和平利用外层空间委员会

空间通信技术应用于远距离教育

秘书长的说明

1. 评价第二次联合国探索及和平利用外层空间会议（82年外空会议）各项建议执行情况全体工作组在其第八届会议工作报告中，建议进行几项更具体的空间应用研究，以证明空间技术的潜力。该工作组确定了几个可能的题目以进行这些研究，包括制订远距离教育方案（A/AC.105/571，附件二，第17(c)段）。

2. 本研究报告是秘书长应全体工作组的要求编写的，其目的是审查空间通信技术在远距离教育方面的应用情况，以及几个国家在实施远距离教育项目方面的经验，主要是供尚未将空间技术用于此目的但对其潜在利益感兴趣的国家所使用。本研究报告的编写采用了报告末尾部分参考文献中所列的各种国家和国际资料来源。下面的研究报告摘要有联合国各种正式语文的版本。本说明附件所载的研究报告全文只以编写时用的语文（英文）分发。

研究报告摘要

3. 教育对于可持续发展、经济增长和减轻贫困极其重要，不断变化的技术和经济改革正迅速改变全世界的经济结构、工业和劳动力市场。这些发展造成教育的三个关键的优先事项：（一）必须使所有人能够接受教育；（二）教育必须支持不断扩展知识；及（三）教育必须满足市场上对能够迅速掌握新技能且适应性强的工人的日益增长的需求。

4. 享有教育机会的问题在占全世界人口约75%的发展中国家尤其重要。如果目前非洲、南亚和中东及北非较高的人口增长率继续下去的话，6至11岁未上学儿童的数量将从1990年的1.29亿增加到2015年的1.62亿。更糟糕的是，上小学的儿童中只有三分之一能够读完小学。其结果是，已影响9亿多人的成人文盲问题可能仍是一个大
问题。

5. 传统的教育手段不完全适合大量人口终身学习的需要，即使在富裕国家也是如此。在发展中国家，要是只采取传统策略的话，那么所有人接受至少是小学程度以上的教育，看起来就像是一个不切实际的梦想。发展远距离教育方案为满足成百上千万儿童和成人的教育需求，提供了一个充满希望的途径。在专门知识与物质和财政资源有限，大量人口生活、工作在农村或偏远地区的发展中国家尤其如此。

6. 最近的趋势表明，工业化和发展中国家的大学都已开始面向地理位置分散的学生的教育项目，这些教育项目发展非常迅速，以便满足对所有人都能享受的灵活终身教育的日益增长的需求。根据大不列颠及北爱尔兰联合王国开放大学国际远距离学习中心提供的数据，目前，英联邦国家的机构大约提供 30,000 门远距离教育课程和教育项目，全世界有大约 850 所远距离教学机构。

7. 传统上，不管是在工业化国家还是在发展中国家，基于课本的函授课程都是提供远距离教育的主要手段。在过去的 30 年间，空间技术的快速发展使得卫星通信系统在提供远距离教育方面非常有效。在向传统通信网络和常规教育系统涉及不到的偏远和农村地区提供教育项目方面尤其如此。

8. 1982 年在维也纳举行的第二次联合国探索及和平利用外层空间会议（ 82 年外空会议）审议了空间通信技术，特别是利用卫星技术的意义。利用卫星技术是为教育目的的发送教学电视（ITV）节目主要手段，并审议了开展区域或国际合作的可能性。82 年外空会议注意到发展中国家需要改进教育基础设施，以便不仅为年轻人提供教育，而且为成年人提供持续的信息、知识和专门知识来源。虽然利用空间技术不能立即解决这些问题，但它可以补充传统的方法，加速教育的传播并提高教育的质量，特别是在偏远和农村地区。

9. 基于卫星的通信网络、信息和数字技术的发展，以及通信和计算机的结合，每月将存储、处理和传输信息的成本降低 50%。除了教学电视节目，这些发展正在为教育工作者提供强有力的工具，他们借此可以与学生进行可靠的支持和双向交流，以便通过电子远距离教育（EDE）促进学习、保持积极性和确保学习不断进步。这已导致接受教育的模式转变，人们不必去中等学校或大学就能接受教育。

10. 在美国，早在本世纪五十年代初就开始用广播和闭路电视进行教学电视节目试验。对这些早期试验节目的评价表明，这种技术与传统的面对面教学方式相比具有相同的效果。教学电视的一个明显好处在于，它可以为许多学科没有合格教师的农村和偏远地区的学生带来受教育的机会。在本世纪七十年代，试验性应用技术卫星（ATS-6）被用于向阿拉巴契亚和落基山区以及阿拉斯加州的偏远和农村地区提供教学电视节目。

11. 在本世纪八十年代，ATS-6试验的积极成果导致许多州，大部分是地域广、人口密度低的州，建立州教育卫星网。许多大学开设了以教学电视为教育节目传送主要手段的远距离教育节目，旨在向农村的中小学校和学院提供普通教育节目，并向校外学生提供合格的研究生和大学本科生课程。随着卫星通信技术的发展，美利坚合众国的学
医学院和大学越来越紧密地与卫星视频网络联系在一起。自本世纪八十年代以来，北美建立了许多网络，以制作特殊教学电视教育节目，或与全部大约 2,000 个配卫星电视接收站的高等教育机构或其中的某些机构共享课程。

12. 在印度，利用定位于印度洋上空的美国 ATS - 6 卫星，从 1975 年到 1976 年进行了卫星教学电视试验（ SITE ）。该试验用的卫星由美国国家航空和航天局（美国航天局）提供，地面设施是印度空间研究组织与全印广播公司（ All India Radio ） /Doordarshan 合作设计和制造的。国内制作的教学电视节目通过 ATS - 6 从设在艾哈迈达巴德和德里的地面站播送。印度几个邦的 2,400 个村庄用专门设计的三米抛物面天线、前端转换器和电视机接收这些节目。卫星教学电视试验方案明确地证明，印度具有技术和组织方面的专门知识，以控制和操纵卫星，制造、维护和操作地面控制站并指挥接收系统，制作充实该系统的足够的教育节目，并使整个系统在城市和农村地区都顺利运作。

13. 卫星教学电视试验的成功导致建立了中央教育技术研究所和六个邦的教育技术研究所，这些研究所利用印度电视和电信卫星系统，发送以卫星为基础的教学电视节目。目前，这项服务固定地分别用于五种地区性语言，为不同年龄组的儿童和教师提供 45 分钟的教育节目。为了充分利用基于卫星的教育的能力，印度空间研究组织正在研制称为 GRAMSAT 的专用卫星飞行任务新概念，以便用各种地区性语言为全国的农村和城市地区提供教学电视节目以及文化和保健信息。

14. 在巴西，教学电视 Telecurso 2000 项目始于 1995 年初，正向辍学或从未进入过巴西正规教育系统的约 5,000 万人提供基于教学电视的小学、中学和职业教育。该项目的关键部分是广泛利用有电视监视器和教学帮助的所谓 telesalas - 特殊培训室，社区中心、教堂、大型工厂和监狱都有这样的特殊培训室。该由由全球电视网受欢迎的“巴西弯早”节目之前播送，白天在教育网络上重播，并由全国各地报摊均有售的印刷材料支持。

15. 在中国，中央广播电视大学（ CIRTVU ）利用广播、教学电视、印刷和视听教学材料开设多媒体远距离高等教育课程。这一现代远距离教育系统由中央广播电视大学，43 所省、自治区和市级电大大学，654 所地区和市级分校、1,500 个县级工作站和 10,000 多个教室组成，范围覆盖中国的农村和城市地区。以中央广播电视大学为中心的整个中国远距离教育系统起初使用中国中央电视台的微波网络，现在则使用能够覆盖全中国和东亚、中亚和东南亚的中国通信卫星。

16. 在建立能够向全国传送教学电视节目的可运作的国内卫星通信网络之前，中国在 1985 年进行了远距离教育试验项目，该项目利用国际通信卫星组织（通信卫星组织）在其卫星和农村教育卫星（ SHARE ）方案框架内免费提供的卫星转发器。结果，在中国偏远和农村地区建造了 53 个小型地面站，以接收教学电视节目并进行重播供当地接收使用。传送的教学电视节目包括不同学科的高级学术课程，以及更多种教学材料，如书法、东方美术和保健讲座。该试验项目证明其在教学成绩和成本效益方面非常成功，这导致建立了一个依赖于国内通信卫星和从通信卫星组织租约的 2 个卫星转发器的。
可在全国运作的中国教育电视台网络。

17. 在澳大利亚，几个州在可运作的基础上，利用卫星教学电视向农村和偏远地区的中小学和中等提供教育节目。到1994年底，维多利亚州170所农村学校配备了小型接收终端，平均成本为每个地点1,700澳大利亚元。该设备提供教室和远程中央导播室之间的双向交互式通信。西澳大利亚州教育部利用政府组织的Westlink服务，向全州所有设在利德维尔的教育交互式电视中心制作的教学电视节目。Westlink服务允许以几分之一的卫星传输正常商业费用发送教学节目。用一个卫星系统每周传输节目4小时，该卫星系统提供一个带有频回程线路的单向宽带视频系统。

18. 1981年，印度尼西亚开始了印度尼西亚远程距离教育卫星系统项目，该项目连接印度尼西亚东部的15所大学。在帕拉帕卫星通信系统的基础上建立了一个开放的交互式视频会议系统，以便向大学生提供学术课程、通过在职培训计划提高教学人员的能力，并促进行政和机构交流。它还使网络所有成员都能利用每个机构的专家资源，从而使每个专业人员的服务范围和作用成倍增加。向网络所有成员提供了各种教育节目，包括60门学术课程和30多个讲习班，有10,000多名学生从印度尼西亚远程距离教育卫星系统提供的交互式节目和其他服务中受益。

19. 作为卫生和农村教育卫星方案项目的后续行动，通信卫星组织确定了Project Access方案，以便在有限期限内提供用于教育和保健的免费卫星容量。最近，Project Access任务下的活动是建立试验性的“美洲远程距离教育和培训网络”。该试验网络由通信卫星组织在国家教育电信组织/教育卫星（NETO/EDSAT）的帮助下设计，它将使美国和美洲其他国家农村和偏远地区的学生受益，以及用作在发展中国家和工业化国家建立类似网络的模式，并导致建立一个专职的自立的全球远程距离教育网络。

20. 许多国家在远程距离教育领域进行的试验性和运作型方案和项目表明，卫星通信技术得到了较好的发展，发展中国家和工业化国家都可以将其成功地用于远程距离教育。无数的研究和研究表明，在许多学科，教学电视能够提供信息和发展能力，其效果可与常规教育系统相比，在某些情况下甚至有过之而无不及。

21. 最近几年，新的信息技术，特别是远程信息处理技术（信息学和电信的交叉学科）的迅速发展，实际上已影响到经济、社会和政治发展的各个领域。技术变化已导致存储、处理和传输信息的硬件和软件成本降低，促进了信息处理和通信设备的小型化、便携性和多样性，并提高了以越来越适合个人爱好和认识风格的方式利用所有媒体——数据、文本、声音、图像和视频——提供的通信信息的能力。

22. 电信、计算机、卫星和光纤技术的结合对于未来以知识为基础的经济至关重要。这种结合还能够使人类的知识基础能够以具有成本效益的价格和交互式格式，在任何地点、任何时间以任何语言获得。联网的电子远距离教育，强调通过在线信息存取和虚拟教室的双向交流性，由于电子网络的全球性、无边界性质及其它能够快速传送信息，联网的教育能够加强接受教育的各个方面的有效利用全球的教育资源，改进学生-教师之间的交流，提供学生对制定课程教学材料作出贡献的机会以及促进教育工作者与研究者共享信息等。
23. 过去几年，工业化国家和发展中国家都越来越多地使用因特网提供教学材料和远距离教育方案。基于因特网的学习允许学生按自己的速度学习和在方便的时候存取信息，并向不能到教室上学的边远地区的学生提供教育。因特网上的一些课程是作为补充学生和教师在教室定期见面的正式课程提供的。许多教育机构通过因特网提供多种学科和专题的在线课程，学习这些课程可以获得毕业证或正式被认可的学位。其他因特网网址免费提供各种专题的非正式教育，并有各种语言版。而包括关于考古学的教育网址。

24. 各国实施了许多发展国家和国际远距离学习基础设施的项目。自 1993 年起，加拿大就开始设计和实现一个称为加拿大学校网络（Canada's SchoolNet）的基于因特网的国家教育网络，日本正在开发用于国际合作、国际文化交流和教育的亚洲及太平洋交互式通信网络（APICNET），旨在在因特网上创建一个全球教室。自 1993 年以来，智利教育部一直在开发连接农村和偏远地区 100 多所小学的教育网络。在澳大利亚，1990年昆士兰州政府创办了昆士兰开放式学习网络（QOLN），以便利用交互式通信技术建立全州范围的教育和培训传送系统。1988 年开始的欧洲学校项目（ESP），是要探讨远程信息处理技术在教育方面的应用问题。在加拿大，1996 年初开始了一个学校网络（SchoolNet）项目，近期目标是连接 50 所中学，使它们能够访问因特网。

25. 这些项目以及许多其他项目表明，基于网络的教育节目传送到边远地区的学生和教育机构带来了很大好处。但由于利用在线电子远距离教育节目的时间相对较短，很难全面评估联网远距离教育在正规教育系统中所起的作用以及电子远距离教育方法的效用。然而，提供联网电子远距离教育节目的机构越来越多，可在获得的教育学科和专题范围越来越广，这些都反映了联网远距离教育已成为目前教育环境不可分割的一部分。这一趋势因成本越来越低，所需的硬件和软件能力越来越高以及通信成本不断下降而得到了加强。

26. 在过去几年里，发展中国家做出大量努力以克服存在的通信问题并加入全球电子网络，以便提高国家教育和科技能力。卫星通信系统已被许多国家用来制定具有成本效益的网络解决方案。诸如 HealthNet 和技术援助自愿者（VITA）等组织实施的几个项目证明，通过通信卫星访问电子函件，可以提供一种向发展中国家偏远和农村地区传送教育节目的低成本和可靠性的手段。

27. 联合国外层空间事务厅（外空事务厅）正在联合国空间应用方案的框架内，就一个项目建议与国际航天局（欧空局）进行合作，该项目建议是在非洲建立一个连接科学家、教育工作者、专业人员和决策者的合作信息网络（COPINE）。在这种合作中，该网络将成为基于卫星的具有交互能力的信息交换网络，它将 13 个非洲国家的城市和农村中心与欧洲的部分医院、大学和信息中心连接在一起。该网络的宽带能力将用于提供各种信息发送服务，特别是计算机文件传递、交互式数据交流与声频、图像和视频传输，以便促进保健、远距离教育、科技信息交流及自然环境资源和环境管理等项目。在非洲初步试验之后，该项目可能最终要扩大到覆盖世界其他区域。

28. 顺应建立国家信息基础设施及其并入全球信息基础设施等全球性趋势，实际上
所有发展中国家都已开始了开发高性能计算机网络的工作，这些网络连接国家大学、中小学校、图书馆和研究中心，能够促进因特网数据高速存取和检索。在许多情况下，这些项目是作为区域或国际性工作进行的。发展中国家进行的并在本研究报告中讨论的几个项目，其目的是要利用卫星、地面线路和微波通路建立教育计算机网络。

29. 电信系统和新的信息技术的发展使得远距离教育，尤其是教学电视和电子远距离教育像常规教学一样有效。如果使用的方法和技术适合教学工作的话。从技术角度来看，卫星通信系统为教育工作者提供了用于发送教学电视和电子远距离教育节目的可靠而有力的手段，使学生特别是偏远和农村地区的学生，有机会收到他们以其他方式不能在当地收到的所需的教育节目。各种技术已经具备，已在国家和国际一级实施的无数项目中证明了这些技术的可行性。计算、电信和电视的进一步结合，有可能在不久的将来在单一网络上提供这三种服务。
Annex*

APPLICATIONS OF SPACE COMMUNICATIONS TECHNOLOGY TO DISTANCE EDUCATION

Study by the Secretariat

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INTRODUCTION

1. Education is extremely critical for sustainable development, economic growth and poverty reduction. Changing technologies and economic reforms are creating dramatic shifts in the structure of economies, industries and labour markets throughout the world. This rapid increase in knowledge and the pace of changing technology raise the possibility that individuals, through frequent job changes, may acquire sustained economic growth. These developments have created three key priorities for education: (i) it must be accessible for all; (ii) it must support the continued expansion of knowledge; and (iii) it must meet growing demands by the market place for adaptable workers who can readily acquire new skills.

*The present study has not been edited.
2. Problems of access to educational opportunities are especially crucial in developing countries, which account for about 75 per cent of the world population. If the current high population growth rates in Africa, South Asia and the Middle East and north Africa continue, the number of 6-to-11-year-old children not attending schools will increase to 162 million by the year 2015, from 129 million in 1990. To make the matter worse, only two thirds of children who start primary school complete it. As a result, adult illiteracy, which already affects over 900 million people, most of them in developing countries, is likely to remain a major problem.

3. Traditional means of education are not fully adequate to meet the needs of large populations for lifelong learning, even in rich countries. In developing countries, education for all, at least past the primary level, looks like an unrealistic dream if only conventional strategies are pursued. Even where available, the quality of education leaves much to be desired and is often declining as costs rise faster than incomes and tax revenues. The increasing cost of education in industrialized countries has consistently outpaced the rate of inflation. This reflects a lack of productivity growth in a crucial sector of what is increasingly becoming a knowledge-based economy.

4. Distance education programmes are a very promising development in meeting the educational needs of millions of children and adults, especially in developing countries where expertise and physical and financial resources are limited and the bulk of the population lives and works in rural or remote areas. The latest trends in education show that universities both in industrialized and developing countries have started programmes oriented to geographically dispersed students. Several institutions specializing in distance education have earned national and international pre-eminence.

5. The Open University of the United Kingdom has gained worldwide attention and many countries have developed their own open universities on this model. Founded in 1969, the Open University is now the largest university in the United Kingdom, with over 3,000 full-time staff and more than 200,000 students. Although television is used extensively, about 90 per cent of the instructional material is print-based. Face-to-face encounters with tutors in 13 regional centres supplement print and televised materials.

6. About 25-30 countries in the sub-Saharan region of Africa have distance teaching institutions, and a number of countries, including Kenya, Malawi, United Republic of Tanzania, Zambia and Zimbabwe, have been implementing distance education curriculums for several years. The University of South Africa (UNISA) is one of the largest distance-teaching institutions in the world. Formed in 1946, UNISA had more than 130,000 students register in 1995. Many countries have even established government institutions responsible for extending the scope and effectiveness of their distance education curriculums, such as the Institute for Distance Learning in South Africa and the Institute for Distance Education in Zimbabwe.

7. Delivery of instructional programmes via radio, which dates back more than six decades to the earliest national broadcasts offered by the British Broadcasting Corporation (BBC) in 1924, have become one of the most effective ways to bring distance education to a very wide audience, especially in developing countries. Supplemented by instructional materials on audio cassettes, educational radio broadcasts still play an important role in many developing countries in delivering programming to both schools and out-of-school learners. The Learning Technologies for Basic Education (LearnTech) project initiated by the non-profit Education Development Center, Inc., based in the United States, has been established to improve distance education in several African countries (Kenya, Lesotho, South Africa and Swaziland) through the use of Interactive Radio Instruction (IRI). Interactive radio is usually used as an aid to the classroom teacher in schools experiencing a lack of instructional materials and qualified staff.

8. Students who learn by IRI actively respond to a “radio teacher” several times each minute by answering questions orally, writing, reading, singing, manipulating simple materials or doing physical exercises. Working with the Open Learning Systems Education Trust (OLSET), a South African non-governmental organization, LearnTech has brought basic education in English and mathematics to over 600 classrooms in South Africa with
excellent results. In many cases, IRI has proven to be less expensive than text-based alternatives, but even more important, studies have indicated that students also learn better and have better attendance and lower drop-out rates.

9. Until recently, little was done in the developing world to bring the benefits of modern telecommunications capabilities to rural and remote areas and to utilize them for educational purposes. Terrestrial systems had to be built one step at a time, spreading out from major urban centres, and had to overcome great geographic barriers and high costs to reach remote areas. Telephone systems planners saw no way to justify the great expense of expanding to rural and remote areas where the number of potential users was too small to make such a service profitable.

10. The rapid development of satellite technology over the last three decades has changed this situation. Earth stations placed at remote sites can create nationwide communications networks without the need to build a complete chain of cable or microwave links covering the entire country. Technical advances have led to more powerful satellites, smaller earth stations and a general reduction in the cost of all the elements of satellite-based systems. A global system of satellites now makes it possible to connect any place on Earth into international telecommunications networks. From an educational standpoint, these networks can be viewed as an all-encompassing, very effective delivery system that can be used to promote human resource development and information exchange.

11. The Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82), held in 1982, considered the implications of satellite communications technology, in particular, direct broadcasting satellite technology, which was a primary means to deliver instructional television (ITV) programmes for educational purposes and the possibility of regional or international cooperation. UNISPACE 82 noted the requirements in developing countries to improve the educational infrastructure, not only to educate the young, but also to provide a continuing source of information, knowledge and know-how to the adult population. While the use of space technology does not provide instant solutions to these problems, it could complement conventional methods, accelerate the spread of education and improve its quality, particularly in remote and rural areas.

12. Developments in satellite-based telecommunications networks, information and digital technologies, as well as the convergence of telecommunications and computers, have been decreasing the cost of storing, processing and transmitting information by 50 per cent every 18 months. In addition to ITV programmes, these developments are providing educators with powerful tools to establish reliable, multi-site, two-way interaction with students in order to facilitate learning, maintain motivation and ensure steady progress via electronic distance education (EDE). This has led to a paradigm shift regarding education access, whereby education goes to the people rather than having people going to the schools or universities.

I. APPLICATIONS TO DISTANCE EDUCATION

A. Instructional television

13. ITV programmes have been used in many countries for a wide range of educational disciplines, with all types of audiences, for elementary, secondary and university education as well as for adult or continuing education in or outside conventional classrooms.

14. In the United States, experiments with ITV programmes were initiated as early as the beginning of the 1950s using both broadcast and closed-circuit television. Evaluation of these first experimental programmes showed that the technology was equally effective compared to conventional face-to-face means of instruction. An obvious
advantage of ITV was that it could bring educational opportunities to students in rural and remote areas where qualified teachers in many disciplines were not available. In the 1970s, the experimental Application Technology Satellite ATS-6 was used to deliver ITV programmes to remote and rural areas in the Appalachian and Rocky Mountain regions and to the state of Alaska.

15. In the 1980s, the positive results of the ATS-6 experiment led a number of states, mostly those with large territories and low population densities, to establish state educational satellite networks. Many universities started distance education programmes using ITV as the primary means for programming delivery and designed to deliver both general educational programmes to rural schools and colleges and to offer accredited graduate and undergraduate degree courses to off-campus students. Now practically every large- or medium-sized university has distance education programmes based on ITV.

16. The Satellite Telecommunications Educational Programming (STEP) network was developed to provide equal learning opportunities for all students regardless of geographic location or educational resources. In 1990, STEP joined with state education agencies from Alaska, Idaho, Montana, Oregon and Washington to form the Pacific Northwest Star Schools partnership to provide distance education services to the five-state region. Using federal funds, STEP/Star partnership enhances and expands distance learning in a region connected by culture and economy. The programme offers ITV courses on a wide range of topics such as foreign languages, mathematics and science. Distance education is provided to approximately 500 schools in the five states serving some 6,000 students in the middle- and high-school grade levels. In addition to student services, the programme also provides professional development activities for teachers and school administrators.

17. The development of the technology also led to the establishment of educational institutions specializing entirely in distance education programmes delivered by ITV and through other new information technologies. The National Technological University (NTU) and the Mind Extension University (ME/U), also known as IEC Knowledge Online, rely heavily on satellite instructional television to distribute the courses of a group of participating conventional universities. NTU was founded in 1984 and it offers a wide range of advanced science and engineering courses using live, satellite-based narrowcast instructional television, sometimes backed by e-mail. About 45 technical universities in North America uplink to the NTU transponder using compressed digital television and there are downlinks in these same universities as well as some 500 sites in high-technology companies and governmental agencies. Both degree courses and continuing education seminars are offered. NTU seeks to be fully global by the year 2000.

18. ME/U employs a similar concept based on satellite and cable television, focusing mainly on technical and business courses, some of which permit interaction with the instructor and other students by telephone and/or e-mail. Of particular interest to educators is the Educational Technology Leadership master's degree programme established in 1988 at George Washington University using ME/U to meet a growing need among education professionals to understand, manage and use electronic educational technologies. The student body for this programme is international.

19. ITV has begun to penetrate the corporate environment as well. Besides large corporations such as IBM, Eastman Kodak and AT&T using their own internal satellite networks for employee training and new product presentations, many other smaller companies have installed their own receiving stations in order to receive programming from external specialized programme providers. A list of some North American ITV programme providers specializing in the development of ITV programmes for schools, universities, continuing and vocational education is given in appendix I.

20. The Public Broadcasting Service (PBS), within the framework of its Project VSAT pilot programme, is promoting the use of a single communications satellite dedicated to educational broadcasts as a carrier of ITV programmes, which now are delivered via a number of satellites, in order to develop better access by schools in
the United States to existing ITV programmes. Implementation of this project would enable schools to receive a variety of ITV programmes using a single small receiving terminal, thus improving access, simplifying equipment and reducing costs. Project VSAT also promotes the use of advanced video-compression technology to increase the capacity of the satellite to allow it to transmit 20-40 programmes using five transponders. The increased satellite capacity will also provide schools with two-way communications capabilities allowing interaction with remote instructors.

21. In India, the Satellite Instructional Television Experiment (SITE), using the United States ATS-6 satellite stationed over the Indian Ocean, was carried out from 1975 to 1976. The satellite for this experiment was provided by NASA and the ground segment was designed and manufactured by the Indian Space Research Organization (ISRO) working in collaboration with All India Radio/Doordarshan. ITV programmes produced domestically were broadcast from earth stations in Ahmedabad and Delhi via ATS-6. These programmes were received in 2,400 villages in several Indian states using specially designed three-metre parabolic antennas, front-end converters and television sets. In some cases the received programmes were rebroadcast by a VHF television transmitter to villages around the transmitter.

22. About 1,400 hours of programming were produced during the experimental period and included both the school ITV programmes and the evening programmes for adults, which combined general education and information with entertainment. Special training programmes in mathematics and science for school teachers were also shown to approximately 50,000 educators in rural and remote areas.

23. Receiving equipment was made in India and its design met climate conditions in the country. Ground stations were placed mostly in electrified villages, but 180 non-electrified villages were selected for battery-powered sets. To address the problem of maintenance and repair, which is as critical as it is common in rural areas in developing countries, a network of field service stations was established. Each field station serviced up to 100 television receiving sets in as many villages, and any equipment problems were reported by mailing a prepaid questionnaire-format postcard to the nearest service station.

24. The development of an operational domestic Indian satellite communications system on the basis of INSAT satellites allowed television coverage to be extended to most of the country through direct reception systems or through a network of community receivers and rebroadcasting stations. The Ministry of Education has established a Central Institute of Educational Technology (CIET) and six State Institutes of Educational Technology (SIETs) to run satellite-based ITV programmes. Currently, this service regularly provides 45 minutes of educational programmes for children of different age groups and for teachers in each of the five regional languages. In order to fully utilize the capabilities of satellite-based ITV, ISRO is developing a new concept of a dedicated GRAMSAT satellite mission to deliver ITV programmes as well as cultural and health information to both rural and urban areas all over the country in each of the regional languages.

25. In Brazil, which also used the ATS-6 satellite for educational broadcasting in the 1970s, the Roberto Marinho Foundation (FRM) has taken the lead in ITV. The FRM has about 15 years of experience in various telecourses and other distance education programmes. FRM is the non-profit subsidiary of the Brazilian Globo Television network, the fourth largest private television network in the world.

26. The latest educational initiative of FRM is the ITV Telecurso 2000 project initiated at the beginning of 1995. It is providing primary, secondary and vocational ITV-based education targeted to the approximately 50 million people who dropped out of or never entered the formal educational system of Brazil. One of the key elements of the project is the extensive use of so-called telesalas—special training rooms with television monitors and teaching assistance available at community centres, churches, large factories and prisons. It is broadcast by the Globo Television network before the popular “Good Morning, Brazil” programme, rebroadcast during the day on educational networks and supported by print materials available at news-stands throughout the country.
Accreditation through a certified examination has been negotiated with state governments.

27. What is unique about this project is that it is financed by the private sector—FRM itself and the Federation of Industries of São Paulo (FIESP)—and is supported by the National Industrial Training Service (SENAI). While the project is still relatively new, the number of participants is growing rapidly and now includes "telesalas" in hundreds of industrial enterprises, industrial training centres, community centres and federal penitentiaries. At the end of March 1996, organized "telesalas" with teaching assistants trained by FRM totalled 1,517 with about 41,000 students. An additional 575 "telesalas" with 15,000 students have been scheduled to start operating with support from the Bradesco Foundation. The number of students studying at home or in informal groups is expected to be much higher.

28. In the Brazilian State of Minas Gerais, the State Secretariat of Education is considering the use of satellite communications systems to deliver ITV programmes developed in support of the Basic Education Quality Improvement Project (ProQualidade). ITV programmes will focus on the training of about 90,000 primary school teachers in Minas Gerais, where 5,500 schools have already been equipped with television sets, video cassette recorders and satellite television receiving antennas under a Brazilian federal government programme.

29. In China, the Central Radio and Television University (CRTVU), an institution that operates directly under the authority of the State Education Commission, runs multimedia distance higher education courses using radio, instructional television, print-based and audiovisual teaching materials. It was inaugurated in February 1979 and now heads a modern distance education system made up of CRTVU, 43 provincial, autonomous regional and municipal television universities, 654 branch schools at the prefecture and city level, 1,500 work stations at the county level and more than 10,000 teaching classes that cover rural and urban areas of China. While initially using the microwave network of China Central Television the entire Chinese distance education system centred on CRTVU now uses Chinese communications satellites capable of reaching all of China plus neighbouring countries in eastern, central and south-east Asia. With 146,000 entering students, 300,000 students matriculated and 120,000 graduates in 1992, CRTVU is probably the world's largest university.

30. Prior to the establishment of an operational domestic satellite communications network capable of nationwide delivery of ITV programmes, China carried out a distance education pilot project in 1985 using a satellite transponder provided free of charge by INTELSAT within the framework of its Satellites for Health and Rural Education (SHARE) programme. As a result, 53 small Earth stations were installed in remote and rural areas of China to receive ITV programmes and for rebroadcast for local reception. Transmitted ITV programmes included advanced academic courses in various disciplines broadcast six hours each day, as well as more diverse educational materials such as lectures on calligraphy, oriental fine arts and health care.

31. The pilot project proved to be very successful in terms of both educational achievements and cost-efficiency, and the Government of China decided to develop a full-scale nationwide ITV network using domestic communications satellite capacity and two satellite transponders leased from INTELSAT. By 1987, the national television network, which included ITV as an integral part of its programming, had become operational. The State Education Commission led the educational effort and established the China Educational Television (CETV) to produce and broadcast ITV programmes via satellite. Working in cooperation with the Ministry of Posts and Telecommunications, CETV operates the earth station to broadcast daily via INTELSAT and Chinasat 31 hours of ITV programming on two channels devoted to educational television. Educational organizations in provinces can produce and broadcast their own ITV programmes through these channels as well.

32. By the end of 1990, about 36,000 hours of ITV programmes had been delivered over two educational channels. More than 600 receiving and rebroadcasting stations and 4,000 direct receiving systems had been installed in 29 provinces. In addition to academic or general education programmes, CETV offers distance training for elementary and secondary school teachers in rural and remote areas as well as programmes in continuing,
professional and adult education. About 20 million people view CETV programmes or take ITV courses either at home or at learning centres throughout the country.

33. In Australia, a number of states use satellite ITV on an operational basis to deliver educational programmes to primary and secondary schools located in rural and remote areas. By the end of 1994, 170 rural schools in the State of Victoria were equipped with small receiving terminals, at an average cost of S 1,700 per site. The equipment provides two-way, interactive communications between the classroom and the remote central studio. During the telesessions, students have the opportunity to communicate with the lecturer/presenter in the central studio while watching the programme and can ask questions and have them answered immediately, allowing them to be actively involved in the learning process. Using this system also enables students to become familiar with modern technology from an early age.

34. The lessons are delivered from the studio of the Victorian Directorate of School Education. From there the programmes are sent via the Telecom network to an Optus uplink facility for transmission to the satellite. Classroom teachers work in partnership with the television presenters to ensure that students get the most out of the programmes. Print and audio materials are supplied to participating schools for use between broadcasts. Funding for this effort has been provided by the Victorian Education Foundation, Country Education Project, the Directorate of School Education and individual sponsors. The success of these ITV programmes led to the decision by the Minister for Education to provide all government schools in Victoria with free satellite receiving equipment.

35. The Education Department of the State of Western Australia uses the government-sponsored Westlink service to deliver state-wide ITV programmes produced by the Education Interactive Television Centre at Leederville. The Westlink service allows the distribution of teaching and learning programmes at a fraction of the normal commercial cost associated with satellite transmission. Programmes are transmitted for four hours each week using a satellite system that provides for a one-way broadband video system with an audio return path. In 1994, 130 hours of ITV programming were delivered to rural schools in Western Australia.

36. Indonesia was the first developing country to operate its own satellite communications system in 1976 when it launched Palapa A-1 and made it possible to provide all 26 provinces of this archipelago nation with improved telephone, telex, radio and television services. The network of Earth stations has expanded from 40 ground stations installed at the beginning to more than 200 after two decades of operation.

37. In order to explore the most effective ways of using the Palapa system for specific development programmes, Indonesia started the Indonesian Distance Education Satellite System (SISDIKSAT) project in 1981 in close cooperation with the United States Agency for International Development (USAID) and as a part of the USAID-sponsored Rural Satellite Program (RSP). Linking 15 distant universities in the eastern part of Indonesia, an open interactive audioconferencing network was established on the basis of the Palapa satellite communications system to deliver academic courses to university students, upgrade faculty skills through in-service training programmes and facilitate administrative and institutional communication. It also made available the expert resources of each institution to all members of the network, thus multiplying each professional’s outreach and effectiveness. A variety of educational programmes was delivered to all members of the network, including 60 academic courses and over 30 seminars. More than 10,000 students benefited from these interactive programmes and other services offered by SISDIKSAT.

38. In Europe, the Education Across Europe project sponsored by Matra Marconi Space connects 12 schools and colleges in the United Kingdom with a number of participating schools in Austria, France and Slovenia. ITV programmes, covering such subjects as geography, history and languages, are transmitted via Eutelsat satellite. The project began in 1992 and is ongoing and developing.
39. INTELSAT, which owns and operates the world’s most extensive global communications satellite system, contributed much to the development of satellite telecommunications applications to distance education, especially through its project SHARE. Project SHARE, initiated jointly by INTELSAT and the International Institute of Communications (IIC) in 1984, provided free use of the INTELSAT international satellite network to foster telecommunications development in rural and remote areas, with the primary aim of assisting in distance education and health care.

40. Originally, the project had been intended for only a 16-month period, but it proved to be such a success that it was extended twice and was operational until the end of 1987. The national ITV network in China, mentioned above, is one example of the types of project undertaken within the SHARE framework.

41. As a follow-up to project SHARE, the Project Access programme was established by INTELSAT to provide free satellite capacity, for a limited duration, for education and health care. One of the latest activities under the Project Access mandate is the establishment of a pilot “Distance Education and Training Network of the Americas”, which will take place in early 1997. The pilot network to be designed by INTELSAT with the assistance of the National Education Telecommunications Organization/Education Satellite NETO/EDSAT, will benefit students in rural and remote areas of the United States and other countries in the Americas, as well as serve as a model for establishing similar networks in developing and industrialized countries and lead to the development of a full-time, self-sustaining global distance education network.

42. Experimental and operational programmes and projects in distance education carried out by many countries have shown that satellite communications technology is well developed and can be successfully applied to distance education by both developing and industrialized countries. Numerous evaluation studies have demonstrated that ITV is capable of delivering information and developing skills in many disciplines with effectiveness comparable to, and in some cases exceeding, conventional education systems.**

43. While technology itself and the equipment associated with this technology currently do not pose any significant problem to ITV projects, the overall organization of a project and ITV programming are among the main difficulties experienced by countries and organizations, including the underestimated importance of organizational issues such as coordination between telecommunication and education authorities, training teachers in distance education methodology, publication and distribution of printed materials that support ITV programmes, synchronization of broadcasts with school curriculums and setting up a network of community centres for viewing programmes. These problems can substantially reduce the effectiveness of any programme.

44. The production of educational programming is also an extremely important, and often a very expensive, element of any ITV project. Programmes should be designed in a fashion that reaches a target group in the most efficient and cost-effective way and taking into account the national and age peculiarity of the students. Use of graphics, special visual effects and on-site recording can enhance educational content and, at the same time, make a programme more attractive for the audience. Organization of interactive telesessions, which make possible live communication between student and remote lecturer, not only increases the effectiveness of ITV programmes but also provides a programme provider with necessary feedback.

**A comprehensive overview of research reports, studies and articles published from 1945 to 1995 on the effectiveness of distance education in general, and ITV in particular, can be found in the paper “The ‘No Significant Difference’ phenomenon”, by Thomas L. Russell, Director, Office of Instructional Telecommunications, North Carolina State University, which is available on the Internet at URL http://tenb.mta.ca/phenom.
B. Electronic Distance Education

45. In recent years, the rapid development of new information technologies, especially telematics (the intersection of informatics and telecommunications), has affected virtually every sector of economic, social and political development. The technological changes have led to decreased costs in hardware and software for storing, processing and transmitting information, increasing miniaturization, portability and diversity of information-processing and communication equipment, and the capability to present and manipulate information in all media—data, text, voice, image and video—in ways that increasingly match individual preferences and cognitive styles.

46. The convergence of telecommunications, computers, satellites and fibre optics technologies is critical to the knowledge-based economy of the future. This convergence also promises to make the knowledge base of humanity available anywhere, any time, in any language, at cost-effective prices and in an interactive format. Because of the global, borderless nature of electronic networks and their fast delivery of information, networked education can enhance the whole spectrum of the educational experience, including the effective use of educational resources worldwide, improved student-teacher interaction, the opportunity for students to contribute to the development of course materials and information sharing between educators and researchers.

47. The Internet is the largest, most powerful and fastest-growing computer network in the world. It is estimated that more than 40 million people have access to the Internet and that in mid-1995 there were around 5 million host computers worldwide connected to the Internet. Over 110 countries have direct Internet access with at least one host computer in the country; if other e-mail networks are taken into account, about 160 countries have links to the Internet.

48. The Internet has been used increasingly in the last few years to deliver educational material and distance education programmes in both industrialized and developing countries. Internet-based learning allows students to learn at their own pace and access the information at a convenient time, and provides education to remote students who otherwise would not be able to travel to a classroom.

49. Some courses available on the Internet are delivered as a formal programme complementing regular meetings between students and teachers in the classroom. A large number of institutions offer on-line courses through the Internet in a wide range of disciplines and topics that can lead to diplomas or formal accredited degrees.

50. Other Internet sites offer informal education at no charge on topics ranging from an interactive medical tutorial on the spinal cord and text books on chemistry, mathematics and physics, to learning languages such as Japanese, German and English, and include an educational site on archaeology.

51. Students participating in EDE programmes receive texts and workbooks via either regular mail or the Internet. Through common files assigned to a class that each student can access, teachers upload syllabuses, lectures, grades and remarks. Remote students download these files, compose their assignment and remarks off-line, then upload them back to the common files. Students and instructors are usually required to log in for a certain number of days during a week. Through these networks, faculty, students and the administration of the institution have easy access to each other as well as access to database resources provided by libraries. Some examples of formal education programmes offered through the Internet are given below:

(a) CyberEd Dartmouth is a World-Wide-Web-based system that offers full-credit university programmes from the University of Massachusetts, Dartmouth Division of Continuing Education. While traditional resources such as textbooks are used, students also draw on the extensive resources already available on the Internet. Class material and assignments are posted on the World Wide Web at a site open only to those students taking the course;
(b) International University College (IUC) offers a Master of Arts in Business Communication. The primary way students communicate with the teaching faculty, administrative staff and other students is through e-mail. IUC uses mailing list managers (listservs) to enable course discussions and these listserv discussions are an important portion of the course grade. Students submit written assignments to teaching faculty through e-mail and assignments are returned with comments and suggestions in the same fashion. Listservs allow students to discuss group projects with other members of the class and to send questions or comments to teaching faculty or classmates;

(c) The University of Paisley Online Education WWW Server provides degree courses from accredited universities aimed at working professionals. The courses can lead to degrees such as a Bachelor of Science in Health Studies, a Master of Business Administration (MBA) in Marketing, a Master of Science in Computer Aided Engineering and an MBA in Total Quality Management. Each enrolled student is provided with an advanced PC, a high-speed modem and a printer, which are delivered and set up in the student's home. Students interact with tutors by connecting to the Electronic Campus on Internet. Frequently travelling students can use notebook computers that allow them to continue studying anywhere. Course materials are pre-loaded in the computer supplied and consist of notes in hypertext, together with a software package for word-processing, graphics, analysis and communication. Students engage in live teleconferencing, closed and open discussion forums and e-mail, through which students send their assignments to their instructors for evaluation. An on-line library on the Internet is also available;

(d) The City University of Bellevue, Washington, Education Resource and Online Academic Degree System (EDROADS) offers more than 80 programmes at the undergraduate and graduate levels that cover a variety of academic fields such as business management and technology, humanities, the social and natural sciences and counselling. Master of Business Administration and Master of Education degree programmes are also offered.

A list of selected programmes and courses available on-line is given in appendix II.

52. A variety of technologies are currently being used to deliver education programmes over the Internet including the World Wide Web for on-line lecture notes, newsgroups for collaborative discussions and class announcements, video and audio instructions, e-mail correspondence between students and instructors, interactive desktop videoconferencing and computer-conferencing for remote participation in classes and group discussions and virtual reality for exploring three-dimensional scenes. Multimedia is increasingly being used in on-line education to enhance the learning process.

53. One of the most prominent trends in distance education brought by informatics is the emergence of the open learning concept, which can be defined as "a student-centred approach to education which removes all barriers to access to information while providing a high degree of learner autonomy". The Internet supports the open learning concept by providing students with the ability to connect to educational resources when it is convenient for them and allowing students to explore the educational resources in a fashion that suits their needs. In an open learning environment the teacher no longer serves as the keeper of knowledge. Instead, the teacher acts as a tutor, facilitator and resource to assist in the student’s learning process.

54. A large number of projects in the development of national and international distance learning infrastructures have been carried out in various countries. Since 1993, Canada has been working on design and implementation of a national Internet-based educational network called Canada’s SchoolNet. Japan is developing the Asia-Pacific Interactive Communication Network (APICNET) for international cooperation, international cultural exchange and education aimed at creating a global classroom on the Internet. APICNET has made it possible for schools in Japan to participate in projects planned by educators in other countries as well as to devise their own projects and invite participation from schools overseas.
55. Since 1993, the Ministry of Education in Chile has been developing an educational network that connects more than 100 elementary schools in rural and remote areas in order to provide students and teachers with educational support as well as with access to information resources available on the Internet. In Australia, the Queensland Open Learning Network (QOLN) was initiated by the State government in 1990 in order to establish a state-wide delivery system for education and training using interactive communications technologies. The network comprises over 40 open learning centres spread throughout the State to provide remote learners with access to computer teleconferencing and audioconferencing, e-mail and satellite ITV reception facilities.

56. The European Schools Project (ESP) was initiated in 1988 by the University of Amsterdam to explore educational applications of telematics. ESP has spread out to 26 countries, offers participating schools educational, organizational and technical support, and provides opportunities for electronic communication between students, teachers and educational networks for the design and implementation of cooperative EDE projects and for the development and effective use of information resources to enhance learning and teaching. In Ghana, a SchoolNet project was initiated at the beginning of 1996 with the immediate goal of connecting 50 secondary schools and providing them with access to the Internet. The project will open new opportunities for students to interact, both locally and internationally, with teachers and other students as well as enable them to participate in the open learning programmes over the Internet.

57. In the United States, the National School Network Testbed (NSNT) project was organized by the National Science Foundation (NSF) in 1992 in order to explore ways in which schools and other educational institutions could take advantage of Internet-based learning and build their own local information infrastructures in support of desired educational reforms. Currently, about 250 institutions participate in the project, including 150 schools across the United States, one school in Canada and one in Australia. The Common Knowledge: Pittsburgh network project was initiated in 1992 to provide participating schools with access to educational and information resources not available to the Pittsburgh school system. The project enhanced the teaching environment and served the development of curricular activities in all subject areas and at all grade levels; for example, a virtual classroom for German language instruction was established on-line.

58. These and many other projects have shown that network-based delivery of education programmes provide many benefits to both the remote student and the educational institution. But owing to the relatively short period of time that on-line EDE programmes have been used, a complete evaluation of the role networked distance education plays in the formal education system as well as the effectiveness of the EDE methodologies is very difficult. However, the growing number of institutions offering networked EDE programmes and the widening range of educational disciplines and topics available on-line reflect the fact that networked distance education has already become an integral part of the current educational environment. This trend is supported by the declining cost and increasing capacity of the required hardware and software as well as by the declining cost of communications.

59. Until recently, the participation of developing countries in global computer networking was extremely limited because of the undeveloped basic communication infrastructures, especially in rural and remote areas. There are more telephone lines in Manhattan, New York, than in all of sub-Saharan Africa, as noted by Thabo Mbeki, Deputy President of South Africa. In 1992, 49 countries had fewer than one telephone per 100 people. Outdated terrestrial communications networks and a lack of international interconnectivity in many developing countries create a situation where a telephone call from Senegal to Zambia is routed through London. In addition, these networks simply cannot support a data transfer speed of 9.6 kilobits per second over a distance of even a few kilometres.

60. In the last few years, developing countries have spent a great deal of effort to overcome their existing communications problems and to join global electronic networks in order to enhance national educational and
scientific capabilities. Satellite communications systems have been used by many countries to develop cost-effective networking solutions. A number of projects carried out by different organizations proved that access to e-mail arranged through communications satellites could provide a low-cost and reliable means of delivery of educational programmes to remote and rural areas in developing countries.

61. For example, HealthNet is a computer-based telecommunications system that links health care and health education workers around the world. Since 1994, HealthNet has provided its users (more than 4,000 in more than 30 countries worldwide) with low-cost e-mail connectivity through a Low Earth Orbit (LEO) HealthSat store-and-forward microsatellite and radio links from any area with little or no telecommunications infrastructure. Inexpensive ground equipment needed to contact the satellite consists of an IBM-compatible PC, a Terminal Node Controller (TNC), a satellite radio and antennas. HealthSat is capable of storing and forwarding full-duplex communication at 9,600 bits per second.

62. The Volunteers in Technical Assistance (VITA) organization is assisting the Global Learning and Observations to Benefit the Environment (GLOBE) Programme to reach into developing countries by providing capacity from its VITASat LEO communications satellite system. This system comprises a store-and-forward communications satellite which allows e-mail and data to be delivered anywhere in the world in 90 minutes and a network of low-cost highly portable ground stations designed specifically for developing countries.

63. The GLOBE Programme was introduced in 1994 as a part of the Global Information Infrastructure (GII) initiative and began operations in early 1995. More than 2,500 schools in 43 countries participate in this international science and education programme aimed at gathering and sharing information to better understand the global environment as well as helping all participating students reach higher standards in science and mathematics. Guided by trained teachers, students in participating schools conduct a wide array of core and elective observations, ranging from basic weather parameters such as temperature, atmospheric pressure and precipitation to more sophisticated measurements such as water chemistry, biodiversity and patterns of seasonal change. These measurements are sent by various means, including global computer networks and communications satellites, to processing centres where they are combined with information gathered by other GLOBE students, scientists and Earth observation satellites. The students receive next-day feedback from the scientific community on how their data is being used.

64. Following the worldwide trend of establishing National Information Infrastructures (NII) and their integration into GII, virtually all developing countries have started working on the development of high-performance computer networks that link national universities, schools, libraries and research centres and are capable of facilitating high-speed Internet data access and retrieval. In many cases these projects are carried out as regional or international efforts.

65. Current satellite communications technology provides a cost-effective and flexible option for establishing access to the Internet (including a full range of services such as e-mail, file-sharing, file transfer and computer-conferencing) as well as for interconnection of remote sites in developing countries through a network of standard ground stations or through Very Small Aperture Terminals (VSATs), which provide a more advanced solution. A number of projects carried out by the developing countries aim at establishing educational computer networks using a combination of satellites, terrestrial lines and microwave links.

66. In 1991, the Organization of American States initiated the Hemisphere-Wide Inter-University Scientific and Technological Information Network (with the Spanish acronym of RedHUCyT) project with the main objective of connecting member States to the Internet by integrating an electronic network to exchange information and programmes among different academic and scientific institutions.
67. In the Caribbean region, an electronic information network linking the universities of the Caribbean, known as the Caribbean Academic, Scientific and Technological Network (CUNet), was formally launched in September 1991. More than 20 nodes in the subregion currently connect, via dial-up, over 1,000 users within the CUNet framework. RedHUCyT has supported the establishment of the Jamaican Electronic Network (JAMNet), allowing Jamaica to be fully connected to the Internet. With a 64-kilobits-per-second satellite link to the United States National Science Foundation Network (NSFNet), 400 hosts at the University of the West Indies have received full connectivity to the Internet.

68. In Central America, resources have been allocated for establishing a backbone of interconnected institutions, with Costa Rica serving as a hub and other countries connected via direct satellite links. The National Research Network of Costa Rica (CRNet) has been connected to the Internet through a satellite link to a NSFNet server in Florida. RedHUCyT provided equipment and technical assistance for setting up the Nicaraguan Academic Network and connecting it to Costa Rica through microwave links. The connection of Panama to the Internet, also through CRNet, linked these three major universities in 1994. RedHUCyT has also provided equipment, technical assistance and training to Argentina, Bolivia, Chile, Ecuador, Mexico, Paraguay, Peru, Uruguay and Venezuela, and satellite earth stations have been installed in Mexico, Peru and Venezuela.

69. The Pan-Pacific Education and Communication Experiments by Satellite (PEACESAT) programme has a primary mission to support international distance education, research, telemedicine, emergency management and economic development experiments and applications, as well as to provide an opportunity for research in the development and applications of low-cost satellite communications technologies. PEACESAT achieves these mission goals through the use of satellite communications and provides many different non-commercial services. These services include access to the Internet and other information services, point-to-point and voice conferencing and compressed video.

70. The PEACESAT network ties together government, educational and other non-profit national and regional organizations in 22 Pacific countries. There are 44 PEACESAT earth stations in this network with nine more in the planning stages. Through this network, PEACESAT helps to integrate participating countries into GII.

71. PEACESAT is funded in part by the National Telecommunications and Information Administration of the United States Department of Commerce. The programme began in 1971 through the use of a single voice circuit on ATS-1, and it now operates nine simplex and three full-duplex circuits on the Geostationary Operational Environmental Satellites of the National Ocean and Atmospheric Administration. In addition to Internet services, PEACESAT has also developed and implemented remote access capability and electronic post-office systems, and is exploring the deployment of special interfaces to its Earth stations to support low-cost continuous access to the Internet for extremely remote areas and for management of emergency cases.

72. In South Africa, the Telematics for African Development Consortium has been established in order to promote distance education programmes in the region. The consortium consists of such companies and institutions as the South African Broadcasting Corporation, the Telcom S.A. telecommunications company, the research centre known as CSIR, the University of South Africa (UNISA), which is a specialized distance education institution, the University of Pretoria, St. Alban's College and some other community organizations and private enterprises.

73. The initial projects of the Consortium are the first phase of a multiphased programme expected to last at least five years and to reach out to other African countries. Through a number of pilot projects, the first phase is intended to prove concepts and to test the efficiency of satellite communications and other wireless technologies for networking and connecting to the Internet through VSATs and specially developed infrared/laser interfaces. The objectives of the first phase are to provide the following:
(a) A prototype Internet-based academic English reading skills course for 7,600 students at UNISA. This programme is aimed at helping raise the scores of students who could not meet the minimum education entrance requirements to institutions of higher education. Once tested and evaluated, the course will be made available to all UNISA students (currently numbering some 128,000) and, as a free public service, to anyone with Internet access through the UNISA server;

(b) A prototype Internet-based biology syllabus and course for use by secondary level school students and teachers. Once tested and evaluated, the programme will be made available to teachers and students with Internet access;

(c) Wireless wide-area high-bandwidth connectivity for the disadvantaged township of Mamelodi and for the rural school outside Pretoria. After testing, this concept will be developed into a system that can be replicated throughout Africa to provide wireless access to networks in remote and rural areas where there are no existing telecommunications infrastructures;

(d) Informal information services through the wireless infrastructure to the disadvantaged community of Mamelodi. This project provides the means to acquire training in basic life skills, transparent governance and small business development;

(e) Examples of development tools which will facilitate and accelerate further development of the project. These include the development of a curriculum creation and management tool and a multimedia interface supporting effective delivery of the educational content to students.

74. The Consortium is actively seeking cooperation with other organizations and institutions interested in contributing to the solution of African telematics problems. The Telecommunications Foundation for Africa, based in Kenya, is involved in the activities of the Consortium and negotiations are under way with the Informatics Centre of Eduardo Mondlane University at Maputo, Mozambique.

75. The Office for Outer Space Affairs (OOSA), within the framework of the United Nations Programme on Space Applications, is working in cooperation with the European Space Agency (ESA) on a project proposal aimed at establishing a cooperative information network linking scientists, educators, professionals and decision makers in Africa (COPINE). This project is the response of OOSA to a recommendation of the United Nations regional conference held at Dakar in 1993 on the need to establish efficient communication links between African scientists and professionals. When operational, COPINE would be a satellite-based information exchange network with interactive capability linking urban and rural centres in 13 African countries (Botswana, Eritrea, Ghana, Malawi, Mozambique, Namibia, Nigeria, South Africa, Tunisia, Uganda, United Republic of Tanzania and Zimbabwe) and selected hospitals, universities and information centres located in Europe.

76. The wideband capabilities of COPINE will be used to provide a variety of information delivery services, particularly computer file transfer, interactive data exchange and audio, image and video transmission, in order to facilitate projects in health care, distance education, scientific and technical information exchange and natural resource and environment management. The objective of the distance education applications of the COPINE system would be to improve the quality of education in remote and rural areas by providing educators in these areas with a tool that gives them easy and efficient access to the education centres of their countries. Through its e-mail connection, COPINE also would offer educators in rural areas electronic access to information databases around the world.
II. CONCLUSIONS

77. Within the global context of rapid technological changes and shifting market conditions, conventional education systems worldwide are challenged, without increased budgets, with providing increased educational opportunities required by a knowledge-based economy. Many countries and national and international educational institutions are answering this challenge by developing distance education programmes. The number of these programmes has grown very rapidly in order to meet the increasing demand for flexible lifelong learning available for all. According to the International Centre for Distance Learning (ICDL) of the Open University of the United Kingdom, there are currently about 30,000 distance courses and programmes offered by institutions in the countries of the Commonwealth and about 850 distance teaching institutions worldwide.***

78. The development of telecommunications systems and new information technologies has made distance education, and in particular interactive ITV and EDE, as effective as traditional instruction, if the methods and technologies used are appropriate to the instructional tasks. The open learning approach, which has been introduced through new information technologies, allows students to work at their own pace and provides them with greater control over the learning process.

79. From a technical point of view, satellite communications systems provide educators with reliable and powerful means for delivery of ITV and EDE programmes, and give learners, especially in remote and rural areas, opportunities to access desired education programmes, which otherwise are not available locally. The technologies are in place and their feasibility has been demonstrated in numerous projects carried out on a national or international scale. Further convergence of computing, telecommunications and television will make it possible to provide all three services over a single network in the near future.

80. However, ITV and EDE programmes should not be viewed as a complete replacement of teachers and conventional educational processes, but rather as important components of improving and enhancing instruction and learning processes. Educational technologies change the role of the instructor, and pro-active steps should be taken to mediate these changes. Efficient organization of projects and the development of appropriate educational content are very important for effective implementation of ITV and EDE programmes. Programming should include interactive elements and should also be designed to meet both the needs of the learners and the requirements of society. Timely feedback from instructors and regular evaluations of the progress of students should be an integral part of the distance education process.

81. The applications of satellite communications to distance education currently are in transition from experimental to operational use, particularly in developing countries. The projects discussed in the present study illustrate the value of space communications systems for the promotion of distance education programmes in various countries, but do not by any means exhaust the ways in which space technology can be used for such programmes. Rather, the examples are intended to reflect ways in which countries and institutions using space communications can develop new approaches to meet the educational needs of society.

82. Updated information on the ongoing distance education projects as well as the latest developments in applications of new technologies, including space communications, to distance education can be found in numerous journals and periodicals, some of which are listed in appendix III.

***ICDL has established a database of distance education resources. This database contains detailed entries on available distance education programmes and on institutions offering these programmes, as well as reference to approximately 8,000 books, journal articles, conference papers, research reports and other types of literature related to all aspects of the theory and practice of distance education. This database can be accessed through its Internet home page at http://www.icdl.open.ac.uk/icdl.
Appendix I

SELECTED NORTH AMERICAN SATELLITE INSTRUCTIONAL TELEVISION PROGRAMME PROVIDERS****

American Chemical Society (ACS) satellite television seminars. The ACS satellite television seminars offer the opportunity to learn directly from and speak with leading experts in a variety of chemically related fields. The broadcasts can be downlinked throughout North America; access to overseas sites can also be arranged.

American Law Network (ALN). ALN transmits high-quality continuing legal education programmes and related events via satellite to viewing sites throughout the United States.

American Management Association (AMA). AMA broadcasts via satellite live interactive management and professional video conferences directly to receiving stations at user sites.

CSUSAT-CHICO. ITV programme consisting of live courses that originate from California State University, Chico campus, and are broadcast via satellite throughout California to selected sites.

Community College Satellite Network (CCSN). A division of the American Association of Community Colleges, CCSN is a coalition of higher-education institutions sharing resources through the cooperative use of satellite technology to serve the needs of its members, their communities and business and industry.

Federal Training Network. The Federal Training Network provides satellite-based training for government and private organizations nationwide.

Mass LearnPike. This interactive educational television network offers programmes designed to supplement the K-12 curriculum and to provide teacher professional development. The programmes can be viewed live via satellite and/or taped for later use.

NASA Aerospace Education Services Program. The NASA Aerospace Education Services Program is a nationwide, free programme for teachers, students and the general public.

National Technological University (NTU). NTU is a private, accredited, non-profit institution founded in 1984 to meet the advanced educational needs of engineers, scientist and technical managers through satellite delivery of advanced technical education.

National University Teleconference Network (NUTN). NUTN supports applications of new and emerging technologies in videoconferencing and distance education.

PBS Adult Learning Satellite Services (ALSS). PBS established ALSS to deliver, via satellite, a broad range of high-quality educational programming directly to colleges, universities, businesses and other organizations.

Satellite Educational Resources Consortium (SERC). With SERC programmes, students can join thousands of others around the United States to participate in courses outside their regular school curriculum.

Satellite Communications for Learning (SCOLA). SCOLA is a non-profit educational consortium that receives and retransmits ITV programming from more than 30 different countries in their original languages. These programmes are transmitted via satellite to schools, colleges, universities, government and military installations, businesses and private individuals throughout North America and much of the north-western hemisphere. SCOLA operates two 24-hour satellite channels with more in the planning stages.

Appendix II

SELECTED PROGRAMMES AND COURSES AVAILABLE ON-LINE*****

_Athabasca University_. Canadian open university specializing in distance education.

_Cornell University_. Programme in instructional and informational applications of microcomputers.

_Christopher Newport University_. On-line full-credit college courses.

_European Association of Distance Teaching Universities/Open University of the Netherlands_. The seventeen national members of the Association collectively provide distance education programmes.

_University of Geneva_. Provides information on designing courses for the World Wide Web.

_University of Indiana, School of Education, Distance Education Programme_. Offers beginning and experienced educators fully accredited coursework that can be completed at home at a pace that suits their schedules.

_Internet University_. On-line college-level credit courses.

_Mercy College_. Offers a number of undergraduate credit courses on-line.

_University of Minnesota, Department of Food Science and Nutrition_. Offers a number of courses via the Internet.

_National Teachers Enhancement Network_. Offers graduate-credit science and mathematics courses to teachers nationally.

_University of Phoenix_. Offers accredited graduate and undergraduate degrees in business administration and management entirely on-line.

_Rochester Institute of Technology_. Offers interactive distance learning programmes in electrical/mechanical/telecommunications software and software development and management.

_SPECTRUM University_. More than 10 free courses are offered over the Internet.

_The Virtual Global College_. Provides lifelong learning via the Internet free of charge to promote learning in developing countries.

_Washington State University_. Offers digital image processing course.

_World Lecture Hall_. Contains links to pages created by faculty worldwide who are using the World Wide Web to deliver class materials such as course syllabuses, assignments, lecture notes, examinations, class schedules and multimedia textbooks.

_Fayetteville Technical Community College (FTCC) Virtual Campus_. Offers a selection of standard, full-credit college courses to the global audience of the World Wide Web.

*****Data Source: TeleEducation New Brunswick, Canada.
Appendix III

SELECTED JOURNALS AND PERIODICALS COVERING DISTANCE EDUCATION******

American Journal of Distance Education. Three issues per year; published by the American Centre for the Study of Distance Education, College of Education, Pennsylvania State University, 403 South Allen Street, Suite 206, University Park, Pennsylvania 16801-5202, United States of America.

Distance Education. Published each May and October by the Distance Education Centre, University of Southern Queensland, Post Office Darling Heights, Toowoomba, Queensland 4350, Australia.

Epistolodidaktika: the European Journal of Distance Education. Two issues per year, journal of the Association of European Correspondence Schools; subscription enquiries to The Rapid Results College, Tuition House, London, SW19 4DS, United Kingdom.

Indian Journal of Open Learning. Published each January and July by the Indira Gandhi National Open University, Maidan Garhi, New Delhi 110 068, India.

Istruzione a Distanza (IAD). Published quarterly by Istruzione a Distanza, Piazza San Carlo III, 42 I-80137 Napoli, Italy. The language of the journal is Italian, but coverage is international.

Journal of Distance Education. Published each November and May by the Canadian Association for Distance Education (CADE), 205-1 Stewart Street, Ottawa, Ontario, Canada, K1N 6H7.

Open Forum: Distance Education and Open Learning. Published by the Distance Education Centre, University of Southern Queensland, Post Office Darling Heights, Toowoomba, Queensland 4350, Australia.

Open Learning. Published each February, June and November by the Longman Group Ltd, Fourth Avenue, Harlow, Essex, CM19 6AA, United Kingdom.

Open Learning Update. Published each February, May, August and November by the Open Learning Technology Corporation Ltd, Science Park, Laffer Drive, Bedford Park, South Australia 5042, Australia.

Open Praxis. Two issues per year, in April/May and September/October, by the international Council for Distance Education (ICDE), Gjerdrums vei 12, N-0486 Oslo 4, Norway, as successor to the ICDE Bulletin.

Revista de Educación a Distancia. Published three times each year by RED, Centro para la Innovación y Desarrollo de la Educación a Distancia, Argumosa No. 43, Pabellón 6, 28012 Madrid, Spain. The journal is in Spanish, but overseas contributions are included.

Revista Iberoamericana de Educación Superior a Distancia. Published each October, February and June by the Asociación Iberoamericana de Educación Superior a Distancia (AIESAD), Universidad Nacional de Educación a Distancia (UNED), Apartado de Correos 50.487, 28080 Madrid, Spain.

IEC News. Published since 1991 by the International Extension College (IEC), Dale’s Brewery, Gwydir Street, Cambridge, CB1 2LJ, United Kingdom.

******Data source: International Centre for Distance Learning.
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United Nations. Committee on the Peaceful Uses of Outer Space. The feasibility of using direct broadcasting satellites for educational purposes and of internationally or regionally owned space segments: study conducted with the assistance of a group of experts. 29 April 1985. (A/AC.105/341/Rev.1)