Claims

1. A system for storing data in a distributed storage network comprising:

a processing unit having instructions executable by said processing unit to:

receive said data to be stored;

determine a code rate, *R*, and a block size, *n* based on a data size of said data to be stored and a Quality of Service (QoS) parameters~~;~~ comprising:

read said data size;

determine said Quality of Service (QoS) parameters;

determine a range of code rates and block sizes using said QoS parameters and said data size;

determine at least one of the following information: a transmission overhead, Input/Output (I/O) constraints, internal load, and spatial overhead;

compute a system performance matrix using any one or combination of said determined information; and

determine said code rate and block size using said system performance matrix;

divide said data into *k* segments based on said determined code rate and block size;

generate an erasure code with said code rate R and said block size n;

encode *k* segments of said data using said generated erasure code;

generate redundant segments by encoding segments of *k* segments; and

store said redundant segments and said encoded *k* segments in said distributed storage network, wherein said code rate *R,* block size, *n,* and *k* are expressed in the following expression *R=k/n.*

~~2. The system according to claim 1 wherein said instructions to determining said code rate and block size comprises instructions to:~~

~~read said data size~~

~~determine said Quality of Service (QoS) parameters;~~

~~determine a range of code rates and block sizes using said QoS parameters and~~

~~said data size;~~

~~compute said code rate and block size.~~

23. The system according to claim 12 wherein said QoS parameters is availability rate being expressed as follows:

$$A_{ldpc}(k,n) = \sum_{i=\lfloor fk \rfloor+1}^{n} \binom{n}{i} \epsilon^i (1-\epsilon)^{n-i}$$

wherein said availability rate for a single node is ϵ, f is an overhead factor, and said erasure code is Low Density Parity Check (LDPC) code.

34. The system according to claim 12 wherein said QoS parameters is latency being expressed as follows:

$$T_L(k) = t_a \frac{F_Size}{k}$$

Where t_a represents the average transmission time/bit, and *F_Size* is said data size.

~~5. The system according to claim 2 wherein said instructions to compute said code rate and block size comprises instructions to:~~

~~determine at least one of the following information: a transmission overhead, Input/Output (I/O) constraints, internal load, and spatial overhead;~~

~~compute a system performance matrix using any one or combination of said determined information; and~~

~~determine said code rate and block size using said system performance matrix.~~

46. The system according to claim 15, wherein said instruction to compute said system performance matrix using any one or combination of said determined information comprises instructions to:

compute said I/O constraints, T_o;

compute said internal load, I_o;

compute said spatial overhead, S_o;

apply a transformation, *f*, to compute said system performance metrics.

57. The system according to claim 46 wherein said code rate and block size are determined using said system performance matrix in the following expression:

$$\{\hat{k}, \hat{R}\} = min\, SPM(k, R) = \min f(T_o, I_o, S_o).$$

68. The system according to claim 46 wherein said a transformation, *f*, is linear.

79. The system according to claim 46 wherein said a transformation, *f*, is non-linear.

810. The system according to claim 46 wherein said I/O constraints is a measure of limit of number of connections said storage system can handle and is determined using the following expression:

$$T_o(t, k) = \frac{I(t)k}{i_{Total}}$$

wherein T_o is an average overhead increased by a single segment, *t* is a time-varying coefficient that introduces a time-varying weighting effect for determining an impact of an increase of the connection number.

911. The system according to claim 46 wherein said internal load includes overhead to transmit, process segment reports and metadata overhead.

102. The system according to claim 911 wherein said internal load caused by a memory required to store said metadata which contains the mapping between the blocks and their physical locations is determined using the following expression:

$$I_o(t,k,R) = \frac{L(t)S_{Size}n}{L_{Total}} + \frac{M(t)n}{M_{Total}}$$

and said internal load caused by a processing power required to process said segment reports is determined using the following expression:

$$I_o(t,k,R) = \left(\frac{L(t)S_{Size}}{L_{Total}} + \frac{M(t)m_o}{M_{Total}}\right)k/R$$

wherein S_{Size} represents the size for a segment report and m_o represents average internal load introduced by a single segment.

113. The system according to claim 46 wherein said spatial overhead is determined using the following expression:

$$S_o(R, F_Size) = F(t)\frac{Sr(R,F_Size_)-F_Size}{S_{Total}} = F(t)\frac{F_Size(1-R)}{S_{Total}R} \quad (5)$$

wherein S_{Total} represents a total storage capacity of said storage system, $F(t)$ represents a percentage of said storage system already in used and *F_Size* is said data size.

124. A method for storing data in a distributed storage network comprising

receiving data to be stored;

determining a code rate, *R*, and a block size, *n* based on a data size of said data to be stored and a Quality of Service (QoS) parameters comprising:

reading said data size;

determining said Quality of Service (QoS) parameters;

determining a range of code rates and block sizes using said QoS parameters and said data size;

determining at least one of the following information: a transmission overhead, Input/Output (I/O) constraints, internal load, and spatial overhead;

computing a system performance matrix using one or combination of said determined information; and

determining said code rate and block size using said system performance matrix;

dividing said data into *k* segments based on said determined code rate and block size;

generating an erasure code with said code rate R and said block size n;

encoding *k* segments of said data based on said generated erasure code;

generating redundant segments by encoding segments of *k* segments; and

transmitting said redundant segments and said encoded *k* segments to said distributed storage network, wherein said code rate *R*, block size, *n*, and *k* are expressed in the following expression *R=k/n.*

~~15. The method according to claim 14 wherein said step of determining said code rate and block size comprises:~~

~~reading said data size~~

~~determining said Quality of Service (QoS) parameters;~~

~~determining a range of code rates and block sizes using said QoS parameters and said data size;~~

~~computing said code rate and block size.~~

136. The method according to claim 125 wherein said QoS parameters is availability rate being expressed as follows:

$$A_{ldpc}(k,n) = \sum_{i=\lfloor fk \rfloor+1}^{n} \binom{n}{i} \epsilon^i (1-\epsilon)^{n-i}$$

wherein said availability rate for a single node is ϵ, *f* is an overhead factor, and said erasure code is Low Density Parity Check (LDPC) code.

147. The method according to claim 125 wherein said QoS parameters is latency being expressed as follows:

$$T_L(k) = t_a \frac{F_Size}{k} \qquad (2)$$

Where t_a represents the average transmission time/bit, and *F_Size* is said data size.

~~18. The method according to claim 15 wherein said step for calculating said code rate and block size comprises:~~

~~determining at least one of the following information: a transmission overhead, Input/Output (I/O) constraints, internal load, and spatial overhead;~~

~~computing a system performance matrix using one or combination of said determined information; and~~

~~determining said code rate and block size using said system performance matrix.~~

15~~9~~. The method according to claim 12~~8~~, wherein said step of computing said system performance matrix using any one or combination of said determined information comprises:

computing said I/O constraints, T_o;

computing said internal load, I_o;

computing said spatial overhead, S_o;

applying a transformation, *f*, to compute said system performance metrics.

16~~20~~. The system according to claim 15~~9~~ wherein said code rate and block size are determined using said system performance matrix in the following expression:

$$\{\hat{k}, \hat{R}\} = min\, SPM(k, R) = \min f(T_o, I_o, S_o).$$

17~~21~~. The system according to claim 15~~9~~ wherein said a transformation, *f*, is linear.

18~~22~~. The system according to claim 15~~9~~ wherein said a transformation, *f*, is non-linear.

19~~23~~. The method according to claim 12~~8~~ wherein said I/O constraints is a measure of limit of number of connections said storage system can handle and is determined using the following expression:

$$T_o(t,k) = \frac{I(t)k}{i_{Total}} \qquad (3)$$

wherein T_o is an average overhead increased by a single segment, t is a time-varying coefficient that introduces a time-varying weighting effect for determining an impact of an increase of the connection number.

204. The method according to claim 128 wherein said internal load includes overhead to transmit, process segment reports and metadata overhead.

215. The method according to claim 204 wherein said internal load caused by a memory required to store the metadata which contains the mapping between the blocks and their physical locations is determined using the following expression:

$$I_o(t,k,R) = \frac{L(t)S_{Size}n}{L_{Total}} + \frac{M(t)n}{M_{Total}}$$

and said internal load caused by a processing power required to process said segment reports is determined using the following expression:

$$I_o(t,k,R) = \left(\frac{L(t)S_{Size}}{L_{Total}} + \frac{M(t)m_o}{M_{Total}}\right)k/R$$

wherein S_{Size} represents the size for a segment report and m_o represents average internal load introduced by a single segment.

226. The method according to claim 128 wherein said spatial overhead is determined using the following expression:

$$S_o(R, F_Size) = F(t)\frac{Sr(R,F_Size_)-F_Size}{S_{Total}} = F(t)\frac{F_Size(1-R)}{S_{Total}R} \qquad (5)$$

wherein S_{Total} represents a total storage capacity of said storage system, $F(t)$

represents a percentage of said storage system already in used and *F_Size* is said data size.

~~27. A method for determining a system performance of a cloud storage system or a distributed storage system between a set of code rate, *R*, and a set of block size, *n*, comprising:~~

~~computing an Input/Output (I/O) constraints, T;~~

~~computing an internal load, I;~~

~~computing a spatial overhead, S; and~~

~~applying a transform, f, to form a performance metrics to determine said system performance.~~

~~28. The method according to claim 27, wherein said performance matrix is determined in the following expression:~~

$$\{\hat{k}, \hat{R}\} = min\ SPM(k, R) = \min f(T_o, I_o, S_o)$$

~~wherein *R=k/n*.~~

~~29. The system according to claim 27 wherein said a transformation, *f*, is linear.~~

~~30. The system according to claim 27 wherein said a transformation, *f*, is non-linear.~~

~~31. The method according to claim 27 wherein said I/O constraints is a measure of limit of number of connections said cloud storage system or said distributed storage system can handle and is determined using the following expression:~~

$$T_o(t, k) = \frac{I(t)k}{i_{Total}} \quad (3)$$

~~wherein T_o is an average overhead increased by a single segment, *t* is a time-varying coefficient that introduces a time-varying weighting effect for determining an impact of an increase of the connection number.~~

32. The method according to claim 27 wherein said internal load caused by a memory required to store the metadata which contains the mapping between the blocks and their physical locations is determined using the following expression:

$$I_o(t,k,R) = \frac{L(t)S_{size}n}{L_{Total}} + \frac{M(t)n}{M_{Total}}$$

and said internal load caused by a processing power required to process said segment reports is determined using the following expression:

$$I_o(t,k,R) = \left(\frac{L(t)S_{Size}}{L_{Total}} + \frac{M(t)m_o}{M_{Total}}\right)k/R$$

wherein S_{Size} represents the size for a segment report and m_o represents average internal load introduced by a single segment.

33. The method according to claim 27 wherein said spatial overhead is determined using the following expression:

$$S_o(R,F_Size) = F(t)\frac{Sr(R,F_Size_)-F_Size}{S_{Total}} = F(t)\frac{F_Size(1-R)}{S_{Total}R} \quad (5)$$

wherein S_{Total} represents a total storage capacity of said cloud storage system or said distributed storage system, $F(t)$ represents a percentage of said cloud storage system or said distributed storage system already in used and *F_Size* is a data size of data to be transferred to said cloud storage system or said distributed storage system.