Gateway Design and functionality

1. Introduction

Figure 1 illustrates possible placement for the Gateway. In figure 1(a), the gateway is placed on a totally separate machine. In this case, the gateway becomes a stand-alone server used in servicing possibly different IRIh sessions. In figure 1(b), the gateway is a component of the session manager, hence it only services this particular session. In either case, the Gateway is responsible for performing the multicast test for any participant. This test decides whether this participant will receive session streams through one of the gateway servers, or not.

The gateway accepts commands from the SM to create new gateway servers. Gateway servers will be created to manage several gateway channels, to provide tunneling and adaptation to IRIh data streams. A gateway server can be an Unreliable Gateway server (e.g., pointer, annotation, layout manager, ipv), or an Unreliable RTP Gateway server (e.g., video, audio). A gateway server services two types of SPs.

- Multicast disabled SPs, in which case a multicast tunnel needs to be established, along with any rate adaptation functions provided.
- Multicast enabled SPs, in which case only rate adaptation functionality is provided.

![Figure 1 (a): SM and GW on different machines](image1)

![Figure 1 (b): SM and GW on the same machine (in the SM machine)](image2)
The session participant which allocates the required resources for a service, will request an additional resource, which is a gateway server to service participants receiving their data streams through the gateway for this particular service. Alternatively, the SM can automatically associate a gateway server with each requested non-gateway channel.

For Intranet machines, their static stored information contains estimates for bandwidth connectivity, and expected delay. This static information, along with dynamic in-session measurements can be used to specify if and how rate adaptation is to be provided for these machines.

For home users (or simply machines we know nothing about, and that can change on a session basis). The SP provides his bandwidth connectivity as initial information, when installing irih on his machine. For example, Microsoft NetMeeting asks you if you connect through a LAN, or 28 Kbps, or higher connection. The bandwidth connectivity information can be stored locally at each participant. When ready to join a session, this information can be passed to SM to correctly classify the SP. Nevertheless, later on we need to devise a protocol by which we can classify an SP in terms of his in-session bandwidth connectivity and delay. In all cases, the multicast test by the Gateway must be performed to insure proper data streams delivery. In addition, The Home user can select to configure some irih settings, e.g., how many video streams are to be received.

2. **Functionality**

2.1 **Gateway servers**

- Based on the type of service, a set of possible data rates are advertised by any gateway server. For example, with a presenter transmitting at 15 frames/sec the gateway server can offer to adapt the rate to 5 f/s, 3 f/s. In addition, the gateway server can block some streams from reaching the SP, if the SP has opted for this configuration. An SP can choose for example to only receive the presenter video. The advertised data rates, and the mechanisms to enforce these data rates are dependent on the service itself.
- The gateway server is associated with a non-gateway (multicast) channel. It has to listen to this non-gateway channel and forward any datagrams received from this channel, to any SP currently serviced by it.
- The gateway server receives any datagrams from a gateway serviced SP, and forwards it to the non-gateway channel, and any other SP it is currently servicing.
- When data rate control is not crucial (e.g., annotation, pointer, layout manager) the gateway server simply offers a pass-through service, and establishes a tunnel and provides the forwarding service.

2.2 **Allocation of gateway servers (One per non-gateway channel)**

- An allocating participant requests a gateway server as one of the service resources. The request couples the gateway server with a non-gateway channel. This coupling is utilized by the gateway server to know which multicast channel to listen to.
- Upon receiving this request, the SM requests the gateway to create a gateway server.
- The gateway upon successful creation, passes back to SM, the server (IP, port) of the gateway server.
- The SM inserts into the group communication database, the gateway server information
<channel name, channel implementation, IP for gateway server, Port for gateway server>. Where
channel name : name given for gateway server
channel implementation : gateway server type
IP for gateway server : assigned IP of gateway server
Port for gateway server : assigned Port.

2.3 Gateway server discovery by session participant
• A participant (currently connected, or a future late-comer) are notified by SM, of each
  service resources, according to the following rules
  • If the resource is a multicast channel and the participant is multicast disabled, then do
    not inform the participant about this resource
  • If the resource is multicast channel and the participant is multicast enabled but
    requires special handling (e.g., due to bandwidth limitations), then he is given the
    gateway channel information
  • All multicast disable clients are passed the gateway channels, but not the multicast
    channels.
• The group comunication layer in SP, contacts the group communication server (transient
  TCP) requesting the information for the gateway channel, the group communication server
  returns the contact info for the responsible gateway server (IP, Port).

2.4 Service Negotiation
• The gateway sever is contacted by the group communication layer in SP (transient TCP by
  the group communication layer in the service manager), to perform the following:
  • The SP selects the level of service (offered/requested data rate). The offered data rate(s) can
    be advertised by the gateway server to each newly connected client. A default value can be
    recommended based on the initial/current connectivity information for this client.
    • Negotiate what IP/Ports are going to be used for send/receive by gateway server and
      SP.
    • If the SP is multicast disabled, it is instructed to allocate a free UDP port, and pass it
      back to gateway server. Meanwhile, the gateway server allocates another free udp
      port to be used to sendto/receivefrom this SP (for this service). This port is in turn
      passed back to SP. Alternatively, the gateway server can allocate one UDP port,
      which all SPs use to send their data streams to. The gateway server needs to obtain
      the SP classification as multicast enabled/disabled. Two choices are possible here,
      either the gateway server has access to the SP classification database, or the gateway
      server queries the GW.
    • If the client is multicast enabled (w.r.t. to gateway machine) it is informed by the
      gateway what multicast channel it needs to listen to. The gateway server allocates a
      multicast channel by forwarding a request to the group communication server.

3. Remaining Issues (Discussion)
• Placement of GW. Are the SM and the GW on the same machine, meaning one
  gateway per session manager? Or separate gateway machine (s) meaning that specific
machine(s) can function as gateway(s), which can be configured for example when setting up the session.

- A group of SPs are multicast enabled with respect to each other (e.g., SPs in the same site), but not w.r.t. to the gateway machine. Need to allocate gateway at their site, and establish a multicast tunnel between the two sites. The gateway in the SPs site receives unicast datagrams, and then forwards using in-site multicast group. We can for example designate a whole site as being multicast disabled.

- This design assumes that the SP, will request/be assigned a specific data rate for his received data stream.
  - Is the SP allowed to change his requested data rate during the session. For example switching from receiving 3 f/s to 5f/s or vice versa?
  - The SP can follow a receiver driven approach, and inform his gateway server of any bandwidth problems (dropped packets are sign of congestion), and hence the gateway server can degrade the current level of subscription of this SP?

- Inter-stream synchronization across gateway servers? The inter-stream synchronization should be performed at the receiver side (SP side), as long as the gateway does not change any synchronization information received along with the data stream.