



Annual Technical Report on Communication Enhancement

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ExCITE evaluates user requirements of social interaction that enables embodiment through robotic telepresence. This evaluation is performed in situ, on a Pan European scale and with a longitudinal perspective. An existing prototype is deployed to the targeted end-users, and is refined by tightly involving the users in the development cycles of the prototype throughout the project. ExCITE involves partners in three partner countries: Italy, Spain and Sweden.

The information in this document has been provided by:

Part · no.*	Participant organization name	Participant short name	Organization type	Country
1	Örebro University	ORU	Academic	Sweden
2	Giraff Technologies AB	GRF	SME	Sweden
3	Consiglio Nazionale delle Ricerche - ISTC	CNR	Academic	Italy
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Communications

Summary:

The purpose of the Giraff solution is to connect elderly with their world and allow them to communicate naturally and conveniently even when face-to-face visits are not practical. Therefore communications lies very much at the core of the successful Giraff experience.

We have learned a great deal over the past year about all aspects of communications and the specific challenges presented to the Giraff solution. We have used that knowledge to create new user features, documentation and support processes to improve the overall experience. Specifically we have begun to map user experiences in terms of audio, video and navigation quality to specific communications problems. Based upon that mapping we have begun to provide general support documentation, specific guidelines and software tools to identify and resolve communications problems.

Internet “backbone” network quality is obviously a key element to the overall experience and fortunately has not generally been a problem for the Giraff. Most network quality problems arise either from the local access (cable, fiber, DSL, etc) or the local wireless networking. We have also found a related but entirely separate set of issues around firewall configuration.

We have created several user documents to address these issues, including a third-party document from the audio/video codec provider with detailed information on firewall configuration. We have also added several features to the Pilot software to aid in troubleshooting network and firewall problems, as well as identifying free third-party web applications that can assist in the troubleshooting process.

There is still much work to be done in terms of understanding specific issues, particularly around wireless networking. We look forward to continuing to improve the Giraff experience by further enhancing solutions in these areas.

Following are detailed descriptions of the communications issues, solutions implemented so far, and work still to be done:

1. Internet network quality

Not surprisingly, network quality is a major factor in the overall Giraff user experience. Latency (the time it takes for a packet of data to arrive at its destination) and throughput (the average bit rate of the Giraff stream as measured in Kb/s) are the two most important measures

of Internet quality, and degradations in each have different impacts on the user experience.

- a. Throughput problems are usually manifested first in video quality, with slow frame rate, images breaking up and in the worst case, frozen images. More severe bandwidth limitations also affect audio quality, resulting in garbled or broken speech, and in the worst case loss of audio altogether.
- b. Latency problems are usually manifested in the navigation of the Giraff. For safety reasons the Giraff continuously measures latency between itself and the Pilot visitor, and thus calculates the “age” of a navigation command such as “move forward.” If a command exceeds a certain age (currently set to 500 ms) the Giraff assumes the Pilot visitor is receiving an “old” video image and does not know the Giraff’s current position, and therefore disregards the command. As a result, the effect of long latency manifests itself as a jerky, “balking” motion in the Giraff, and in the worst case the Giraff will not move at all.

Third-party web sites such as www.speedtest.net are available to test latency and throughput between sites anywhere in the world. Anecdotal tests suggest that the Internet “backbone” (the network not including local access) within the EU is generally adequate for the Giraff application, and in fact seems adequate even on a global basis. Most quality issues can be traced to shortcomings in local access.

It is also important to note that if the Pilot computer CPU is overloaded or inadequate for the Giraff application, the Pilot visitor can experience the same symptoms as are seen in the case of network problems.

Based on these experiences we have developed several tools for users to identify, test and resolve quality problems, and isolate them to network or hardware issues:

- a. The operational guides provided to advanced users and technical support personnel now describe these troubleshooting processes in detail (although are probably too advanced for novice users).
- b. We have added diagnostic tools to the Pilot application that allows users to measure network performance.
- c. We have added the ability to run the audio/video codec software (provided by a third party, VSee) separately to help isolate network vs. other problems such as firewalls (see discussion below).
- d. We have integrated P2P operation (where an Internet connection is not required) into these procedures, as it is a highly effective way of isolating Internet network vs. other problems (see discussion below on wireless networking).

2. Local Internet access

As described above, most Internet quality issues can be traced to access vs. network problems. We have seen that Internet access quality varies greatly from municipality to municipality even within counties that are generally regarded as having excellent Internet access (e.g. Sweden and Denmark). The tools described above can be used to isolate and measure local performance, at least indirectly.

Generally, cable and fiber optic access are adequate for the Giraff application, although local congesting at the Internet Service Provider (ISP) can degrade even the best access technologies. DSL access is also adequate in most cases if the ISP connection to the Internet backbone is of sufficient quality.

We have also completed preliminary testing with 3G and 4G access services. These have the advantage that no installation is required in the home because they access the network in the same way a cell phone does. However, 3G testing so far indicates that it is not generally adequate for the Giraff application, and that in the best case it might be a solution for specific homes where the reception is very good. 4G holds greater promise but is available only in limited areas today.

We need to complete a user document describing our findings so far, to guide technical personnel in making decisions about Internet access and troubleshooting problems.

3. Wireless networking

Wireless network has created a number of challenges for the Giraff application and the ExCITE project in general. We outline the issues and accomplishments here:

a. Router configuration

Most Windows devices (PCs and laptops) use standard wireless configuration that allow them to join wireless networks without intervention by the user except to enter a password. The Giraff is a Windows device and the wireless utility operates in the same way as any other. However, because the Giraff allows virtual entry into a home, security and privacy are even greater issues than with other Windows devices. Therefore the Giraff is currently configured to join only wireless networks with specific names and passwords. If Giraff administrators/technical personnel want to name a router something different they must change the permanent memory of the wireless utility.

Otherwise, the prescribed router configuration for the Giraff follows standard Windows guidelines, which are documented in the operational guides. Of course, Pilot visitors who use wireless networks must ensure that their devices can connect to those routers, and this is outside the control of the Giraff infrastructure.

b. Spectrum

Currently the Giraff uses the 802.11 standard which operates at 2 frequencies, 2.4 and 5 GHz. The 2.4 band is by far the most commonly used but is therefore also the most congested. It is also the band used by cell phones with 802.11 capabilities for accessing the Internet. We have many experiences where Giraffs connected to routers operating in the 2.4 band experience network problems with throughput and latency, especially in public forums such as industry conferences where other exhibits are also using the 2.4 band (or where many cell phones are in use).

The Giraff also operates in the 5 GHz band and we have never seen a wireless network problem in that band. Therefore we now recommend to users to deploy a 5 GHz wireless router for the Giraff if possible. Previously, the Giraff required a physical cable change to move to the 5 GHz spectrum, but based on user experience we modified the design to allow for seamless transition between the 2.4 and 5 GHz bands.

In most cases (especially at 5 GHz) the auto-channel selection of the wireless utility provides good wireless performance. Occasionally there is congestion that requires the Giraff to select a specific frequency, and we have updated the user documentation with instructions on how to do this, including how to access a free third-party application to monitor wireless signals across the available channels.

c. Home wireless considerations

Once the router has been selected and configured with the Giraff there are practical considerations in home deployment. Range and signal strength are rarely problems in home use but occasionally can be in nursing homes where there is much more physical area for the Giraff to cover. In nursing homes there can also be more walls between the Giraff and the router, so care must be taken in deciding where to place the router and how to position the external antennae when present. We have updated the user documentation to include some guidelines in these areas.

d. Firewalls

Firewall problems are rare in home deployments because most home routers do not configure any firewall restrictions such as blocking ports, blocking video traffic, etc. However, in testing at facilities like care organization central offices, universities and other technical organizations we have often encountered firewall problems.

The Giraff audio/video connection has enough intelligence to detect if a firewall is blocking a direct connection and attempt a different type such as HTTP tunneling. The advantage of this capability is flexibility but the quality of the connection may be lower in this case. Indeed, a firewall problem can “disguise” itself as a network quality

problem and we have experienced this many times. Therefore we added the capability in the Pilot application to show what type of connection has been established, and included this check in the troubleshooting guidelines to help determine if there is a firewall problem.

We have also included an entire separate document on firewalls, including detailed instructions for IT personnel on how to unblock ports or IP addresses. We have also made available a separate document from the codec provider, VSee with detailed information on how the application establishes connections under various firewall scenarios.

There is still much to learn about communications in general that will improve the Giraff experience for all users, both in terms of connection quality and in helping technical personnel configure and troubleshoot networks. For example, the 802.11 standard allows for “handing off” devices between multiple wireless routers within

Ratio Consult in Italy was added to the ExCITE team specifically to assist with communications challenges particularly in the wireless area. Our experience so far makes it clear this is a critical part of the overall Giraff experience and we look forward to engaging with them as soon as funding is released to them.