Mobile Peer-to-Peer Systems

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Peer-to-peer systems are gaining increasing popularity as a scalable means to share data among a large number of autonomous nodes. Since the shared data are unstructured and they do not follow a global schema, XML-based descriptions of the data can be used to provide a uniform way to query the heterogeneous data. In our research, we are interested in designing a fully decentralized approach for the problem of efficiently routing path queries among the nodes of a peer-to-peer system. Our approach is based on (a) selecting and maintaining specialized data structures, called filters that efficiently summarize the content, i.e., the documents, of one or more node and (b) using these filters to build an overlay network that groups together nodes with similar content. Our proposed filters for XML documents, called multi-level Bloom filters [1], are based on extending Bloom filters so that they maintain information about the structure of the documents that they summarize. The filters can summarize a large number of documents with a small space overhead while maintaining a low false positive probability. Furthermore, multi-level Bloom filters are used for building a hierarchical organization of nodes by clustering together nodes with similar content [2]. Similarity between nodes is related to the similarity between the corresponding filters and the experimental results demonstrate that the system's recall is significantly increased. In mobile peer-to-peer systems where the nodes have different stability properties and different processing and storage capabilities a hierarchical organization is very suitable. Non-mobile "strong" nodes can be placed at the upper levels of the hierarchies and thus acquire more responsibilities while mobile weaker nodes can be accommodated at the lower levels with only few responsibilities. Furthermore, s proximity-based approach can be used to group nodes according to their geographical proximity. A new node that joins the system chooses to attach to its "closest" neighbor in terms of geographical proximity. This way, searches are first targeted within its local hierarchy and only if they fail they are directed to other hierarchies whose nodes are located further away. In addition, a proximity-based hierarchical organization is more efficient in the updates propagation. The updates have to be propagated only locally within a hierarchy while the other hierarchies remain unaffected.

References

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2. Koloniari, G., Pitoura, E.: Content-based routing of path queries in peer-to-peer systems. (In: EDBT 2004)

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