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Real-time Group Video Sharing tied with Online Social Networks

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Abstract: The exploding growth of OSNs (Online Social Networks) is a common trend in current mobile Internet era. In this paper, by linking the features of Facebook OSN and MOVi+ (Mobile Opportunistic Video-on-demand Plus) [1-3], we realize real-time P2P video sharing among mobile nodes. The realized prototype implementation clearly verifies the convenience and economic feasibility of OSN-initiated application development.

Keywords: Mobile P2P video streaming; WiFi direct; online social networks.

1. Introduction

Recently most application developers are realizing their services, without wasting their effort on reinventing the existing wheels, by chaining their own unique services with the group-information services provided by OSNs (Online Social Networks) [5, 6]. In other words, through the service chaining based on OSNs, the developers are efficiently generating new services in a speedy and economic manner. In this paper, echoing to this technical trend, we attempt to realize real-time group video sharing among multiple mobile nodes connected by Facebook OSN friendship. The real-time video sharing feature is utilizing MOVi+ (Mobile Opportunistic Video-on-demand Plus) [1-3] that coordinates the segment-based scheduling among participating mobile nodes. That is, the centralized MOVi+ Coordinator opportunistically schedules the segment-based real-time sharing of video contents among mobile nodes[1] of selected Facebook group. Note that, with Facebook, we can form a variety of different groups that connect selected friends of participating Facebook users.

[1] As of now, we only consider the users with WiFi-direct capable mobile nodes located in a localized area so that we can leverage the advantage of mobile P2P video sharing.

In Section II, we introduce the proposed service chaining along with the key operation principles behind MOVi+ service. Section III then presents the prototype implementation and functionality verification of the service chaining between Facebook OSN and MOVi+. Finally, in Section IV, we conclude this paper.

2. Realizing Group Play based on MOVi+

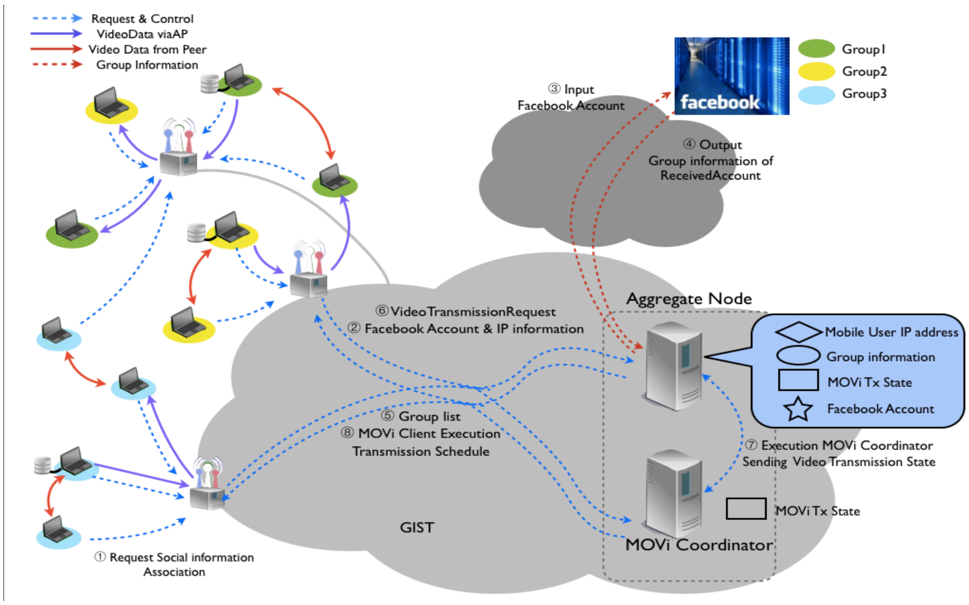

Figure 1. Real-time MOVi+ group video sharing tied with Facebook OSN.

Figure 1 outlines how we approach the service chaining of Facebook friendship service and MOVi+ real-time video sharing service. The majority of Facebook users actually use mobile smart devices, which provides a perfect match for MOVi+ deployment. Facebook also provides various types of APIs (e.g., Android, iOS, Web), with which we can easily construct the required grouping (in fact, the collection of user-ID / IP-address pairs) for MOVi+ real-time video sharing.

2.1 Grouping for Real-time Play Sharing

The grouping information plays the key role for this service chaining, since it provides the collection of unique user-ID / IP-address pairs. For this, we utilize the web version of Facebook APIs [4], since the MOVi+ prototype implementation is available only for Linux operating system. The detailed procedure for service chaining is as follows. The logical Aggregation node manages the grouping information by maintaining a directory-style repository for participating mobile nodes. For each mobile node, it keeps Facebook ID and IP address as well as the state link with MOVi+. It also provides each participating user the grouping UI (user interface) with listed names and pictures from Facebook friendship profile. By using this grouping UI, the leading mobile user selects (and invites) users they want to share a video content and all invited users are alerted to choose whether he or she will join the grouping. The resulting grouping information is then completed by collecting the above user-ID / IP-address pairs. This collection of grouping information plays the key medium to initiate the service chaining by launching the execution of MOVi+ services at all participating mobile nodes.

2.2. MOVi+ P2P-based Mobile VoD

As shown in Fig. 2, MOVi+ [3] employs several types of nodes such as content node, centralized coordinator, caching-enabled switch node, and mobile nodes. The content node, which is replaced by the leading mobile node in Fig. 1, owns the entire video segments and provides requested segments by using AP (access point) downlinks. The centralized coordinator schedules segment transports after identifying opportunity among all mobile nodes. This scheduling is adjusted based on periodically collected status, conveyed via the request messages from mobile nodes. The collected status includes how many segments are remained in a playback buffer and the list of neighboring mobile nodes qualified for P2P connections. When there exists multiple connection opportunity for a selected mobile node, this mobile node should exploit it intelligently. Note that, in order to check the existence of opportunity, the centralized coordinator checks whether the following two conditions are satisfied: 1) Both nodes are in IDLE and reachable status; 2) Content segment matches between the connected nodes. Note also that, in MOVi+, caching-enabled switch nodes are introduced as special nodes [3].

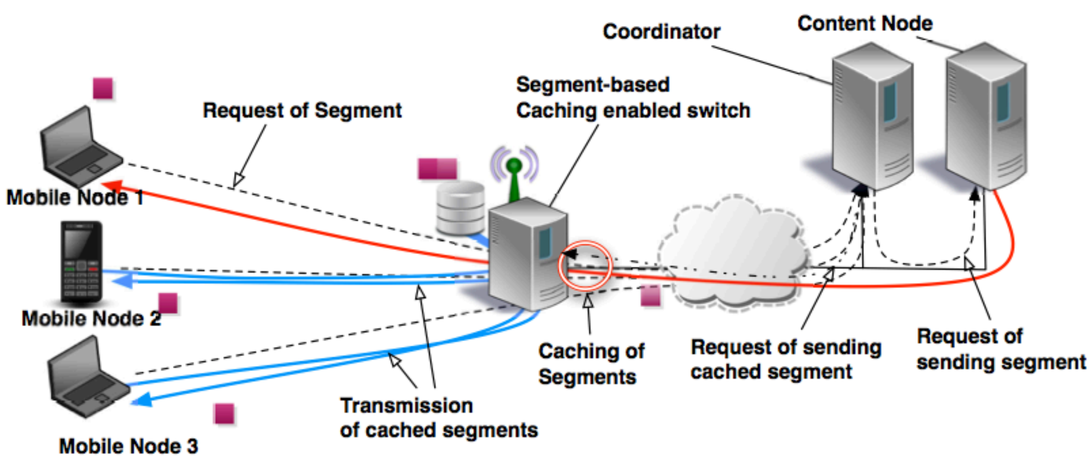

Figure 2. MOVi+ with pre-diffusion-aware scheduling [3].

2.3. MOVi+ Scheduler for More Direct Segment Transport

To promote the direct P2P connections, we partially allow the centralized coordinator to perform non-sequential segment transports. Algorithm 1 shows the scheduling algorithm of MOVi+. After sorting out the mobile nodes based on the RBT (remaining buffer time) value, the centralized coordinator updates priorities for pre-diffusion (i.e., non-sequential). It then begins to schedule segment transports among peer (e.g., mobile/content/switch) nodes. For each mobile node in IDLE status, it first searches for suitable nodes for P2P connection. In this search for suitable nodes, it also considers the neighboring caching-enabled switch node. After finishing the scheduling for all segment requests from mobile nodes, the centralized coordinator schedules segments in the pre-diffusion list to better utilize the remaining transport opportunity.

Algorithm 1. MOVi+ scheduling algorithm.

```
doSortRBT(Mnode_list)
for Mnode_list(i)
  if Mnode_list(i).RBT>ENOUGH_BUF then
    Mnode_list(i).Priority <= Low
  else
    Mnode_list(i).Priority <= High
doUpdatePreDiff(Prediff_list)
for Mnode_list(i)isIDLE do
 if Mnode_list(i).Priority == High
    N_i <= getContact(Mnode_list(i))
  if Mnode_list(i).Priority ==Low
   N_i <= getNonSeqContact(Mnode_list(i))
    if N_i == 0 then
       N_i <= getContact(CS_list(i))
    if N_i == 0 && Mnode_list(i).Priority == High then
         doScheduleDownlink(Mnode_list(i))
    else
      doScheduleP2P(CS_list)
    end if
  else
   peer <= getHighestRBT (Ni)
    doScheduleP2P(Mnode list(i), peer)
    setState(peer, BUSY)
     nghbr_list <= getNghbr(peer, Mnode_list(i))
    setState(nghbr list,INTFRD)
    setState(Mnode list(i), BUSY)
    UpdateOppMap(Mnode_list(i, nghbr))
  end if
end for
while PreDiff_list! = NULL do
  doSchedulePreDiff(PreDiff list)
end while
```

3. Prototype Implementation and Functional Verification

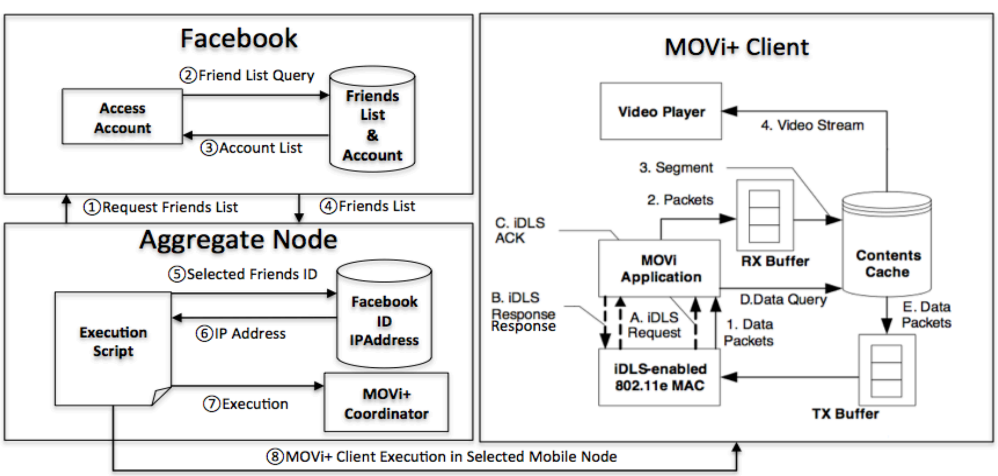

Figure 3. Prototype Implementation.

The prototype implementation is realized, as shown in Fig. 3. The grouping-tied functions are implemented in Java by utilizing the REST-style APIs. Also, in order to verify the proper execution of overall service chaining procedure, we examine whether all participating mobile node can receive video segments continuously and in real-time. Figure 4(a) shows the testing environment with aggregate node, one caching-enabled switch node and four mobile nodes. In this case, all mobile nodes request the same content and buffer size is limited to 0.94 minutes. The grouping UI at selected mobile node is depicted in Fig. 4(b). Also, as shown in Fig. 5, the proposed scheduling algorithm can increase the use of direct P2P connections (in comparison to MOVi+ [3]) while partially decreasing the total streaming latency.

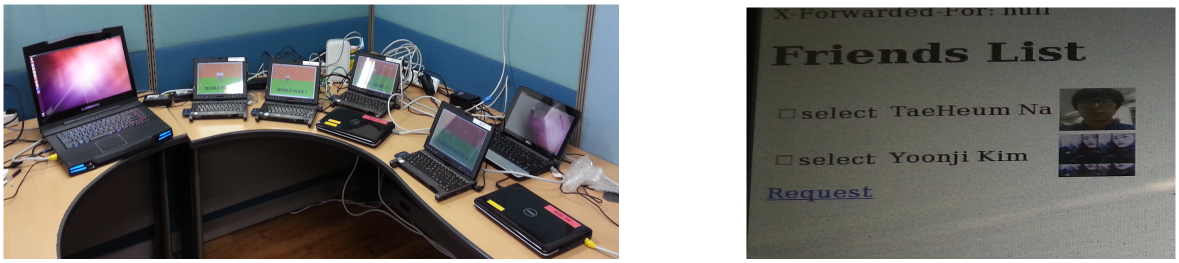

Figure 4. (a) Testing environment. **(b)** Grouping UI.

4. Conclusions

In this paper, real-time group video sharing is realized by chaining the services of Facebook OSN and MOVi+. With prototype-based verification experiments, we show that the creation of diversified services is effectively simplified and the performance gain of adopted non-sequential scheduling algorithm is also demonstrated.

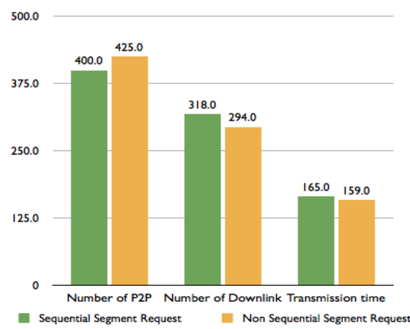

Figure 5. Scheduling method comparison.

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