The **Virtual Classroom** is an integrated wireless network system to provide a distributed, near real-time electronic collaborative environment that allows video, audio, data and sensor participation by a worldwide community of participants in experiments undertaken in physically remote locations. These locations, due to cost, accessibility, safety or other concerns often do not permit communities to participate at the location. For example, all of the student members of a robotic satellite team may not be able to be at the launch and recovery site. The **Virtual Classroom** permits all members of these teams with a broadband Internet connection to view and participate in these experiments with many of the tools that on-site experimenters have and might well bring access to remote analysis tools that are impractical to bring to the remote site.

Virtual Classroom Facts

- *Web 2.0 user interface available worldwide*
- *High speed packet satellite Internet backbone*
- *Data, VoIP, video Internet Gateway*
- *Wide experimental area radio coverage*
  - *1200 km³*
  - *70cm and 2m APRS geotracking, telemetry and weather*
  - *36 Mbps IEEE 802.11 data, VoIP and video*

ARLISS

The **Virtual Classroom** is used for the **ARLISS** student satellite program at Black Rock, Nevada. ARLISS has a ten year


history of delivering over 200 autonomous robotic student satellite payloads to 3 miles altitude for recovery in harsh desert conditions. The **Virtual Classroom** provides real-time video, audio, chat and telemetry support for both payloads and airframes.

Balloon Flights

2m APRS services have often been used to track and support high altitude near earth balloon experiments. The **Virtual Classroom**

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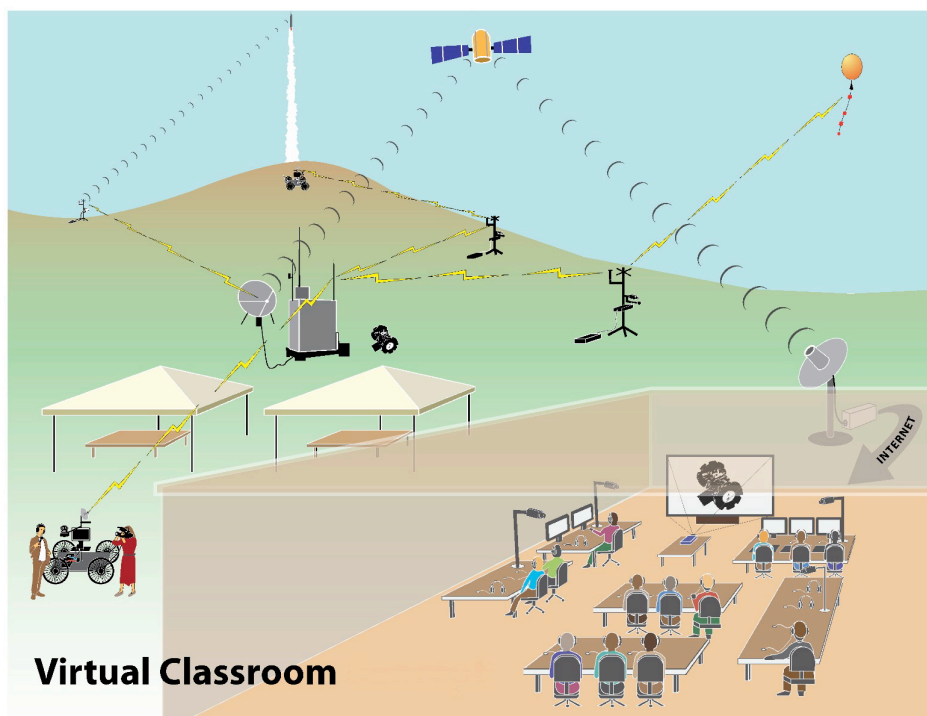
Virtual Classroom

supports these services but adds high bandwidth IEEE 802.11 services that can extend to the altitudes these balloons achieve. The **Virtual Classroom** provides real-time forwarding of these experiments to the Internet and real-time access from remote experimenters to these experiments.

Robot Tele-Presence

Robots can benefit from high bandwidth, multimegabit communications. High bandwidth communications permit near real-time remote processing of data rich media. The **Virtual Classroom** is expected to be a strong asset for such robotic experiments.

Improvements

The prototype **Virtual Classroom** has demonstrated the potential of the concept and exposes key opportunities for improvements.

User interface. The current user interface to the **Virtual Classroom** is the aggregate of existing, individual service user interfaces. Providing an integrated Web 2.0 based user interface to the aggregate services will likely substantially increase the usability of the system to experimenters that are not computer experts.

Increased performance. The IEEE 802.11 family of standards on which the **Virtual Classroom** is based is an evolving standard. The latest IEEE 802.11n standard promises to increase throughput performance by a factor of 2.

Increased Coverage. More repeaters and more access points can be used to increase the coverage area.

Power independence. Upgrade with solar panels to be completely power self-sufficient.

LEO communications. 2m and 70cm APRS has the proven capability for the support of APRS LEO satellite communications. The **Virtual Classroom** has the hardware capability to support this service and further integration to explicitly support LEO communications is likely.

New Applications

Originally designed for support of student satellite experiments, the **Virtual Classroom** can be easily extended to provide remote access to any field based experiments.

One intriguing future new application is the exploration of extending IEEE 802.11 communications to domains currently unexplored. Overhead high bandwidth network coverage to near space - high altitude rockets, balloons and LEO satellites – is a potentially profitable area of examination.

Replication

The **Virtual Classroom** is an inexpensive, open system constructed with the intent of ease of replication for other experimenters and applications.

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