Notes on communications

How far away can you use different media? For example, is it possible to participate in an AR meeting on an orbiting spaceship?

Neutrinos, lasers and radio are all lightspeed. QE is "instantaneous" but low bandwidth. Along optical fibers, you typically get 4.9 microseconds of latency for every kilometer. Lightspeed limits are hard limits, and the only way around them is to use ultra-expensive QE. What communications companies can compete with is bandwidth (how many bits per second you can send), quality (can you assure less than X% lost packets?) and security (how good encryption infrastructure do you have).

It is worth noting that **latency** (delays due to long distances) can be less problematic than **lags** due to network congestion, lost packets etc - latency changes very slowly, while lags can peak and jitter.

Note that clever software can buffer and fill in details, just like it does today with webpages and computer games. But it cannot handle interaction where the typical timescales are faster than the lag. One way of solving it for personal interaction is of course to send forks. Noninteractive media just stream information, and the latency only affects when they start.

- Text chatting can likely handle several seconds delay, turning more into IM and email as it gets slower. Web surfing becomes intolerable after latency becomes more than a few seconds.
- Talking to people tends to become tricky once you get delays of a few tenths of a second. The recommended max delay for phone services is 0.15 s.
- Interactive video is more sensitive; I expect a limit of about 0.1 seconds for truly interactive social responses.
- To puppet someone or something remotely you need delays significantly smaller than typical human reaction times, 0.1 s.
- I think convincing AR need to update at around 50 Hz, so if an object is handled by a remote server it must have delays shorter than 0.02 s.
- Convincing interactive tactile VR needs to update even faster (because you cause vibrations in the VR objects that are important for the experience): if it cannot be done locally, I suspect that even delays on the order of 0.01 s will make things feel different.
- Neural delays across the brain are a few milliseconds: if a distributed neural computation is going on, it cannot have a round-trip longer than 10^{-3} seconds (and it gets worse if the brain is running faster, of course).

Turning this into distances, I get the following estimates:

- Brain-to-brain communication: max distance 300 km.
- Convincing remote VR: 3,000 km
- Remote AR: 6,000 km
- Puppeteering and telepresence: 30,000 km
- Interactive video: 30,000 km

- Voice: 45,000 km
- Text chat: 3,000,000 km (or more, depending on patience)

Note that you could slow yourself down to make communications easier.

Communications hypercorps

Public services tend to be pretty clogged, especially in the outer system, for the same reason P2P tends to fill flat rate ISPs today: there is no extra cost to the user, so they will use a lot and fill all capacity. If you have a price system (Extropia, likely much of the inner system) then you are discouraged from wasting by having to pay a market rate. Outer system spammers of course get lowered rep, but that doesn't hurt weblife and untraceable AIs.

Nimbus seems to be the big player. They are the only ones mentioned, but here are some inventions of the head:

QLight - Early quantum encryption and QE specialist. Provides very expensive QE links to customers, for example linking the Martian and Extropian stock markets. Maintains a fleet of courier ships for transporting qubits and massive amounts of one-time pad information.

VCG Distribution - Media distribution, especially high bandwidth entertainment such as XP. Maintains servers on most major habitats.

Iris - The major Jovian communications provider. Run by the Republic, it makes sure censorship is built into the comms infrastructure at the lowest level.

Tietong-Integral Telecom - Descended from the Chinese telecoms industry. Lots of capacity in the Mars and Earth system.

Farband Communications - Pre-fall giant, pioneered neutrino communications and very long-distance communications in the solar system. Retains a number of transponders and systems in the outer system. Run as an employee cooperative.

Sauteдé Networks - Ship-to-ship communications, navigation aid and logistics. A subsidary of Cometary Express.