

Parallels in Peer-to-peer and Grid systems: a Mobile Service Perspective

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INTRODUCTION

- Peer-to-peer and Grid systems are the latest trends in distributed computing
- They originate from different motivations, they target different user communities, and deploy in radically different application domains
- Despite these apparent differences, they share enough common characteristics that they can be viewed as parts of the same family
- Both peer-to-peer and grid systems are still evolving, and finding definitions of these terms acceptable for all is a challenge
- Instead, we try to underline their communalities on a business perspective

WHEN PEER-TO-PEER APPEARED

- Historically, the concepts behind peer-to-peer can be traced back to early distributed applications
 - Beowulf project and AOL instant messaging, ...
- Successively Client-Server paradigm became predominant
- Napster was the first peer-to-peer Internet file sharing application that brought massively attention to peer-to-peer
- Following that success, improvements like the use of DHT were introduced
 - Chord, CAN, PAST, ...
- Data sharing remains the main driver in P2P
 - Freenet, eDonkey, BitTorrent, ...
- But P2P is increasingly becoming an important technology in various fast growing areas
 - communication and collaboration (Skype, Bibster).
 - platform level (JXTA project)

THE EVOLUTION THAT LED TO GRID COMPUTING

- The foundations for grid infrastructure appeared back in the mid-80's.
 - PVM MPI
- Gradually, similar interconnection infrastructures were developed and enriched with new capabilities
 - load balancing capabilities (Condor)
 - reliability (Legion)
- Eventually, the influence of the Service Oriented Architecture (SOA) and the standardization efforts of WSRF, led to fully-fledged grid infrastructures
 - Globus Toolkit 4

EVOLVING DEFINITIONS

- Grid computing promises the virtualization of resources in an ensemble of interconnected computers
 - weather forecasting applications, data mining, video-stream processing and biomedical analysis
- As such, grid computing is about creating a general-purpose platform for massively parallel computing over a network of vastly heterogeneous devices
- On the other hand, peer-to-peer promises to provide access to resources that are found at the periphery of the network.
 - access to data of various formats (audio, video, text) that is located on other peer devices
- As such, peer-to-peer computing is about locating and establishing contact with unknown remote devices based only on the information of the content they contain.
- In a mobile service perspective, both peer-to-peer and grid are very important:
 - Peer-to-peer techniques for establishing communication links between mobile peers have the potential to bring new customers to the mobile IT industry
 - grid techniques and mechanisms for sharing computing resources mean cost reduction for mobile network enterprises and IMS content providers

OVERLAY INFRASTRUCTURE IN COMMON

- Despite their differences grid and p2p systems are both converging towards creating overlay infrastructures that support sharing resources among virtual communities and reducing the maintenance costs
- These common characteristics are:
 - data storage and retrieval, service lookup, dynamic reconfiguration, self stabilization and intermittent node connectivity
- At the heart of peer-to-peer and grid systems, there is the basic capability for forming an overlay infrastructure:
 - addressing schemes and routing techniques, message formatting and packaging of data

MOBILITY NOT COMPLETELY ADDRESSED

- Peer-to-peer and grid systems lack considerations of the problems introduced by the possible mobility of their nodes
 - Investigating the possibility to create novel formations of overlays is important for mobile service industry in its effort to discover new business areas
- Extending the existing techniques to consider mobility constraints is vital for enabling mobile devices to become drivers in P2P and grid systems
 - The P2P is pushing the research towards new domains, such as resilient and distributed file systems for data backup
 - New scenarios like ad hoc network creation for instant group meeting necessitate a strong overlay in terms of security and reliability

SHARING CONTENT

- Sharing content is one of the driving forces in evolving mobile devices
- P2P and grid systems employ techniques on data fragmentation, replication, caching and distribution that help in realizing true content sharing among mobile devices
- Similar techniques can lead to novel suggestions for services to IMS providers
- In grid, such techniques are usually coupled with some load balancing policy in order to increase the data availability and reduce the data access latency
- In peer-to-peer similar techniques are used to ensure the persistence of data in systems with highly intermittent connectivity

BENEFITS FROM DYNAMIC RECONFIGURATION

- Dynamic reconfiguration mechanisms allow a distributed system to update on-the-fly the interconnections that define its structure, without system interruptions
- In grid systems, such techniques are used primarily to enable scheduled maintenance events
- In P2P systems, these techniques are used mainly to support the highly irregular but frequent joins and splits of individual peers
- Dynamic reconfiguration mechanisms can be exploited in the mobile service industry to create new business scenarios.
 - P2p-like games can be derived from the facility to combine different network technologies to allow group challenges and location-aware situations
 - Instant messaging, chatting and blogs acquire a new dimension when enabled in a mobile environment, attracting new users and thus reinforcing the vision of a mobile society

DIFFERENCES AFFECTING INTEROPERABILITY

- Two fundamental differences exist between grid and P2p systems:
- In grid computing the different organizations offer their computational resources to the system and ensure the good behavior of their users and their infrastructure (via contractual SLAs if necessary)
- While P2P participants are little accountable (or not at all) for their behavior in the system
- Second, grid ambition is to comprise vastly heterogeneous computational resources in the system
- While in P2P systems a single content sharing application interconnects large number of homogeneous computational resources.
- One result of the above differences is that interoperability has been of paramount importance in grid systems
 - OGSI, WSRF WS-Resources..
- while it has not yet attracted the attention of peer-to-peer systems
 - a single end user who wants to be part of any two popular P2P systems, must run the two distinct applications and sometimes has to duplicate the content to be shared

SECURITY AND SELF-PRESERVATION

- Another result of the differences between peer-to-peer and grid is the need for a system to protect its own operations.
- In a grid the system execute in a friendly environment
 - Creation of mechanisms that automate the negotiation and supervision of Service Level Agreements (SLAs) between the established organizations
- On the contrary, the unaccountability of individual participants in a P2P system makes a system execute in a hostile environment
 - SETI@home false results, viruses and spyware, "free riders" ...
- Moreover, P2P systems have to circumvent the connectivity obstacles places by firewalls and NAT servers.
- In a mobile service perspective, the possible advantages of P2P and grid systems can be overshadowed if security concerns or incidents would occur
- There is the need to strengthen the research effort in security related to accessing personal devices either for data sharing purposes or data push

CONFIGURING DISTRIBUTED SOFTWARE

- Another area of concern in P2P systems is the creation of self-configuring software for the end user
- The majority of P2P users are non-experts
 - Need of self installing applications
 - But existence of obscurity around the algorithms and the techniques used by different applications
- Grid systems instead consist of clusters of well- administered computation resources rather than individually owned computers
- The deployment of software on different machines in a grid is a task carried out by trained professionals whose work includes configuring software such as parts of a grid overlay infrastructure

CONCLUSIONS

- Despite apparent differences in motivations, targets and audiences, both peer-to-peer and grid systems create overlay infrastructures to share hardware and software resources
- Peer-to-peer systems can offer business inspirations and technical solutions in using mobile devices for a variety of new purposes (e.g. to share personal content, to play multiparty games, to access web services, etc)
- Grid computing can be beneficial for the mobile industry in offering platforms that enable mobile enterprises to be built over a lightweight hardware infrastructure, and provide for the quick and cheap deployment of IMS and other 3G services for mobile phones.

