



Elluminate *Live!* Bandwidth Management

The Collaborative Communication Framework

All network communications in Elluminate *Live!* are handled by the unique and proprietary Collaborative Communication Framework (CCF). The CCF provides for superior user experience and bandwidth management. Rather than depending on a browser for communications, the CCF optimizes separate data streams for each individual user based on their connection speed, actual data throughput, and configurable bandwidth limits.

The result is network data loads that can be strictly controlled while each user is maintained in real-time, whether they are connected on a 28.8Kbps modem or on a high-speed LAN.

Network Management Options

An Elluminate *Live!* server can be configured to limit aggregate bandwidth to any specified amount. If the instantaneous bandwidth requirement ever tops this limit, the server will automatically and immediately slow down all user connections (starting with the highest speed users) to ensure that the limit is never exceeded. The design of the CCF makes sure that audio continues to work without interruption, all virtual room features continue to work optimally, and everyone stays in sync.

If required, it is also possible to specify the maximum participant connection speed. This can be done on a per-server or on a per-room basis. Each participant can also specify the maximum throughput that they have available or that they wish to use.

CCF Advantages

The Network Management features of the CCF enable an Elluminate *Live!* server to work flawlessly under very controlled conditions. For instance, if the server is behind a shared T1 line, it can be configured to only use 800Kbps of bandwidth. With only two participants on the server, they would have an average of 400Kbps peak bandwidth available, while 20 people on the server would have available an average peak bandwidth of 40Kbps. In both these cases, the virtual meeting rooms would operate flawlessly, and in real time.

CCF Network Management Key Advantages:

- There are multiple options for specifying client and server throughput limits.
- Intelligent individual bandwidth monitoring and management ensures that audio is not interrupted, everyone is in sync, and no content is ever lost.
- Moderators do not have to reduce the quality of their presentation to the lowest common denominator. Moderators can share data at the highest quality and the server automatically compensates for network load conditions and for individuals on lower speed connections. Moderators, of course, can also be on a low speed connections.

Network Loading

In addition to the CCF network management features, Elluminate *Live!* has a number of other innovations that allow it to work effectively at very low bandwidths, including:

- A proprietary telephone quality audio compression scheme that requires less than 8 Kbps.
- Persistent object oriented whiteboards with vector graphics. Specifying or changing the position, size, color, etc. of whiteboard objects requires very little bandwidth. The loading sequence of whiteboard slides is individually dynamic and adaptive to network conditions.
- Highly optimized application sharing that changes its network requirements for each participant based on allocated bandwidth and actual throughput.

For server throughput planning, we recommend about 1Mbps of outbound bandwidth per 25 simultaneous users. Although this is a recommended amount, a unique aspect of our technology is in its automatic and graceful handling of extreme loads and restrictive limits. And in practice, Elluminate *Live!* servers generally require less than 15Kbps average participant throughput—although peak loads can be much higher.

As an example of maximum requirements, the following chart illustrates 60 seconds of participant peak data rates recorded during a variety of situations. For the purpose of determining these peak requirements, no bandwidth limitations were placed on the participant for whom the data rates were captured. If rate limiting had been applied, there would be no numbers above the rate limits. All tests were done with one moderator and one participant, both on LAN connections.

Note: Video in Elluminate *Live!* is configurable to each participant so as to maximize the usability of this feature. A participant may receive (in proper conditions) video at bandwidths of up to 2 Mbits/sec, this is of course in prime conditions where bandwidth is not an issue.

Illuminate Live! v8	Moderator Transfer Results			Participant Transfer Results		
Description of the testing parameters.	Average Kbits/sec	Maximum Kbits/sec	Total Kilobytes	Average Kbits/sec	Maximum Kbits/sec	Total Kilobytes
Sending audio from the moderator's system	8.2	10.8	495.1	7.8	10.0	470.2
Sending audio from the moderator's system and the participant's system simultaneously	8.8	14.2	529.9	8.9	12.9	545.2
Sending audio from the moderator's system while drawing a math problem on the Whiteboard	11.5	17.4	712.7	11.3	17.0	688.5
Loading a 2,559,445 byte whiteboard (WBD) file (converted with a 800x600 resolution) as the moderator	194.5	3,174.4	11,755.52	195.0	1,843.2	1,497.6
Audio on while application sharing and updating an MS Excel spreadsheet; Excel window size 800x750 with image quality set to Higher Speed	27.8	145.7	1,710.08	27.1	246.3	208.64
Audio on while taking remote control of participant's desk top, opening the Control Panel and then Audio Settings; resolution set to 1280x1024 with image quality set to Higher Speed	15.6	49.7	936.0	17.4	50.7	131.84
Audio on while application sharing Google Earth, zooming in on Las Vegas; Google Earth window size 950x750 with image quality set to Higher Speed	311.7	2,457.6	18,196.48	288.9	1,843.2	2,214.4
Audio on while application sharing Google Earth, zooming in on Las Vegas; Google Earth window size 950x750 with image quality set to Best Quality	1,126.4	2,969.6	66,723.84	1,126.4	2,150.4	8,194.56
Loaded a 12,518,695 bytes MOV file onto the Multimedia Library; this test ran 75 seconds instead of 60	1,433.6	2,048.0	112,936.96	1,536.0	2,355.2	112,384.0
Loaded a 8,906,406 bytes SWF file onto the Multimedia Library	1,331.2	2,048.0	80,281.6	1,331.2	2,662.4	9,996.8
Transferred a 5,175,296 bytes PowerPoint file	748.0	1,945.6	46,725.12	763.2	2,867.2	5,861.12