

Infrastructures for Online Social Networking Services

Anwitaman Datta
Nanyang Technological University

Marios D. Dikaiakos
University of Cyprus

Seif Haridi
*Royal Institute
of Technology, Sweden*

Liviu Iftode
Rutgers University

The rapid proliferation of rich social media, online communities, and collectively produced knowledge resources has accelerated the convergence of technological and social networks, resulting in a dynamic ecosystem of online social networking services, environments, and applications. Online social networks (OSNs) represent one of the most popular application categories on the Web, attracting a massive user base that claims more than two thirds of the world's Internet population. OSNs such as Facebook, LinkedIn, Google+, and Twitter provide computer-mediated support for those wanting to establish social relations over the Internet, and promote a vision of a more personalized Web in which our network of friends, colleagues, peers, and family becomes our primary source of information, just as it is offline.

The OSN Explosion

Major OSNs have opened their APIs to developers, leading to applications that leverage the underlying social graph to support new ways of social interaction

and are taken up by millions of users through viral distribution. According to recent reports, online social networking accounts for almost 10 percent of all time spent on the Internet; together with blogs, OSN usage has overtaken email to become the fourth most popular online sector (http://blog.nielsen.com/nielsenwire/wp-content/uploads/2009/03/nielsen_globalfaces_mar09.pdf). Researchers believe that the impressive growth in the sheer volume of users, the diversity of applications run using OSNs as distribution platforms, and the wide range of new technologies underpinning OSN growth, offer strong evidence that OSNs' wide adoption will endure in the future.

OSNs' proliferation has also had a profound impact on the Internet, reshaping its structure, design, and utility. In fact, the online social networking industry aspires to become a second Internet, one that includes users' most personal data and resides entirely on social networking servers. So, OSNs are expected to become the largest source of personal data online,

the predominant driver of Web traffic, and a dominant power in Web advertising.¹ Industry experts believe that online social networking services potentially transform consumer behavior and will have far-reaching effects on traditional industries such as content, media, and communications, opening new pathways in social networking monetization.

However, despite the impressive success of OSNs, the research community must address significant challenges to enable further development of these services. Such challenges include the development, deployment, management, and operation of scalable, secure, and interoperable OSN infrastructures that can sustain continuous innovative application development, improved user experience, high-quality service provision, privacy protection, and a healthy market expansion.

In This Issue

Given the continued, intense activity in and the dynamic evolution of online social networking services, we invited researchers and practitioners to submit articles to this special issue that describe recent efforts and results in systems, software, and services that provide novel, ubiquitous, scalable, secure, and trustworthy OSN infrastructures. The three articles we selected expose only the proverbial tip of the iceberg.

In “The Social Hourglass: An Infrastructure for Socially Aware Applications and Services,” Adriana Iamnitchi, Jeremy Blackburn, and Nicolas Kourtellis envision an infrastructure that cumulates social signals from various services and sources for analysis and interpretation that can in turn enable value-added services and applications. Inspired by the Internet’s hourglass architecture – where a minimalistic primitive (IPv4) binds and supports diverse implementations, systems, and applications at the other networking layers – they set out to identify and propose a “social hourglass.” This architecture can capture and aggregate myriad social signals, interpret them, manage the corresponding data, and expose a set of social inference functions for other applications to build on. Their initial proposal is likely just a starting point rather than the ultimate shape a social hourglass will take. Note also that recent studies indicate an evolutionary aspect to the emergence of the Internet’s hourglass architecture.² Nonetheless, this article charts


the path for convergence in social networking applications.

“Disk Layout Techniques for Online Social Network Data,” by Imranul Hoque and Indranil Gupta, delves into the actual physical infrastructure that supports the rapidly increasing volume of social data managed by OSN service providers. They make an interesting case that existing storage technology has been optimized for workload characteristics that are much different from those encountered in managing social network data. Specifically, they argue that the disk layout must take into account the community structure in a social graph as well as read/write characteristics. Often, OSN service provision results in “write once/read frequently” workloads. To this end, the authors propose a new disk layout technique optimized for read latency. Their layout manager, Bondhu, is integrated with a popular graph database (Neo4j), and the authors demonstrate with experiments a significant performance improvement achieved through disk layout optimization.

The amount of social (network) data being created is exploding, and the first two articles look at how to manage and store this data and support complex analytics to increase its utility. Many benefits are possible – particularly in the form of personalized services for individuals. However, a genuine concern exists about individual privacy in OSNs. Likewise, recent events demonstrate that censorship is a global threat, affecting the free speech of people worldwide – this past year’s Arab Spring, for example, demonstrated why free speech is, in balance, a force for the good. Free speech and privacy advocates have thus been trying to realize online social networking in a decentralized environment, where no single service provider owns the data and communication channels (that it can then monitor or censor). In their article “HorNet: Microblogging for a Contributory Social Network,” Daniel Lázaro, Joan Manuel Marquès, Guillem Cabrera, Helena Rifà-Pous, and Albert Montané present a Twitter-like microblogging system that utilizes end users’ computing resources.

The articles in this issue showcase some of the important frontiers of systems research for realizing better OSN infrastructures, but

many other interesting aspects remain unexplored. For instance, while two of the articles examine OSN infrastructures' data acquisition, management, and storage aspects, the issue doesn't cover how one might mine information from such vast amounts of data or take into account the fast pace at which data accumulates and how the information to be inferred itself changes.

As a communication and interaction paradigm, online social networking is in its infancy. The enabling underlying infrastructure must evolve accordingly. An immediate step that we're already witnessing is a rapid convergence of mobile technology and the still-nascent and evolving cloud computing technologies with social networking applications. This is an interesting time not only for end users but also for the engineers and system designers of such infrastructures. This special issue provides only a small sample of the many things yet to come. 

References

1. G. Pallis, D. Zeinalipour-Yazti, and M.D. Dikaiakos, "Online Social Networks: Status and Trends," *New Directions in Web Data Management*, vol. 1, 2011, pp. 213–234.
2. S. Akhshabi and C. Dovrolis, "The Evolution of Layered Protocol Stacks Leads to an Hourglass-Shaped Architecture," *Proc. ACM SIGCOMM 2011 Conf.*, ACM Press, 2011, pp. 206–217.

Anwitaman Datta is an assistant professor in the School of Computer Engineering at Nanyang Technological University, Singapore, where he also leads the self-* and algorithmic aspects of the Networked Distributed Systems research group. His research interests include large-scale networked distributed information systems and social collaboration networks, self-organization and algorithmic issues of these systems and networks, and their scalability, resilience, and performance. Datta has a PhD in computer and communication sciences from École Polytechnique Fédérale de Lausanne, Switzerland. Contact him at anwitaman@ntu.edu.sg.

Marios D. Dikaiakos is chairman of the Computer Science Department at the University of Cyprus, Nicosia, Cyprus, where he also leads the Laboratory for Internet Computing. His research interests focus on large-scale network-centric systems, including grid and cloud computing infrastructures, vehicular computing, and software retrieval in distributed environments. Dikaiakos has a PhD in computer science from Princeton University. Contact him at mdd@cs.ucy.ac.cy.

Seif Haridi is a professor of computer systems at the Royal Institute of Technology, Sweden, and the chief scientist at the Swedish Institute of Computer Science, and leads the cloud computing research program at the European Institute of Innovation and Technology. His research interests are mainly in distributed computing and programming systems, with a focus on overlay networks, scalable cloud storage, P2P media distribution, and data-intensive computing frameworks. Contact him at haridi@kth.se.

Liviu Iftode is a professor in the Department of Computer Science at Rutgers University. His research interests include operating systems, distributed systems, networking and security issues in mobile and social media systems, and pervasive and vehicular computing. Iftode has a PhD in computer science from Princeton University. Contact him at iftode@cs.rutgers.edu.

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