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AVAILABILITY FACTOR OF THE ATMOSPHERIC COMMUNICATION CHANNEL

Abstract. The present work is devoted to the concept of the availability factor of an atmospheric channel when meeting the corresponding requirements for choosing a route for atmospheric optical communication systems, where the values of the integral distribution function of average kilometer fading at the boundaries of the region are met.

Keywords: atmospheric channel, readiness factor, damping, interval length, probability

Each geographical region has its own characteristics of climatic conditions, therefore, the integral distribution function of kilometer attenuation (IDF_{KA}) for each atmospheric channel will be individual. The characteristics of the atmospheric channel are influenced by the type of terrain through which the optical channel passes (in open or closed areas, in a ravine or on a hill, etc.). However, these differences are insignificant and it is believed that within the area the average values of IDF_{KA} will not lead to a significant difference in the availability of the atmospheric channel ($K_{A\text{-}AC}$), provided that the relevant requirements are met when choosing a path for atmospheric optical communication systems.

To more accurately determine the readiness of the KG-AK atmospheric channel, you can first use the averaged value of the integral distribution function of the kilometer attenuation for a given geographical region. Using a large set of measured cumulative distribution function - meteorological visibility range, the errors that exist when choosing the averaged cumulative distribution function - meteorological visibility range are determined [1].

Atmospheric optical communication systems mainly operate in transparency windows corresponding to the range of 0.785 μm, therefore, based on the integral distribution function - meteorological visibility range 0.55, it is necessary to calculate the integral distribution function - meteorological visibility range 0.55 for the operating wavelength of atmospheric optical communication systems.

The effectiveness of the introduction of atmospheric optical communication systems on access networks in the Republic of Uzbekistan is possible if there is a unified point of view on this problem among operators and equipment manufacturers. The telecom operator operates with external parameters of atmospheric optical communication systems, this is the maximum interval length, availability factor ($K_{A\text{-}AC}$), the speed at which information is transmitted and the reliability provided, and the manufacturer provides the declared parameters of atmospheric optical communication systems equipment. In this case, a designer is needed, who must also act as the customer of the equipment with the given parameters. To determine the external parameters of atmospheric optical communication systems in which the operator is interested, the designer needs an appropriate calculation method.

Significant assistance in the design will be provided if all the equipment of atmospheric optical communication systems is classified into classes according to its internal parameters and capabilities. The classification of specific equipment atmospheric optical communication systems is carried out according to the value of some generalized parameter (energy resource-A), which should be determined. Then, in accordance with the value of this parameter, it is assigned to the corresponding class of equipment, with the maximum allowable length of the atmospheric channel for a specific geographical region, with the fulfillment of the standard $K_{A\text{-}AC}$ availability factor.

Availability factor (AF) - the probability that the object will be in working condition at an arbitrary point in time during the period of normal operation. It simultaneously characterizes two different properties of an object: reliability and maintainability.

There are cases when telecom operators indicate a percentage characterizing the operability of communication channels, for example, four nines - 99.99, or 0.9999.

Calculated as follows: Minutes per year: 365*24*60=525600

Minutes of downtime per year due to the operator: x Availability in %:

(525600 - x)/525600 * 100%

For example, if downtime was 1 hour per year, then we have a percentage of readiness (525600 - 60) / 525600 * 100% = 99.98%

B indicates the requirements for the availability factor for data transmission networks - 0.99. Here, 100% is not multiplied [2].

Table 1

№	Telecommunication network type	Name of indicator	Norm
1.	Intercity and international telephone communication network	Availability factor	at least 0,999
2.	Area telephone network	Availability factor	at least 0,9995
3.	Local telephone network	Availability factor	at least 0,9999
4.	Telegraph communication network and Telex network	Availability factor	at least 0,9999
5.	Data network	Availability factor	at least 0,99

The introduction of atmospheric optical communication systems in local telecommunication networks requires solving the problem of determining the availability factor of the atmospheric channel. In this regard, additional measures were taken to solve this problem [3]. In particular, the entire S_{MVR} interval was divided into a number of intermediate distances for ease of classification and is shown in Table 2.

Table 2

Weather conditions at various S_{MVR} and λ=0.55 μm

№	Weather	S_{MVR} (Km)	$\beta_{0,55}$ (dB/Km)
1	Clear	$10 \div 20$	$0,65 \div 1,3$
2	light haze	$4 \div 10$	$1,3 \div 3,3$
3	Haze	$2 \div 4$	$3,3 \div 6,5$
4	rare mist	$1 \div 2$	$6,5 \div 13$
5	Light fog	$0,5 \div 1$	$13 \div 26$
б	Medium fog	$0,2 \div 0,5$	$26 \div 65$
7	thick fog	$0,1 \div 0,2$	$65 \div 130$
8	dense fog	$0,05 \div 0,1$	$130 \div 260$
9	heavy fog	$0,02 \div 0,05$	$260 \div 650$

Максимально допустимое затухание, которое возможно при переходе с λ=0,55 мкм на другую длину волны вычисляется по следующей формуле:

The maximum allowable attenuation that is possible when switching from λ=0.55 μm to another wavelength is calculated using the following formula:

$$\text{max.all.}_{\lambda \neq 0,55} = \text{max.all.}\beta_{0,55} \times \left(\frac{\lambda \neq 0,55}{0,55} \right)^{-q(S_{МДВ})}.$$

As practice shows, for the above selected intervals it is difficult to provide the required atmospheric channel availability factor ($K_{A\text{-}AC}$) and therefore it becomes necessary to provide for the possibility of redundancy, for example, by a radio channel in the millimeter range. In connection with the foregoing, we will divide the entire operating range of lengths into smaller distances for trouble-free operation of atmospheric optical communication systems.

If the reservation of the optical channel is provided, then the availability factor is determined based on how much time the transmission was carried out on the backup channel. In the absence of such, it will be determined from the threshold value of the BER parameter (percentage of erroneous bits received during data transmission), when it exceeds the allowable rate and the data transmission will be stopped.

References:

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