range (90° sector, 30 cm terminal antenna, 5mmph rain rate)	7.5 km
Environment	-45 °C .. +50 °C

Receiver

RF Bandwidth	1200 MHz
Polarization	Vertical/Horizontal
Cross-polarization factor	20 dB
Noise figure	8 dB
HF/RF gain	35 dB
IF	950-2150 MHz
LO stability	+/-2.5 MHz
Antenna	30 cm/38 dB/1.6° 45 cm/42 dB/1.0° 60 cm/44 dB/0.7°
Power	18 V, 250 mA
Mounting	On vertical pipe 40~70 mm diameter
Dimensions (without antenna)	Diam. 75x 150 mm
Weight	2 kg
Alignment	
vertical	+/-20°
horizontal	360°

Transmitter

RF Bandwidth	200 MHz
Output power	22 dBm Psat min
Polarization	Vertical/Horizontal
Phase noise	<-51 dB/Hz at 1 kHz offset <-81 dB/Hz at 10 kHz offset
Unwanted emission:	
30 MHz .. 21.2 ГГц	< - 90 dBW
21.2 GHz .. 40.5 GHz	< - 60 dBW
43.5 GHz .. 43.5 GHz	< - 80 dBW
43.5 GHz .. 80 GHz	< - 60 dBW
IF	1250-1750 MHz, 10 dBm QPSK modulation N-type connector
Input noise	<- 55 dBc in 4kHz band
Antenna	90°x10°, 16 dB 60°x10°, 17 dB 45°x10°, 18 dB 30°x10°, 20 dB
Power	54 VDC, 2A
Dimensions	288x242x120 mm, antenna: 140 x diam.85
Weight	5 kg
Mounting	On vertical pipe 40~70 mm diameter
Alignment	
vertical	+/-25°
horizontal	360°