Poster: Localized Content for Village Schools

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1. INTRODUCTION

Studies on global Internet connectivity report that only 40% of the world population has access to the Internet [1]. While Internet connectivity has the potential to provide numerous educational opportunities, there is often a lack of educational content that is relevant with respect to the culture and language of those attending schools in largely disconnected communities. Inspired by the problem of sharing relevant educational content within and between schools, we extend VillageShare to facilitate content sharing between village schools that are networked together via low-bandwidth wireless links. Originally designed to localize social media content in a single community [2], the extended version of VillageShare operates across multiple sites to ensure that relevant educational content is 1) highly available to local users and 2) made globally available using a robust synchronization protocol. This design enables village teachers and students to create regional repositories of relevant digital curricula that are accessible even during network failures and outages.

2. SYSTEM OVERVIEW

The VillageShare system consists of a logical core (ownCloud Server), a social networking layer (Friends Application), a multi-server support layer (MultiInstance Application), synchronization directories, and a MySQL database that stores user information and user content information. VillageShare servers act as local content repositories that are fully functional during times of disconnection. VillageShare servers are networked together by long-distance wireless links or over the Internet. When VillageShare servers are connected, servers located near a high-bandwidth Internet link act as coordinators between VillageShare servers placed in resource-poor environments. A subset of the VillageShare database tables are synchronized between remote VillageShare servers and a central server. There is a tradeoff between robustness to equipment failure and minimizing bandwidth requirements. Equipment failure is a documented challenge of deploying technical systems in rural developing contexts [3]. Likewise, limited bandwidth capacity is another significant challenge for these systems. Thus, creating full backups of all content and all database tables hosted by a rural VillageShare server would be inconceivable due to the bandwidth requirements. We address this tradeoff by providing a backup of database tables required for content maintenance and sharing. Even though ownCloud provides database tables for maintaining app configuration, file versioning, deleted files, and system preferences, only user profiles, friendships, file metadata, and file contents are backed up at the central VillageShare server. This is done by storing data for remote backup in queued database tables. When it is time for synchronization, files are synchronized between remote synchronization directories using the Unix rsync utility[1]. Remote servers only maintain a single directory that corresponds with the central server through which they coordinate. Central servers maintain synchronization directories for each remote server they coordinate. Feasibility tests with laboratory evaluations of this synchronization process demonstrate that the latency of file synchronization for a single gigabyte file is less than 22 minutes for a link experiencing a bursty loss rate of 10% and a link latency of 3 seconds. Synchronization of a single gigabyte file scales linearly for link latencies up to 2 seconds. We are currently working with CSIR to deploy VillageShare in local South African schools.

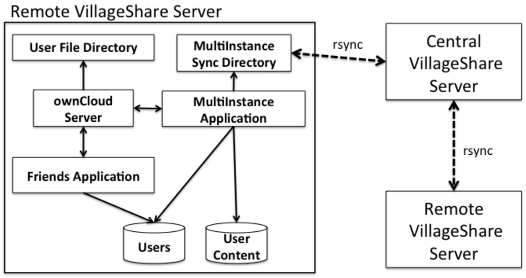
Remote VillageShare Server
User File Directory
MultiInstance Sync Directory
ownCloud Server
MultiInstance Application
Friends Application
Users
User Content
rsync
Central VillageShare Server
rsync
Remote VillageShare Server

Figure 1: Overview of VillageShare components.

3. REFERENCES

[1] International Telecommunications Union, "The World in 2014," `http://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2014-e.pdf`, November 2014.

[2] David L Johnson, Veljko Pejovic, Elizabeth M Belding, and Gertjan van Stam, "VillageShare: Facilitating Content Generation and Sharing in Rural Networks," in *Proceedings of the 2nd ACM Symposium on Computing for Development*, Atlanta, Georgia, USA, March 2012, pp. 61–70.

[3] E. Brewer, M. Demmer, M. Ho, R.J. Honicky, J. Pal, M. Plauche, and S. Surana, "The Challenges of Technology Research for Developing Regions," *Pervasive Computing, IEEE*, vol. 5, no. 2, pp. 15–23, April 2006.

[1] http://linux.die.net/man/1/rsync

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