THE INTEGRATED HIGH SPEED COMMUNICATION SYSTEM FOR IHEP ACCELERATING AND EXPERIMENTAL COMPLEX

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Abstract

The combined system for collection, conversion and transfer of information based on high speed medium data transfer in IHEP is described. The feature of that approach is the usage of long and short distance radio-relay links for connecting computer networks to remote buildings and short general purpose locations.

I. Introduction

IHEP has rather extensive and growing computing base. However the rigorous realization of possibilities for IHEP was limited essentially by a lack of high-speed channels of computer connection with centers of science. It was determined to be essential to connect IHEP with basic points of access to global computer networks. The nearest points are in Moscow at a distance about 100 km. Possible modes of access are obvious: satellite channels, fiber-optical lines and radio-relay. For many reasons, both technical and economic, a radio-relay (RRL) connection with Moscow was selected.

II. Configuration

Owing to distance and low elevation, IHEP does not have direct visibility with any point in Moscow. (Direct line-of-sight communication would require 200 m antenna altitudes at both ends, impractical in this case.) Research showed that three retransmissions would be necessary. This approach is undesirable for many reasons, mainly due to organizational problems of equipment exploitation.

A successful solution was found by a careful choice of an installation site requiring only one re-translator between Moscow and Protvino (Fig.1). The choice was made to use the unique 300 m meteorological mast in the city of Obninsk. This location is 47 km from Protvino and 100 km from Moscow. From this mast direct visibility with any high building on territory of IHEP and with two points in Moscow is realized: a television tower "Ostankino" and a building of MSU (Moscow State University) (Fig.2). Both these locations in Moscow are large communication nodes for connection to global webs.

III. Engineering Realization

Researches were made as to the choice of parameters for a radio-relay station providing a reliable connection on the rather extended (100 km) segment, given the complicated conditions and the rules on frequency and power of transmitters in the Moscow region. Finally the project was realized using specialized (television) radio-relay stations, working at the frequency 7.5 GHz and at an emitted power of 0.5 W. Presence of a low noise receiver has allowed use of parabolic antennas of diameter 0.65 m; this small size has eliminated potential problems related to wind forces. The frequency is sufficiently low to avoid signal attenuation due to precipitation but is high enough to obtain a narrow rf beam with a small antenna. The potential channel capacity of this radio-relay station reaches 34 Mbits/sec (T3/E3).

For two years the RRL was operated at an experimental data rate of 2.048 Mbits/s (E1). For more than 95% of a one year operating period the daily average error level using the HDB3 code did not exceed 10^{-8}. At this time two channels of 2.048 Mbits/s are realized with a connection at one point with satellite communication channels to European networks. Through a node at MSU we have reached DESY, Hamburg via the "Raduga" satellite.

The radio-relay communications have been integrated with the IHEP computer network (Fig. 3). Multifiber optical cables connect the main buildings on the IHEP site. Thick ethernet is used for intra-building connections.

IV. New Applications

The operation of this communication circuit has pointed out the possibility of using radio-relay communication circuits not only for long distances, but also for short ones, comparable with the size of our accelerator. It has been observed that remote locations of the institute can be given high-speed communications to our computer center using RRL (Fig.4). The top balcony of the heating plant's chimney provides line of sight visibility from the retransmitter to all buildings in the UNK complex. Among these are experimental labs, with huge streams of an information, and monitoring systems and controls of the accelerator. Therefore we researched transmission of digital information at a frequency of 39 GHz for a

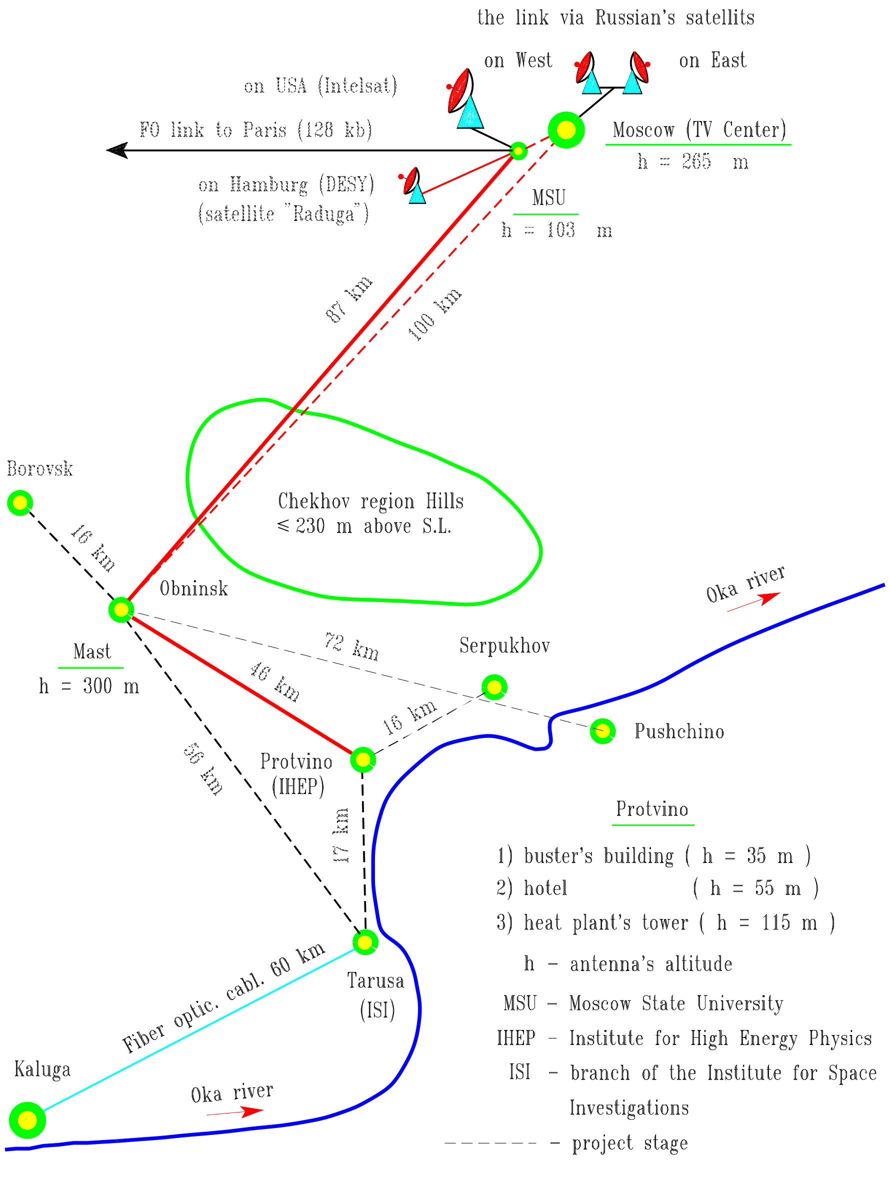

Fig.1 Radio relay network for Protvino (IHEP)

distance of 5 km, and a data rate of up to 140 Mbits/s was attained. It is important to note that the simplicity and speed of realization of the installation of RRL are attractive compared with other connection modes. We suggest this approach as a possible alternative to more conventional ones.

V. Development

We will continuously carry out work on growth of channel capacity of the high-speed channel connecting Protvino - Obninsk - Moscow (MSU) from 2 up to 8 and eventually to 16 channels at 2.048 Mbits/s. The application of radio-relay methods of communication for the purposes of a data gathering and control on the accelerator complex is in a stage of active research.

VI. Conclusion

Our experience here allows us to state that RRL-based methods provide a useful supplement to other communication techniques. This combination permits an inexpensive and fast realization of networking projects for extended plants such as accelerator complexes.

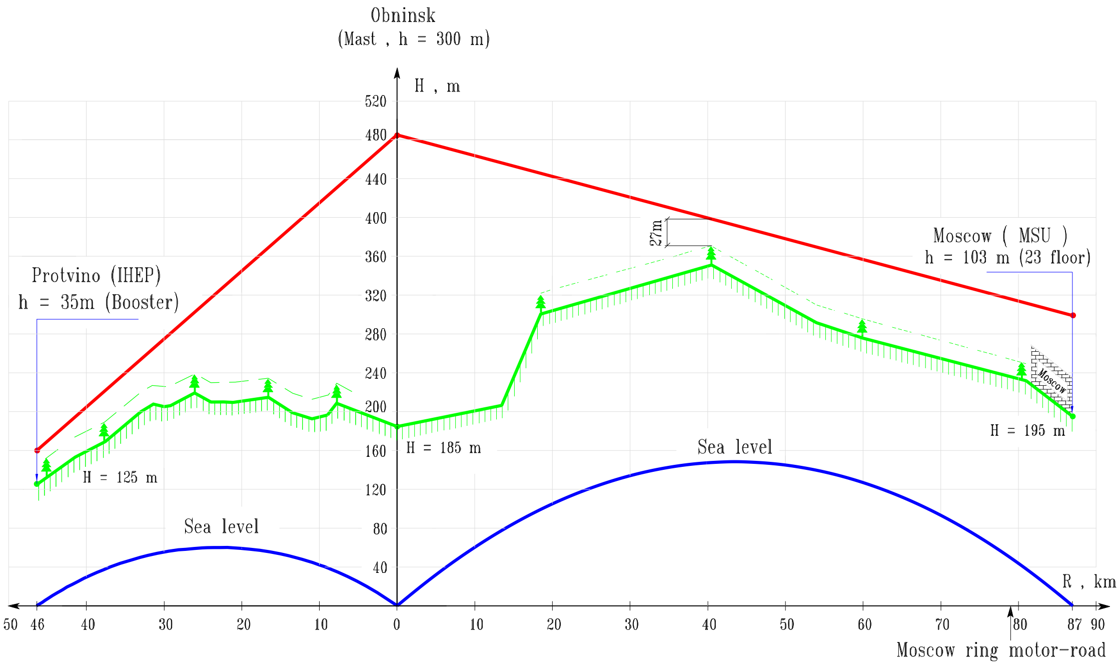

Fig. 2 The profile of trace Protvino (IHEP) – Moscow (MSU)

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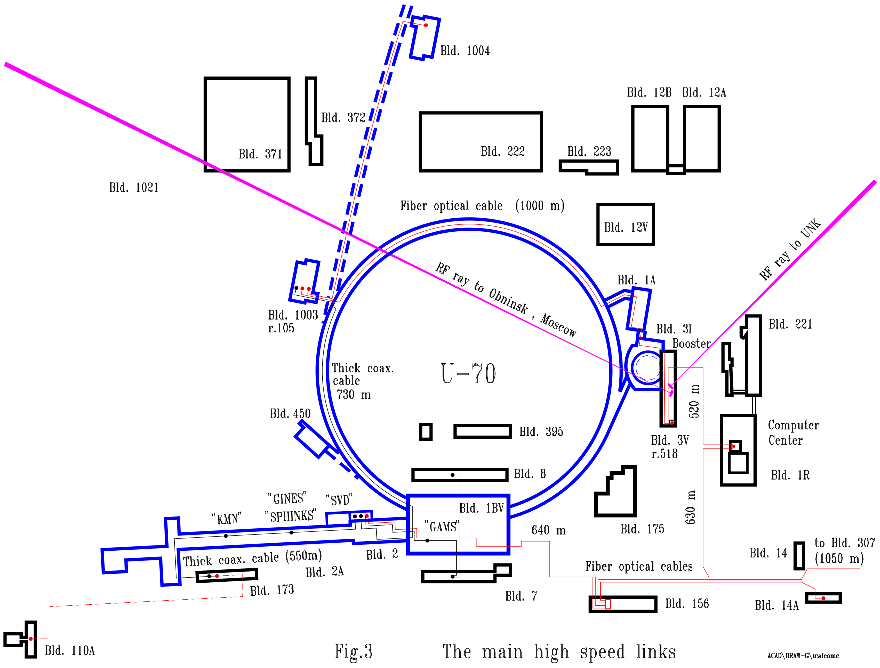

Fig.3 The main high speed links