Criteria for a Storage Concept in a P2P Archival System

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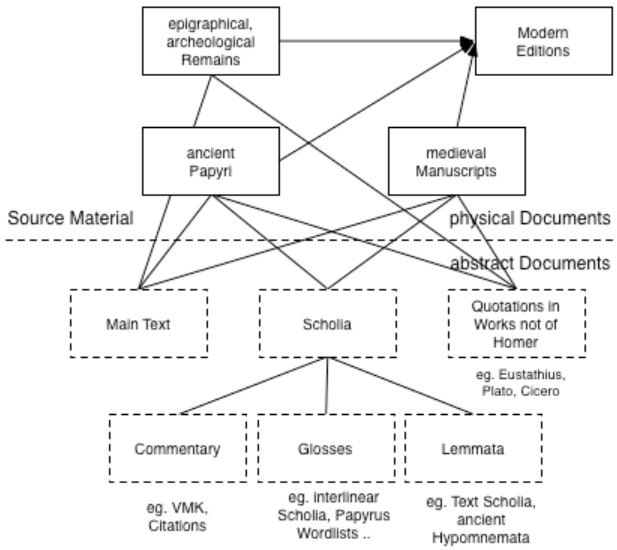
1. Introduction

The history of tradition of historical source materials shows a wide range of paths preserved information has undergone to arrive in present time.
In the first part the various possibilities of preserving information on the basis of the tradition of Homer's Iliad are demonstrated. According to the results the second part defines a storage concept for an archival storage (OAIS) being built by a distributed system. By implementing this concept a good chance of successful archiving could be achieved.
The remarks at hand are focused on the continuing definition of the Distarnet protocol [1] and present new results of its implementation studies. Even though the elaborated criteria could be used for any kind of an archival storage.

2. Homer's Iliad

Which parts of the ancient Greek epic poem exactly are the work of one author, Homer, or have been compiled by various other characters will likely remain a secret to history. Even if Homer was the first man to write down the epic story and by this the first to start the written tradition, this first written representation of the Iliad is not preserved from ancient times. What we nowadays now as the Iliad is a version compiled from various fragments and other compilations, which again are based on other (partly) lost fragments or compilations. The original words are misty and remain subject to many present and future studies [e.g. 2]:
The oldest documents from the past are ancient papyri, epigraphical and archaeological remains [3]: Various quotations in epigraphical works of other ancient authors provide traces to the 'original' Iliad. The papyri mainly contain smaller text fragments, but also scholarly commentaries, abstracts and lists of words providing newer and more common translations of older terms used in the poem. From the middle ages many manuscripts have survived. Mainly the 10th centuries Codex Venetus A is a vast source of information: It combines a text version with lots of scholia, providing commentaries, glosses and lemmata from the past. Medieval scholia often give clues to many other now lost manuscripts. All these sometimes preserved, sometimes lost source materials have expanded into modern editions starting with the editio princeps in 1488 by Demetrios Chalkondyles in Florence. The following figure enlightens the connections of various pieces of information and material preserved from the past:



It can easily be seen that the tradition of this work depends upon various circumstances: Text versions on physical representations have been copied or included in other works unnumbered times. As a consequence comparisons between different sources can be undertaken, which render the reconstruction of the original work more probable. Additionally all these documents have been kept in various distant places. The continuous and repeating use of the work through times may have supported such copying. In terms of digital preservation these documents were migrated and often accessed. Wordlists and commentaries preserved additional information. They now offer many possible backwards deductions to the original work. In terms of digital preservation wordlists and commentaries embody metadata.

3. Criteria for peer-to-peer archival storage

A peer-to-peer storage like Distarnet offers different storage places on nodes of its network. The main concept of Distarnet is to define a redundancy for every data container and its metadata stored [4]. This redundancy gets controlled regularly and remains stable: If a data container is lost or its storage media is replaced, the

container gets restored on another node or on the new media to re-establish the defined redundancy.
To establish and balance the distribution of the redundancy for a data container, Distarnet needs to evaluate storage places according to various criteria. Every evaluated node scores points in every criterion. Additionally to points, all criteria have a weight. The total of points a node has scored is calculated as the sum of all multiplies of points by weight of each criterion. The criteria are:
Ingester: The ingester node of a data container in Distarnet is the node on which the data was ingested. If this node is live in the network, there must be a copy of the data on it at all times.
Geographical Location: The geographical location of a node is split into the Cartesian coordinates of latitude and longitude of the earth's geographic coordinate system. The best node is the one with the geographical location that shows the biggest distance to the geographical location of the ingester node. If the ingester node is not available anymore, the best node is one of the two nodes of the whole network having the biggest distance between them. The next best node is determined as the one holding the biggest sum of distances from his geographical location to all previously determined nodes. By recursively calculating next best nodes an order of storage nodes results, which ensures the widest possible geographical distribution of data containers in the network.
Space Ratio: The space ratio is the proportion of free space to total storage space of a node. To distribute data containers regularly and to not overload one node, a space ratio of 0.75 is considered as the minimal value: If a node shows a space ratio higher than 0.75 it is considered as a worse storage place than nodes with a space ratio under 0.75. As such a node with no containers stored yet and thus free total storage is considered as the most attractive storage node for containers.
Uptime: Uptime describes the milliseconds a node is running since his last restart. The evaluating node stores all uptimes he gets from distant nodes and calculates the arithmetic average for every node. The bigger the average the longer a node usually stays up and offers access to its data. The best node results as the one with the highest average uptime.
Speed: Speed describes the connection speed of a node to the network. Since access is one of the most important criteria to ensure the tradition of data, the time matters that passes until data of a node is retrieved.

4. Conclusion

The analysis of the tradition of Homer's Iliad shows basically three different criteria that make a successful preservation more probable: geographical distribution, continuous reuse and citations in other works. These are considered by the Distarnet protocol as follows:
The geographical distribution of data is achieved by evaluating the most widely spread distribution of storage places.
The continuous and repeating use of the data cannot be implemented by an archival storage, but its access can be supported: Therefore the Distarnet protocol considers the ingester node, speed and uptime as criteria for a storage place having a strong influence on access of the data. The ingester is most likely an entity, which will be again interested in its data. Thus it is considered as the most important or the absolute criteria. The weights of all other criteria are subject to the ongoing research.
Citation and commentaries in other works can be seen as metadata about the original work. The tradition of Homer's Iliad shows its importance to the preservation of the original information. So far the Distarnet protocol defines metadata, as it is common these days, as having to be stored right next to its data. Under the present results this assumption has to be reconsidered. Instead it could be argued that it is more probable to lose all information if data and metadata are stored in the same place, as it would be, if metadata was geographically reciprocal stored to its data.

5. Literature

[1] http://www.distarnet.ch
[2] http://www.stoa.org/chs/
[3] West, Martin L. Geschichte des Textes. In: Homers Ilias, Gesamtkommentar. Ed. Joachim Latacz. Prolegomena. München, Leipzig 2002. p. 27-38.
[4] Subotic, Ivan. Margulies, Simon. Rosenthaler, Lukas. Distarnet: Distributed Archival Network. In Conference Proceedings of Archiving 2006, Ottawa CA, May 23, 2006. p. 131-134.

6. Authors

Simon Margulies studied History and Computer Sciences at the University of Zurich. He is working on his Ph.D. in History in the field of archiving digital data. Together with Ivan Subotic he develops Distarnet, a DISTributed ARchival Network.