Tutorial 4

In this tutorial we do some calculations of the expected number of hard disk read failures (URE, unrecoverable read error) during RAID 5 array rebuilds. Basically if an URE happens, the hard disk gives out an error saying that it can not read a particular data item stored on the hard disk. This in turn will result in a rebuild failure of the RAID 5 array.

In the following, assume URE failures form a Bernoulli process (a discrete time analogy to the continuous time Poisson process), i.e., they are independent for each read bit of data.

1. When using consumer hard disks in RAID 5 configuration, compute the expected number of URE errors during RAID 5 array rebuild. Use the typical consumer URE rate of 1 bit error per 10^{15} bits read.

   Assume the RAID 5 arrays are full of data and consist of the following amounts of storage space:

   a) 4 TB
   b) 16 TB
   c) 64 TB
   d) 256 TB
   e) 1024 TB

   Hint: The RAID 5 rebuild reads in as much data as the storage array has storage space.

2. When using enterprise hard disks in RAID 5 configuration, compute the expected number of URE errors during RAID 5 array rebuild. Use the typical enterprise URE rate of 1 bit error per 10^{16} bits read.

   Assume the RAID 5 arrays are full of data and consist of the following amounts of storage space:

   a) 4 TB
   b) 16 TB
   c) 64 TB
   d) 256 TB
   e) 1024 TB

   Hint: The RAID 5 rebuild reads in as much data as the storage array has storage space.