

# Google services are not necessarily the answer for group communication among mobile users

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Recent trends are that resource rich laptops are ubiquitous and are becoming the primary computing platform for many users. USA today [2] described the emergence of about 30 million (American) nomadic users. Gartner Dataquest predicted a yearly growth of 10% of these users. Newer laptops are also boasting resources as high as 2.6 GHz dual core processors, 320 GB of storage, 4 GB of memory and 300 Mbps 802.11n wireless LANs.

Consider an university setting; student groups work on academic and social projects while groups of students and faculty collaborate on course and research projects. These collaborations are enhanced by using rich media such as audio and video. For example, faculty members distribute audio and video of the lecture material [1] to students while student groups work on a group report. Traditionally wireless laptops relied on services provided by the wired infrastructure. Either the university provided the shared storage space or the users used services such as Google Docs<sup>1</sup> to share contents. However, even though raw storage is inexpensive, it is expensive for the university to provide large amounts of managed storage. Even though services such as Google Docs are *free*, the users might express privacy concerns. Besides, using Internet storage could require the university to upgrade its Internet capacity, a potentially expensive proposition. Laptops rarely shared and utilized the resources available among other laptops even though the potential for large amounts of unmanaged storage is high. In our campus, we observed about 12,500 active mobile devices. Even if each laptop volunteered 10 GB of shared storage, the aggregate storage can be quite large (over 100 TB). Hence, we investigated the behavior of collaborations systems built among wireless users in a campus environment.

We based our analysis on the empirical availability patterns of a large number of wireless users in two universities. We focus on two different kinds of group communications. In direct delivery systems, shared contents were directly served by the providers (or their replicas); clients are not required to maintain a local copy. Applications such as Apple iTunes follow this sharing model. Instructor can distribute their lectures using this model. Our analysis [4] showed that laptop users require a large number of replicas to service contents to members of the class or to Internet users. Depending on the time of day,

even replication rates as high as 25 copies achieved object availability of only between 80% and 95%. Clearly, infrastructure based services such a Google services are preferable for direct delivery systems.

When user availability is poor, epidemic algorithms [3] were preferred to asynchronously propagate shared contents to other group members; each group member maintains a copy of all the shared contents. Our analysis showed that typical campus wireless users exhibited poor availability. Hence, we analyzed [5] the epidemic propagation rates among a random group of campus users. Our analysis showed that the epidemic propagations rates were poor; reaching 50% of the group in a day without reaching all the participants even after eleven days. Interestingly, these rates were not significantly improved even with the use of a centralized storage to hold the updates; the fundamental limitation was the availability of certain group members. This meant that using a centralized service such as Google need not improve the time it takes to propagate the updates to all the group members.

Conventional wisdom suggests that Google Docs would obviate the need for a system that relied on shared storage among wireless laptops. Our analysis showed that the system behavior was limited by the availability of the wireless laptops; Google Docs is not always the answer for creating shared storage space<sup>2</sup>. System performance can be improved by developing incentive mechanisms to increase the user availability durations and not necessarily by using centralized storage services.

## References

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<sup>1</sup>Google Docs currently only supports Word, Excel and Powerpoint documents and does not support audio or video contents

<sup>2</sup>we acknowledge that centralized services might offer other benefits such as better content control