The Access Grid

What is the Access Grid? . . . and what is it good for?

Bill Blyth*

A simple question: what is the Access Grid? A simple (but wrong) answer is that the Access Grid is video-conferencing. A better answer is that the Access Grid (AG) is video-conferencing on steroids. However the AG provides many more features and functionality than video-conferencing and might be better referred to as *video-conferencingPlus*. Many commercial video-conferencing products are available and being used increasingly in business, industry and universities. Basic video-conferencing provides video and audio for meetings. This can be augmented by using a document camera to provide a video image of documents to remote locations. On the other hand, many video-conferencingPlus systems now provide extra features, particularly data transmission or some form of desktop sharing which incudes the capability to not only display, but also to remotely control, the software and data analysis. For example, a spreadsheet or Maple file (or any other software file) can be displayed and remotely controlled. One such system is Bridgit, from SMART Technologies who also developed SMART Boards (see http://www2.smarttech.com/st/en-US/Products/Bridgit/Features.htm). Bridgit is being used for undergraduate mathematics teaching, in suitably equipped lecture theatres, across several campuses at Charles Sturt University. Another system, Elluminate, is being used for international remote teaching via desktops for some of the UK's Open University mathematics courses.

The Access Grid was developed at Argonne National Laboratories in the US and further developments have been an international effort, notably from the US, Canada, UK and Australia (see http://www.accessgrid.org). The AG is at the high end of video-conferencingPlus systems, and it's open source (that is, the software's free). The AG is fully featured and flexible: there isn't a typical Access Grid Room (AGR). However an AGR usually has three (or four) screens which are linked and so operate as one large projection screen, referred to as the wall. In addition, usually there are three cameras positioned to capture the presenter and participants from various angles which provide video streams and there is one audio stream.

The wall is often a large projection 'screen' where the three screens are linked into one seamless screen, such as the AGRs at the University of Birmingham and at La Trobe University. In these cases, provision for handwriting is made by using a normal whiteboard (on a side wall) and the Mimeo hardware and software: this

*Australian Mathematical Sciences Institute, The University of Melbourne, VIC 3010.
E-mail: bill@amsi.org.au

involves using special magnetic sleeves for each whiteboard marker (with different colours) which are tracked by the Mimeo hardware to produce a digital image of the whiteboard handwriting and sketches.

Bill Blyth in the RMIT University Access Grid Room

The wall can include interactive whiteboards. For example, the RMIT University AGR (illustrated above) has three linked SMART Boards and a motorised drop-down fourth screen set at 45° from the front wall: during an AG session presentation from the RMIT AGR, this fourth screen would be used for the videos of the remote audiences (so that the presenter can see the remote audiences). Many variations exist: for example, the AGR at The Mathematical Institute, University of Oxford, uses a front wall of three screens consisting of two inert projection screens and a SMART Board as the middle screen. One of the front screens is used as an audience screen which is copied to a fourth inert screen at the rear of the AGR.

Many presenters like to be able to work with two screens. One screen is used for the main presentation (pdf slides, say) and one screen for demonstrations (using software such as Maple, MATLAB, etc.) or for digital ink (handwritten asides, worked examples or sketches). The presenter can choose to enable, or not, remote control of the software being used: for example remote collaborators can take over the mouse and control the software (which might be Maple, Excel, Word, etc.). This facility is provided by the AG using VNC for the data/software stream.

AG for collaborative research and teaching

AGRs have been well established and widely used for collaborative research. For the last three years, about 90 regional and coast-to-coast seminars, in mathematics and computer science, have been conducted via a network of Canadian AGRs [1]. Recently Australia and the UK have led the use of AGRs for collaborative teaching of advanced courses in the mathematical sciences.

The International Centre of Excellence for Education in Mathematics (ICE-EM, the education arm of AMSI) is coordinating and has partially funded the introduction of a national network of AGRs located in mathematics departments at AMSI member universities. All of these AGRs run a Windows environment for applications. However the AG can also be run under UNIX or Mac environments.

In 2008, there are 11 AGRs operating in mathematics precincts, and there are about 30 additional AG nodes in Australia, some of which could be used by mathematical science departments. Most of the 38 universities in Australia have access to an AGR. In December 2007, an AMSI special one-day seminar was hosted in the RMIT AGR with 16 remote AGRs participating.

The first three mathematical science departments with AGRs ran a pilot program in semester two of 2006: collaboratively teaching Honours mathematics and statistics courses. During 2008, all of the AMSI AGRs are engaged with this national collaborative teaching program, coordinated by the ICE-EM, offering 17 Honours maths and statistics courses (see the ICE-EM website [3]). Students, with the approval of their home university, can take courses for credit toward their Honours degree. All AMSI member universities are invited to participate in this national collaborative teaching program (as well as other AMSI AGR activities such as seminars and workshops).

Six centres in the UK, funded by the Engineering and Physical Sciences Research Council for five years, commenced in October 2007 the teaching of broadening courses for PhD students [2]. Two of these centres use AG technology. They are the MAGIC consortium of 15 universities (see http://www.maths.dept.shef.ac.uk/magic/index.php) and the Taught Course Centre which is a collaboration between the mathematics departments at the Universities of Bath, Bristol, Imperial, Oxford and Warwick (see http://tcc.maths.ox.ac.uk/). A lot of information is freely available from these websites. Many courses are run and the AGRs are timetabled with these teaching commitments for most of each weekday during term.

AGR issues for mathematicians

There are many variations to how AGRs are constructed and how they operate. Mathematicians are often highly computer literate, but are not computer scientists. It is necessary to have good support from IT and network specialists. However it's desirable for standard connections to operate essentially in a turnkey mode (to minimise the specialist IT support that's needed): limited success with turnkey operation has been reported, but this is still an important goal.

ICE-EM has provided AGR teaching guidelines and presentation guidelines (see [4], although these will be revised soon). These include a requirement for the lecturer to have training in AGR use. Training programs are under development: at RMIT the IT Training group, with advice from me, has developed and delivered lessons interactively in small groups. These lessons are not immediately transferable to other institutions for two reasons: the AGRS are different (RMIT is the only one to have linked multiple SMART Boards) and RMIT usage of the mathematical software Maple is atypical.

Each AGR lecturer must be highly organised with prepared teaching and assessment materials and needs to be aware of variable student backgrounds. For AGR courses there are additional requirements for the use of electronic materials and access to these by the students, and pastoral care of the remote students.

At the ICE-EM, we wish to provide advice and support for effective use of the local AGR and remote AGRs. We want lecturers to be able to choose from a wide range of pedagogical styles and software. Typically, lecture notes are prepared as pdf files. The lecturer also uses some mathematical software for demonstrations and/or digital ink. Students submit work done by hand and/or software. Files are exchanged by email or web course management packages such as BlackBoard.

We are currently preparing advice on digital ink and annotations for asides and highlighting during the lecture (laser pointers are not effective) and for marking student work (as a pdf file and marked using a TabletPC and PDF Annotator or Jarnal, say).

Conclusion

The Access Grid is a system that provides video-conferencing and many more features to enable very rich multi-nodal remote collaborations in research and teaching. The mathematics community, especially in Australia and the UK, is leading the way with collaborative teaching of advanced mathematics across networks of AGRs.

References

[1] Borwein, J., Jungic, V., Langstroth, D., Macklem, A. and Wilson, S. (2008). Coast-to-coast (C2C) seminar: background, history, and practice. Also Apendices A & B. In: Borwein, J., Rocha, E.M. and Rodrigues, J.F. (eds) *Communicating Mathematics in the Digital Era*. AK Peters. http://users.cs.dal.ca/~jborwein/c2c08.pdf.

[2] Engineering and Physical Sciences Research Council (2007). New mathematical sciences taught courses. *Connect* **49,** 3. http://www.epsrc.ac.uk/CMSWeb/Downloads/Publications/Connect/Connect49.pdf.

[3] International Centre of Excellence for Education in Mathematics (2008). Subject and Course List. http://www.ice-em.org.au/index.php?option=com_content&task=view&id=51&Itemid=1.

[4] International Centre of Excellence for Education in Mathematics (2008). AGR Presentation Guidelines. http://www.ice-em.org.au/index.php?option=com_content&task=view&id=12&itemid=37\#PresentationGuidelines.

Bill Blyth is Associate Professor (Adjunct) of computational mathematics at RMIT University and was Head of the Department of Mathematics for $6\frac{1}{2}$ years. He is Chair of the Engineering Mathematics Group of Australia, a Center Affiliate at the International Centre for Classroom Research (at the University of Melbourne), led the design, construction and initial delivery phases of the RMIT University AGR and is currently at The Australian Mathematical Sciences Institute, AMSI, as the national coordinator of AMSI's Access Grid Room project. His PhD was in theoretical physics at Imperial College, London. He has an unusually broad range of research interests in mathematics education (in technology-rich classrooms) and the numerical solution of differential and integral equations. He has published more than 60 refereed papers.