Temporal Variations in Networked User Engagement

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Abstract. In the online industry, user engagement refers to the quality of the user experience and the desire to use a website regularly. Engagement can be measured through metrics aiming at assessing users' depth of interaction with a website, referred from now on as site. Widely-used metrics include click-through rates, dwell time, page views, return rates, number of unique users. Many large online providers, such as AOL, Google, MSN and Yahoo!, offer a *network* of sites, ranging from news to mail. Certainly the success of each site largely depends on itself, but also on how it can be reached from other sites. The standard approach to evaluate user engagement of a site is through engagement metrics calculated for the site. However, when assessing engagement within a network of sites, it is crucial to take into account the traffic between the sites. Our long-term goal is the development of a methodology to study user engagement within a network of sites, which we refer to as *networked user engagement*. We are proposing to model sites (the nodes) and user traffic between them (the edges) as a network, and to apply complex network analysis metrics in conjunction with engagement metrics to study networked user engagement.

This paper focuses on the temporal variations of networked user engagement. Using complex network analysis and engagement metrics, we characterise the networks, which we define at several time-based granularity levels: hourly, daily, weekly and monthly. Studying and comparing networks at such different granularities allow us to identify long-term and sudden variations in traffic between sites, including non-lasting fluctuations. Our objective is to identify whether temporal variations in the user traffic affect user engagement with the sites in the network. The networks are built from interaction data extracted from one year of browsing activity of 2.5M users across 770 sites encompassing diverse types of services such as social media, news and mail. The research questions we are attempting to address are:

1. Do the temporal variations in user traffic influence user engagement on sites in the network?
2. How do external sources (e.g. search or social media sites that are not part of the network) that experience a sudden burst in activity influence user engagement within the network?
3. Can we draw conclusions related to the long-term user engagement based on the temporal variations in the user traffic?