A NEW REAL-TIME MULTIMEDIA CONTROL PROTOCOL FOR DISTANCE LEARNING

The University of Manchester

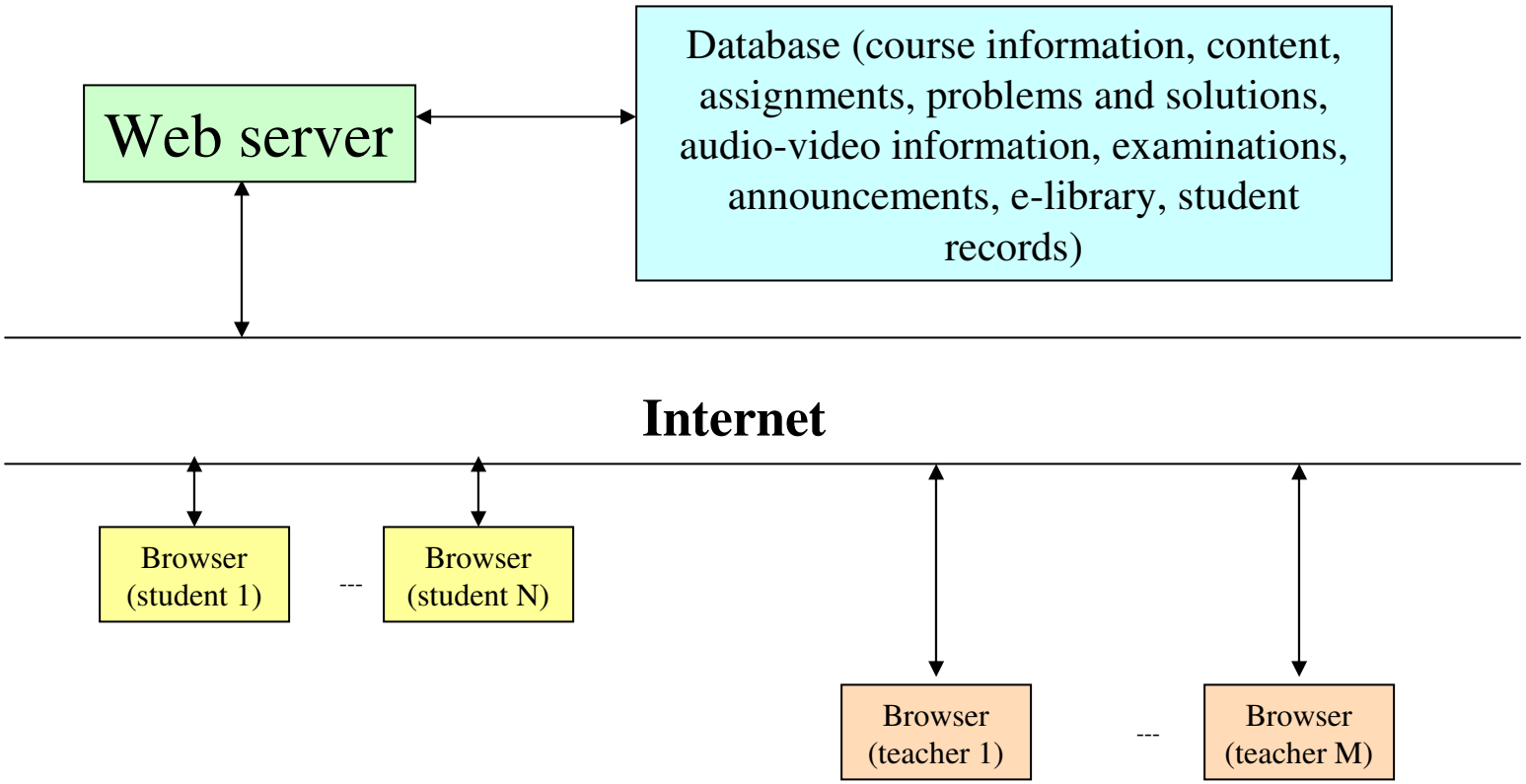
Distance learning is applied in these fields:

* Providing open learning environments
* Offering more information for traditional teaching
* Providing continuing education after graduation
* Developing academic cooperation

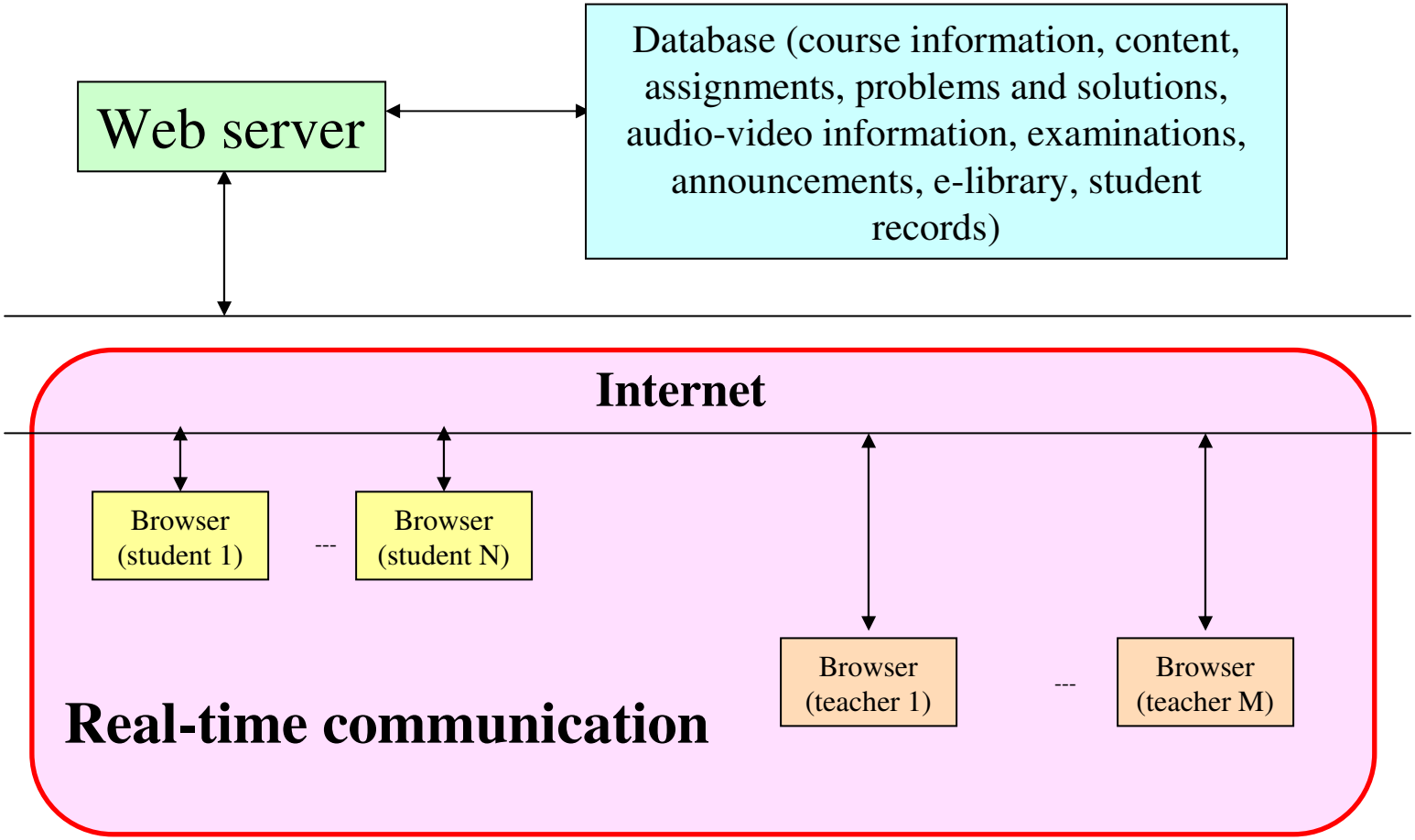
Different types of multimedia facilities for distance learning

- TV and radio
- CD-ROMs with a variety of educational software
- Internet

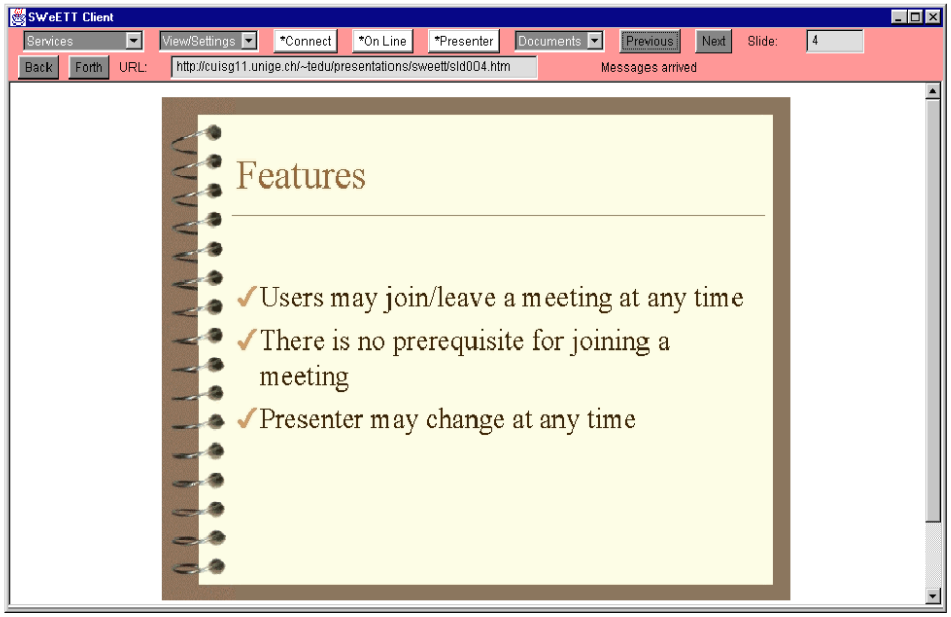
Real-time multimedia distance-learning

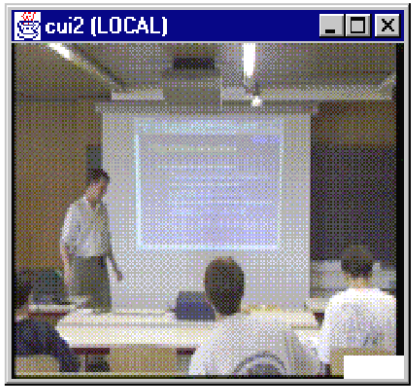


Real-time multimedia distance learning



The virtual classroom





Real-time multimedia has a number of advantages for distance learning:

- Liveliness
- Efficiency
- Interactivity

Real-time communication protocols:

- Current real-time multimedia e-learning systems based on real-time transport protocol (RTP) and real-time control protocol (RTCP)
- Face-to-face communication can provide anytime and anywhere for e-learning. The quality of real-time communication is poor.

The problem:

The biggest problem facing the use of RTP in distance learning occurs in achieving a good quality of speech and image transmission.

The requirements for real-time distance learning:

- **Speech and image requirements**

  Audio data is normally the most crucial element.

- **Time delay requirement**

  A total delay of below 150ms is the ideal for two-way real-time communication, and a total delay of up to 250ms is still acceptable for long distance real-time communication.

  It is able to dynamically switch audio codecs so as to maximise the intelligibility of the audio data for varying network conditions.

- **Packet priority assignment requirement**

  Packet types have a field for expressing the relative importance of the packet.

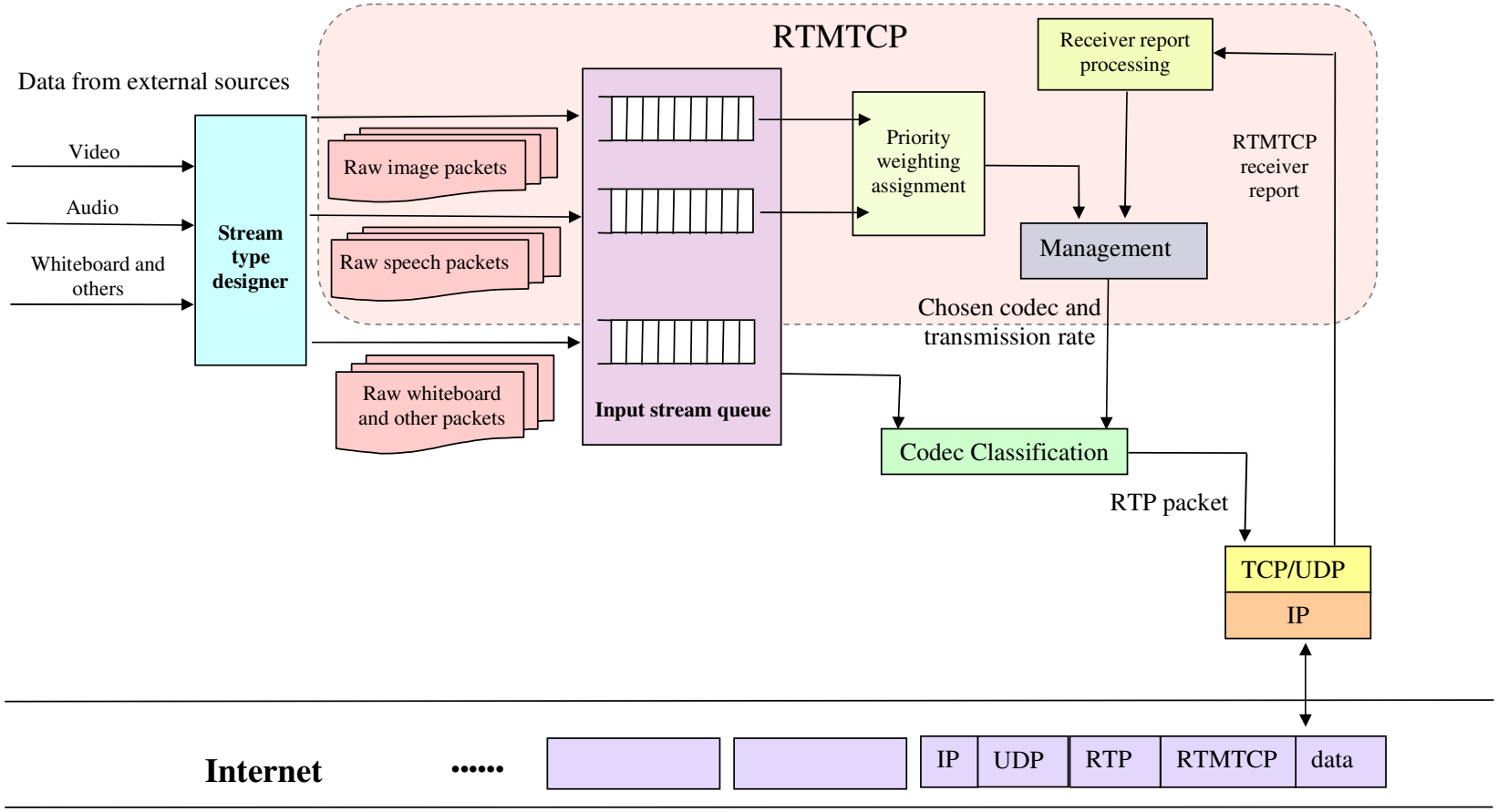
The research:

We observed that current real-time multimedia control protocols were inadequate for real-time distance learning. We designed and prototyped a new real-time multimedia protocol that improved distance learning communication.

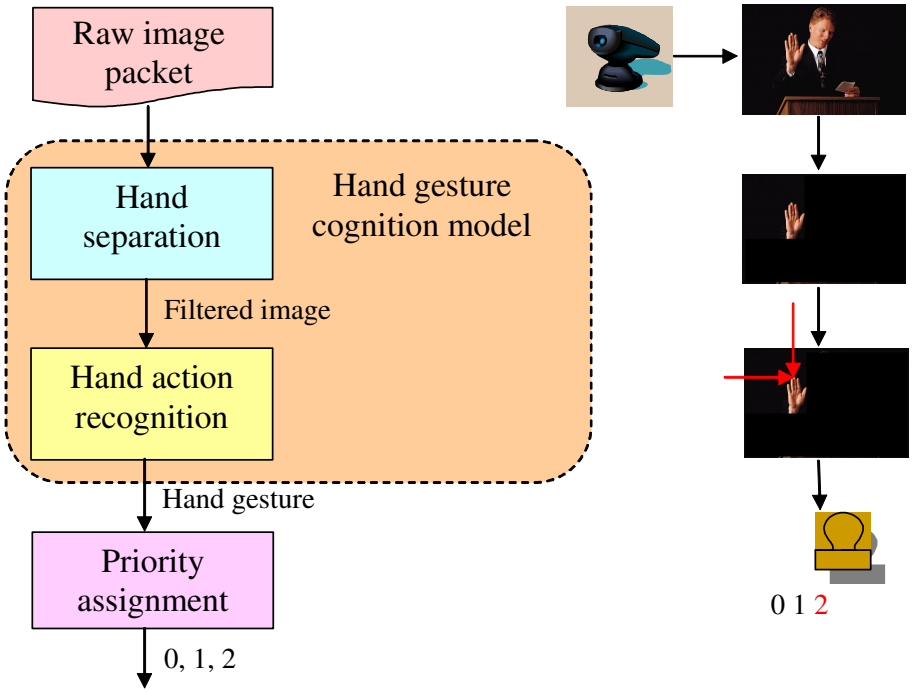
The new Real-Time Multimedia Transport Control Protocol (RTMTCP):

The control method uses feedback and priority weightings to determine whether packets should be sent over the network and if so using which codec. The control method maximizes the quality of the transmitted data in un-congested networks, reduces its bandwidth usage in congested networks and attempts to reduce the chance of making the network congested.

The RTMTCP protocol:



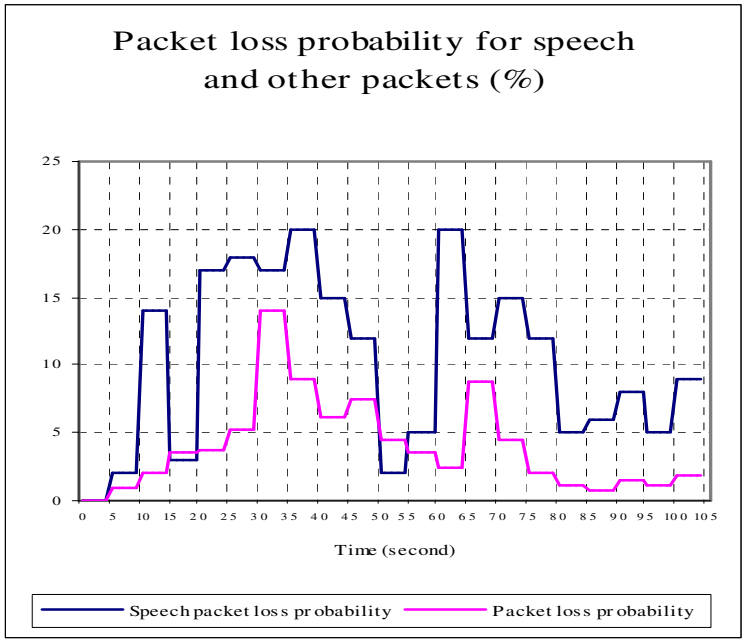
Human gesture recognition model:

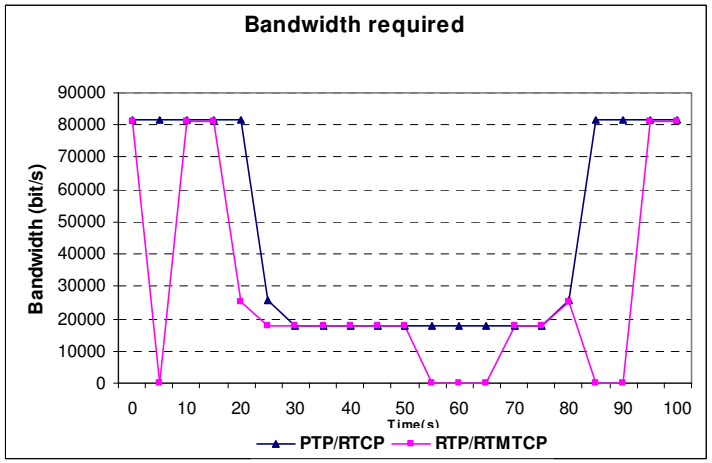


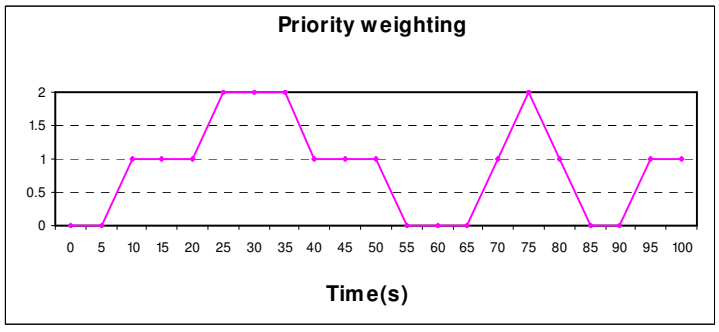
Developing and evaluating the new protocol:

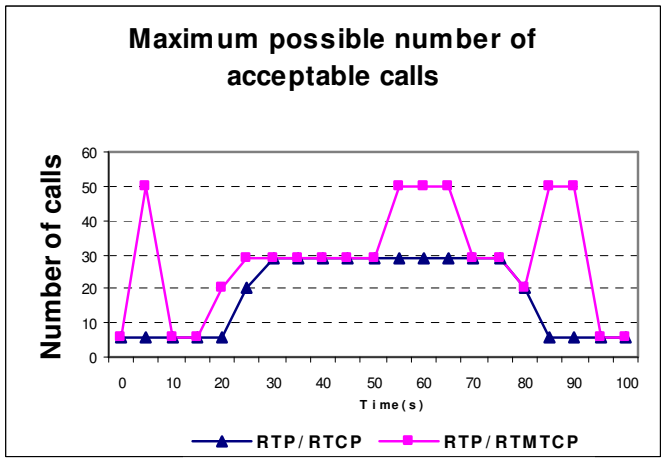
The real-time multimedia e-learning protocol was primarily evaluated over the link between the University of Manchester and the Tsing Hua University (China).

Results:


Packet loss probability for speech and other packets (%)
25
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105
Time (second)
Speech packet loss probability
Packet loss probability


Bandwidth required
Bandwidth (bit/s)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
0 10 20 30 40 50 60 70 80 90 100
Time(s)
PTP/RTCP
RTP/RTMTCP


Priority weighting
2
1.5
1
0.5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Time(s)


Maximum possible number of acceptable calls
Number of calls
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100
Time(s)
RTP/RTCP
RTP/RTMTCP

The differences between the RTP/RTCP and RTP/RTMTCP protocols for real-time multimedia distance learning:

Protocols	Speech and image requirements	Speech	Image	Time delay requirement	Bandwidth	Packet priority assignment requirement	Easy to use
RTP/ RTCP	No	Poor	Poor	No	Moderate to high	No	Yes
RTP/ RTMTCP	Yes	Good	Good	Yes	Low	Yes	Yes

Conclusions

- **The real-time multimedia distance learning system improves the quality of communication in the distance learning model and improves:**
    - Traditional teaching
    - Blended learning
    - Differentiated pace
    - Differentiated programme
    - Anytime learning
    - Remote learning anytime- anywhere
- **The new protocol allows an increased number of connections on a congested network, reduces the chance of congestion and improves quality when the network is un-congested.**
- **Network measurements show improvements as well as analysis of perceived quality by the user.**


Thank you!