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National Policy on Information and Communication Technology (ICT) In School Education

Department of School Education and Literacy
Ministry of Human Resource Development
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with comments as track changes
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Information and Communication Technology Policy in School Education - 2010

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1. Preamble

The National Policy on Education 1986, as modified in 1992, stressed upon employing educational technology to improve the quality of education. The policy statement led to two major centrally sponsored schemes, namely, Educational Technology (ET) and Computer Literacy and Studies in Schools (CLASS) paving the way for a more comprehensive centrally sponsored scheme – Information and Communication Technology @ Schools in 2004. Educational technology also found a significant place in another scheme on upgradation of science education. The significant role of ICT in school education been highlighted in the National Curriculum Framework 2005 (NCF) 2005.

Use of ICT for quality improvement also figures in Government of India's flagship programme on education, Sarva Shiksha Abhiyan (SSA). Again, ICT figured comprehensively in the norm of schooling recommended by Central Advisory Board of Education (CABE), in its report on Universal Secondary Education, in 2005.

With the convergence of technologies it has become imperative to take a comprehensive look at all possible information and communication technologies for improving school education in the country. The comprehensive choice of ICT for holistic development of education can be built only on a sound policy. The initiative of ICT Policy in School Education is inspired by the tremendous potential of ICT for enhancing outreach and improving quality of education. This policy endeavours to provide guidelines to assist the States in optimizing the use of ICT in school education within a national policy framework.

2. Vision, Mission and Policy Goals

Vision

The ICT Policy in School Education aims at preparing teachers and youth to participate creatively in the
establishment, sustenance and growth of a knowledge society leading to all round socio-economic development of the nation and global competitiveness.

The policy should note the central role of teachers in any such process- all our policy documents have stressed this. Given the tendency in ICT programs to bypass teachers and reach students directly through para (ICT) teachers, this is a omission that needs to be corrected.

Mission

To devise, catalyse, support and sustain ICT and ICT enabled activities and processes in order to improve access, quality and efficiency in the school system

We need to move from a 'ICT as a tool' approach where we 'use' ICTs in education to a more integrated approach – considering ICTs as a critical pedagogical as well as systemic strengthening resource – the successful programs, whether Kerala IT@Schools or the USRN have done this integration.

Policy Goals

To achieve the above, the ICT Policy in School Education will endeavour to:

Create

- an environment to develop an ICT knowledgeable community
- an ICT literate teacher and student community who can deploy, utilise, benefit from ICT and contribute to nation building
- an environment of collaboration, cooperation and sharing, conducive to the creation of a demand for optimal utilisation of and **optimum returns on the potentials of ICT** in education

the idea of optimum returns is inconsistent with the ideals of education – education is not only an instrumental process and ICTs in education also cannot be an instrumental process, ICTs need to be seen as integral to the educational processes.

Promote

- universal, equitable, open and free access to state of the art ICT and ICT enabled tools and resources to all students and teachers

The stress on free and open is important – an important principle in public education is the public ownership of educational resources. Since ICTs represent important educational resources, their public ownership is essential for free and open sharing. Both ICT tools (software applications) as well as ICT resources (digital learning resources) must be publicly owned. Privatised ownership (through proprietary software or content) is antithetical to this foundational consideration

- development of local and localised quality content and enable students and teachers to partner in the development and critical use of shared digital resources
- development of professional networks of teachers, resource persons and schools to catalyse and support resource sharing, upgradation, and continuing education of teachers; guidance, counselling and academic support to students; and resource sharing, management and networking of school managers and administrators, resulting in improved efficiencies in the schooling process this is an important step. However much more than promoting efficiencies (which it will), this process of local resource creation and sharing can rejuvenate teacher education in the country. Creation, sharing, peer review of digital learning resources by teachers, in collaboration with other teachers and mentoring of teacher educators is one of the most powerful methods of self-directed, self-paced, need-based and continous teacher professional development. This has the potential to rejuvenate our teacher training system, a dire need especially given RTE,

- research, evaluation and experimentation in ICT tools and ICT enabled practices in order to inform, guide and critically utilise the potentials of ICT in school education

Motivate and enable

- wider participation of all sections of society in strengthening the school education process through appropriate utilisation of ICT

3. Operational Definitions of ICT

Information and Communication Technologies are defined as all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital forms, which can be deployed for realising the goals of teaching learning, enhancing access to and reach of resources, building of capacities, as well as management of the educational system.

These will not only include hardware devices connected to computers, and software applications, but also interactive digital content, internet and other satellite communication devices, radio and television services, web based content repositories, interactive forums, learning management systems, and management information systems.

These will also include processes for digitisation, deployment and management of content, development and deployment of platforms and processes for capacity development, and creation of forums for interaction and exchange.

The term digital learning resources is preferable to the term content. The role of teaching learning material (TLM) is well understood in the education system and ICTs provide methods of creating digital teaching-learning resources. The process as well as the output (DLR) is dynamic and inherently a educational activity. Content creation does not capture this meaning.

4. Information and Communication Technology in School Education

4.1 Challenges and Issues

Challenges before the Education System in India

Concerns of reach and access to education continue to attract widespread attention of all segments of society. Following sustained initiatives spread over many decades, the country can today boast of perhaps one of the largest ever schooling systems. With increased throughput, and ever increasing numbers of students aspiring for higher education, concerns of equity in education and issues of quality have also begun to attract attention. The challenge of developing alternate modes of education, continuing education, teacher capacity building, information systems for efficient management of the school system are being addressed. With Information and Communication technologies becoming more accessible, reliable and mature, the prospect of leveraging ICT for education is becoming increasingly feasible.

While ICTs do provide enormous access and outreach, the role in empowering teachers through participatory processes / decentralised programs should not be underestimated. The promise of a new teacher professional development model that is self-directed, self-paced, need-based and continuous is only possible through appropriate use of ICTs (as the pioneering USRN project has shown)

Information and Communication Technologies in Schools

Information and Communication Technologies have enabled the convergence of a wide array of technology based and technology mediated resources for teaching learning. It has therefore become possible to employ ICT as an omnibus support system for education. The various challenges the Indian education system poses and the potential of ICT to respond to these are:

1. ICT can be beneficially leveraged to disseminate information about and catalyze adaptation, adoption, translation and distribution of sparse educational resources distributed across various media and forms. This will help promote its widespread availability and extensive use.
2. There is an urgent need to digitize and make available educational audio and video resources, which exist in different languages, media standards and formats.
3. Given the scarcity of print resources as well as web content in Indian languages, ICT can be very gainfully employed for digitizing and disseminating existing print resources like books, documents, handouts, charts and posters, which have been used extensively in the school system, in order to enhance its reach and use.
4. ICT can address teacher capacity building, ongoing teacher support and strengthening school system's ability to manage and improve efficiencies which have been difficult to address so far due to the size of the school system and the limited reach of conventional methods of training and support.
5. Using computers and the Internet as mere information delivery devices grossly underutilizes its power and capabilities. There is an urgent need to develop and deploy a large variety of applications, software tools, media and interactive devices in order to promote creative, aesthetic, analytical and problem solving abilities and sensitivities in students and teachers.

This is an important statement. ICTs are delivery channels but even more importantly, provide opportunities for collaboration / sharing / peer learning as well as co-construction of digital learning resources at all levels in the education system – this process can result in a huge explosion of digital learning resources in the education system – this would address the two critical requirements of our education system
a. connecting teachers/schools/teacher educators and reducing isolation
b. creating digital resources on large scale (english wikipedia has 35lakh articles while a few Indian languages have less than ten thousand and our teachers need to be seen as best possible contributors at a systemic level to digital knowledge in Indian languages)

4.2 ICT Literacy and Competency Enhancement

The policy should clearly define that teacher digital literacy and comfort is an essential pre-requisite to student digital literacy. Bypassing teachers is a dangerous and flawed approach – any such program would not sustain without the ownership and commitment of the regular teachers, secondly learning is a mediated process. In the absence of teachers, the student would be vulnerable to dangers and risks in the digital world and the teacher has the responsibility of helping students negotiate and navigate this space. (The nobel prize winning novel 'Lord of the flies' is a scary reminder of what can happen if adults entirely left children to their ways)

The policy defines ICT Literacy in terms of levels of competence. Based on the stage of schooling at which a student or teacher is introduced to ICT, they may progress to different levels. These levels are suggestive and adaptations must be made to suit local conditions. The levels do not correspond to class levels and time duration must also be locally

determined. Also, these levels must be revised periodically to keep pace with changing technology. However for uniformity a certain level of competency would mean achievement of a certain stage.

Stage 1: Basic

Basics of computers and basic use of tools and techniques – operating a computer, storing, retrieving and managing data, using a computer to achieve basic word and data processing tasks; connect, disconnect and troubleshoot basic storage, input and output devices

Connecting to the internet, using e-mail and web surfing, using search engines, keeping the computer updated and virus free, operating and managing content from external devices (sound recorders, digital cameras, scanners etc.); connect, disconnect, operate and troubleshoot digital devices;

using a variety of public educational software applications in different subjects (this has been used in Kerala program for last 8 years). Teachers and students can learn to use thes applications since they are relevant to their regular subject learning. This should be part of the basic component.

The software applications available in different subjects (and used in thousands of schools in Kerala and across the world) are provided in table below

Application Area	Public Software	Description
Science	Kalzium	This shows the periodic table and the properties of elements. It acts as an encyclopedia, explaining states of matter, evolution of elements. Basic equations can be balanced using this tool.
	Kstars	Desktop planetarium-Astronomy with over 130000 stars, all planets, etc.
	Stellarium	This is a desktop planetarium software that shows exactly what you see when you look up at the stars.
	Phet	Fun, interactive simulations of physical phenomenon
	KTechLab	This tool can be used to build your own circuits and explain its various components
Maths	Geogebra	An algebra and geometry package providing for both graphical and algebraic input
	Tux Math	A fun game through which children can practise their addition, subtraction, multiplication and division.
	KBruch	This tool can be used to explain fractions as well as for the children to practice arithmetic problems.
Logic	KTurtle	The turtle will follow whatever directions you give it. Can be used to draw various symmetrical figures and is a good exercise of logic.
Social Studies	KGeography	Quiz on different states and capitals across the globe
	Marble	This acts as a desktop atlas.
English	KHangman	Guess the correct work with a certain number of guesses

		allowed
	KAnagram	Unscramble the word
	KLetters	Identify the alphabets by recognising the sound
Typing	Tux typing	"Tux Typing" is an educational typing tutor for children.
Educational Games for young children	GCompris	GCompris is an educational software suite comprising of numerous activities for children aged 2 to 10.
	Childsplay	Childsplay is a suite of educational games for young children
Multimedia	Audacity	Software for recording and editing sounds.
	Kdenlive	Kdenlive is an intuitive and powerful multi-track video editor, including most recent video technologies
	Blender	3D graphics tool
Collaborative Learning	Sugar	Sugar reinvents how computers can be used for education. Sugar promotes sharing, collaborative learning, and reflection
Others	Tux Paint	Children can identify objects and can use their creativity to prepare pictures

All these tools are publicly owned, hence there is are financial implications of providing them to schools, unlike proprietary software tools.

Stage 2: Advanced

Creating and managing content using a variety of software applications and digital devices; using web sites and search engines to locate, retrieve and manage content, tools and resources; install, uninstall and troubleshoot simple software applications etc.

Implementation Strategies

4.2.1 A programme of ICT literacy will be implemented across all secondary schools in the States, both government and private within the XI plan period.

4.2.2 States will develop an ICT literacy curriculum and appropriate course materials mapped to the stages mentioned above for uniformity. These will be in the form of self-instructional materials, enabling students and teachers to process them on their own. The ICT literacy programme will endeavour to provide a broad set of generic skills and conceptual knowledge and not focus on mastering the use of specific software applications.

The focus should not be on ICT Literacy alone, but on ICT enabled learning – using ICTs for reglar subject teaching-learning by teachers and through teachers with students. Focusing on ICT literacy makes it decontextualised and hence does not get the ownership of teachers. This is also clear from the Kerala program

4.2.3 The Boards of Secondary Education will develop a suitable scheme of Evaluation. ICT would be an additional subject, with the marks/grade listed separately together with the award of a certificate of proficiency.

4.2.4 The ICT Literacy programme will be extended to the upper primary stage by the end of the XII plan period. However States may take up this expansion earlier, based on resource availability and capacity of the system.

4.2.5 A dedicated teacher with appropriate qualification will be engaged in each school. This teacher will also function as the ICT coordinator of the school where ICT Literacy is to be imparted. With the growth of infrastructure in the school, a suitably qualified technical assistant may also be provided.

The 'computer teacher' model has proved to be a failure across the country
While a lab attendant may be useful in the school, to take care of the lab, raise complaints and track with vendors, a specialist computer teacher would greatly harm the program. Even basic digital literacy should be taught to students through regular subject teachers – as the Kerala progra shows, this is essential to making the program sustainable. Specialist computer teachers are not necessary, since this model isolates ICT program from the school/teachers and does not create ownership and commitment amongst the regular teachers (in our research in schools, teachers clearly stated this lack of engagement)

4.2.6 A Curriculum Framework for ICT in Education (CFICT) will be developed at National Level and States will be encouraged to develop their Curriculum on the basis of CFICT.
this should be developed through the same structures that are responsible for curricular frameworks – NCERT- SCERT institutions – this is necessary to look at ICTs as educational resources rather than as standalone technologies.

4.3 ICT enabled teaching – learning process

4.3.1 ICT enabled teaching-learning encompasses a variety of techniques, tools, content and resources aimed at improving the quality and efficiency of the teaching-learning process.
There needs to be equal stress on participation of teachers in the processes – ICTs have enormous potential for decentralised, participatory approaches and should not be looked purely as efficiency inducing centralising tools

Ranging from projecting media to support a lesson, to multimedia self-learning modules, to simulations to virtual learning environments, there are a variety of options available to the teacher to utilise various modes/ICT tools for effective pedagogy including digital resource creation. Each such device or strategy also involves changes in the classroom environment, understanding of which has a bearing on its effectiveness. Availability of a wide range of such teaching-learning materials will catalyse transformation of classrooms into ICT Enabled classrooms.

4.3.2 All teachers, all of whom would have acquired a basic competency to handle these resources, will be encouraged to adopt ICT enabled practices in teaching learning. A wide range of appropriate software applications (for this it is essential that these be publicly owned and not proprietary), digital content, tools and resources will be made available through the proposed digital repositories. Teachers will participate in selection and critical evaluation of digital content and resources. They will also be encouraged to develop their own digital resources, sharing them with colleagues through the digital repositories.

4.3.3 In schools equipped with EDUSAT terminals, DTH or other media devices, relevant activities will be planned and incorporated into the time schedule of the school.

4.3.4 Initially the teachers may use the Computer lab for teaching-learning but progressively more classrooms will be equipped with appropriate ICTs, making way for ICT Enabled classes

4.4 ICT related Elective Courses at the Higher Secondary level

4.4.1 States will initiate the process of launching/creating courses in different areas of ICT for the higher secondary stage. The courses will factor in the requirements of students of different streams.

4.4.2 Courses will be modular in design to enable students to select appropriate software applications based on current needs of higher education and job prospects. Courses will be revised frequently to keep pace with emerging trends in ICT.

4.4.3 A Post Graduate teacher with appropriate qualifications to teach these courses will be appointed.

The 'computer teacher' model has proved to be a failure across the country

While a lab attendant may be useful in the school, to take care of the lab, raise complaints and track with vendors, a specialist computer teacher would greatly harm the program. Even basic digital literacy should be taught to students through regular subject teachers – as the Kerala progra shows, this is essential to making the program sustainable. Specialist computer teachers are not necessary, since this model isolates ICT program from the school/teachers and does not create ownership and commitment amongst the regular teachers (in our research in schools, teachers clearly stated this lack of engagement)

4.4.4 An ICT Lab attendant/technical assistant with appropriate qualifications will be appointed to manage the ICT/Multimedia Resource lab.

5. ICT Infrastructure

There will be two types of Infrastructure:

Core ICT Infrastructure

Enabling Infrastructure

5.1 Hardware

5.1.1 The States will establish state of the art, appropriate, cost effective and adequate ICT and other enabling infrastructure in all secondary schools

there have been significant innovations in hardware space, however programs still use obsolete models.

5.1.2 Based on the size of the school, needs of the ICT programme and time sharing possibilities, States will define an optimum ICT infrastructure in each school. Not more than two students will work at a computer at a given time. At least one printer, scanner, projector, digital camera, audio recorders and such other devices will be part of the infrastructure.

5.1.3 Each school will be equipped with at least one computer laboratory with at least 10 networked computers to begin with. Each laboratory will have a maximum of 20 computers, accommodating 40 students at a time. A student computer ratio of minimum 10: 1 is to be achieved progressively in all schools.

5.1.4 Exclusive laboratories with appropriate hardware and software will be provided for the higher secondary classes. (Please refer to Annexure I).

5.1.5 In addition, at least one classroom will be equipped with appropriate audio visual facilities to support an ICT enabled teaching-learning.

5.1.6 Appropriate hardware for Satellite terminals will be provided to selected schools in a progressive manner.

5.1.7 Computers will be provided at the library, teachers' common room and the school head's office to realise the objectives of automated school management and professional development activities.
5.1.8 ICT enabled education can be significantly enhanced and the range of classroom practices expanded with the introduction of digital devices like still and video cameras, music and audio devices, digital microscopes and telescopes, digital probes for investigation of various physical parameters. These will also form a part of the infrastructure. States will make appropriate choices and promote the use of such devices in classrooms.
5.1.9 Standard framework defining norms to be adopted for procurement of requisite computer hardware / software etc. will be prepared. Outsourcing of the provisioning of various services under the Scheme, suggested methodologies and processes to be adopted, indicative cost projections for their adoption in the implementation of the Scheme by various States and UTs will be included in the same.
outsourcing of hardware maintenance can have benefits. However, core curricular and pedagogical processes should not be outsourced – thus ICTs should be used by teachers to teach regular subjects as well.

5.2 Network and Connectivity
5.2.1 All computers in the school will be part of a single local area network to enable optimum sharing of resources. In addition to the laboratory, internet connections will also be provided at the library, teachers' common room and the school head's office.
5.2.2 Each school will be serviced with broadband connectivity of at least 2 MBPS capacity. The number of computers given internet connectivity will be governed by the available bandwidth, in order to ensure adequate speeds. A mechanism to have offline access to internet content will be set.
5.2.3 Teachers and students will be educated on issues related to the safe use of internet Firewalls and other security measures will be implemented to block inappropriate sites and to guard the school network against misuse of the ICT facilities. Appropriate guidelines for network connectivity will be developed.

5.3 Software
5.3.1 A wide variety of software applications and tools, going well beyond an office suite is required to meet the demands of a broad based ICT literacy and ICT enabled teaching learning programme. Graphics and animation, desktop publishing, web designing, databases, and programming tools have the potential of increasing the range of skills and conceptual knowledge of the students and teachers. A judicious mix of software will be introduced in schools to keep Total Cost of Ownership (TCO) to the minimum.

The fundamental issue about software is not economic but pedagogical. Software is essentially an educational resource – whether these are subject software applications in mathematics, science etc (refer table provided) or web browsers to access internet resources, or text editors or audio-video editors that enable teachers and students to create resources. Educational resources used in the public education system MUST be under public ownership – private ownership over educational resources can be hugely detrimental to achieving our educational aims and can subvert state curricular goals by making it dependant on private parties.

In all domains, educational resources are publicly owned – this allows for free sharing, contextualisation, modifications as required. Thus the policy needs to unequivocally require all digital resources – both software tools, applications as well as digital learning resources to be in the public domain.

Proprietary software and proprietary digital resources cannot be used in the public education

system.
Secondly, public software applications are being used widely. In India, Kerala, Gujarat, Assam, Orissa have preferred to use public software. CDAC, has made available public software applications in operating system and office automation areas. On GNU/Linux, hundreds of publicly owned educational tools are available. One important reason for the success of the Kerala IT@Schools program is its wide use of publicly owned educational software tools

Mandating publicly owned software tools would move us from a 'minimalist' learning resource proprietary environment to a resource rich maximalist public software environment

Many countries in Europe, South America also have clear preference for public software. Hence there is no reason to allow proprietary software to be used.

Even on economic grounds it is obvious that publicly owned software is better – there are no license fees on initial purchase and on upgrades. Customisations can be done locally without being locked into one vendor (such monopoly/vendor lock in is expensive). GNU/Linux platform is virus resistant and this means higher uptime.

5.3.2 Creation and widespread dissemination of software compilations, including specialised software for different subjects, simulations, virtual laboratories, modelling and problem solving applications will be encouraged.

The second draft clearly had a provision favouring free and open source software. See below

5.3.2
Free ware, free and open source software applications will be preferred. Creation and widespread dissemination of software compilations, including specialised software for different subjects, simulations, virtual laboratories, modelling and problem solving applications will be encouraged.

This is an omission which would be very detrimental to public education system, reasons given in previous section

5.4 Enabling Infrastructure
5.4.1 The enabling infrastructure required to efficiently maintain the ICT facility will be defined, established and maintained.
5.4.2 Regular and regulated supply of electricity, appropriate electrical fixtures, adequate power backup and support, including alternate sources of energy, where needed, will be ensured. Students and teachers will also be trained in the safe use of electrical outlets and fittings.

5.4.3 Physical facilities like an adequately large room, appropriate lighting and ventilation, durable and economic furniture suitable for optimisation of space and long hours of working will be established.
5.4.4 Adequate safety precautions and rules for use will be established. Each laboratory will be equipped with a portable fire extinguisher and students and teachers trained in its use. An appropriate fire drill will also be implemented.
5.4.5 All the equipment and resources will be covered under an appropriate insurance policy against theft and damage.

6. Digital Resources

6.1 Digital Content and Resources

6.1.1 The state shall endeavour to provide universal, equitable, open and free access to ICT and ICT enabled tools and resources to all students and teachers.
6.1.2 Given the diversity of the country's educational, linguistic and social situation, there exists a need for a wide variety of digital content and resources for different subjects, curriculum, ages/grade levels and languages.
6.1.3 States will ensure an appropriate definition of use, mechanisms for generation of content and capacity building for integration into the curriculum.

6.1.4 The State shall strive to maintain and share e-content which is in conformity with Open Standards. Open Standards are royalty free, non-commercial and publicly maintained. Content may be maintained in version controlled system so as to enable collaborative development of the same. Sharing of digital content and resources would require the development of teacher communities, which will function as self help groups providing peer support, showcasing best practices and exchange of know how.
Open standards is mandatory – open standards compliance will also mean popular proprietary office application cannot be used since it uses proprietary document standards (.doc, .xls and .ppt). The open standards notification has mentioned ODF as the open standard for documents

Use of free and open source
applications for developing content and simulations in various subjects will be encouraged to facilitate unrestricted and unencumbered sharing of tools, code and content, particularly for easy translation into different languages and its widespread use.
This should be provided in the section 5.3.2 on software

These communities will
also benefit from the active participation and support of interested individuals, groups and the IT industry.

FOSS community and FOSS enterprise linkages very important – these are voluntary groups working to create digital tools for use of all

6.2 Development of Content

6.2.1 There is a need to phase out digital content development – initially concentrating on difficult to teach/comprehend concepts, moving further to development of content for all concepts and finally culminating towards more sophisticated interactive ICT tools for teaching and learning, e.g. virtual laboratories. The e-content could be in the form of e-books, animations, lessons, exercises, interactive games, models and simulations, videos, Presentation slides, plain text materials, graphics, or any combinations of the above.
again policy should focus on decentralised resource creation in addition to centralised creation. Similarly review mechanims can also combine traditional review structures with decentralised peer

mechanisms. ICTs provide opportunities for both centralised and decentralised processes. There is a need for both. Specially decentralised teachers communities of learning can collaborate to create, review content which is also locally relevant. This should be emphasised.

6.2.2 The proposed web based digital repositories will host a variety of digital content, appropriate to the needs of different levels of students and teachers.
6.2.3 Raw content resources like photographs, video, audio and animations will be remodelled to develop multimedia learning objects.

6.2.4 Teachers and students should be encouraged to develop e-content collaboratively.
6.2.5 Textbooks, teachers'/students' guides, question banks, FAQs, laboratory manuals, problem sets, activities, notes and a variety of other print based learning resources available in the public domain will be digitised and deployed on the national and state level web based digital repositories.
6.2.6 Educational standards and instructional designs for a variety of digital content and resources will be widely disseminated to enable development of quality digital content, including interactive multimedia materials and learning objects.

6.3 Sharing and Dissemination of digital content

6.3.1. Widespread sharing and dissemination of digital content will promote infusion of ICT into classroom practice. Suitable open standards for interoperability, web based sharing and appropriate norms for free access will be defined to catalyse use of digital content and resources.
6.3.2 Collections of digital content and resources will be deployed on web based digital repositories, which will be universally accessible. Private Public partnership projects for the same could be encouraged. State level and National level repositories will be developed and maintained. Emphasis will have to be placed on multi lingual e-content development in State Regional Languages with facilities for translation to other languages so as to optimise time, effort and cost. Content Delivery Networks will be developed to enable multipoint transmission of content.
6.3.3 National level organisations like Central Institute of Educational Technology (CIET), National Council of Educational Research and Training (NCERT). Indira Gandhi National Open University (IGNOU) and State level organisations like State Institutes of Educational Technology (SIETs) will play a proactive role in developing and sharing of digital content. They will also support the capacity building activities of teachers in digital content development and usage.
6.3.4 Content developed by state funded projects and programmes will be deployed under appropriate licensing norms (like the creative commons) to facilitate open and free access to these resources.
6.3.5 A web portal for monitoring ICT implementation by various States / UTs with built in mechanisms for capturing success stories and best practices amongst various others will be designed and developed.
6.3.6 Teachers and students will be oriented to prevailing copyright regimes, different types of restrictions on reuse of content and the need to respect copyright. Teachers and students will also be educated about alternate forms of licences like the creative commons and encouraged to use them. (Pl see Annexure II for a description of Proprietary and Open Licenses)

6.4 Role of School Library

6.4.1 The library in the school will search, collate and categorise digital resources and make them available to the teachers and students. The school library will have to be digitized in cataloguing and the library automation will gradually will need to be in

place for facilitating access to the variety of digital resources. An automated library with internet access will catalyse the use of digital resources in all classes.

7. Capacity Building

7.1 Capacity building of In-service Teachers

7.1.1 Capacity building of teachers will be the key to the widespread infusion of ICT enabled practices in the school system. A phased out programme of capacity building will be planned. In service training of teachers will comprise of Induction Training as well as Refresher Courses. The induction trainings should be imparted by the Regional Institutes of Education (NCERT), State Councils of Educational Research and Training (SCERTs) or such other institutions of the Central and State Governments and should preferably be completed before the commencement of the academic year. The refresher trainings should be carried out every year to enable the teachers to share, learn and keep abreast of the latest trends in ICT based teaching learning processes. The induction training would be followed by teacher's evaluation to ensure that the minimum competency is achieved.

7.1.2 Training in ICT will be integrated with general training programmes organised for teachers and school leaders at all levels in order to popularise its use and to demonstrate effective practices in ICT.

7.1.3 Beginning with an initial sensitisation through ICT operational skills and ICT enabled subject teaching skills, teachers will become part of online professional groups (e.g. English teachers association) to continue their education, pool in their resources and actively contribute to the strengthening of domain specific knowledge within the country.

7.1.4 Teacher participation in the digital content development process will catalyse its broad based usage in the classrooms. Teacher capacities will be developed in instructional design, selection and critical evaluation of digital content, and strategies for effective use of digital content to enhance student learning.

7.2 Capacity building through Pre-service Teacher Education

7.2.1 Teacher educators will be suitably oriented and trained to use ICT in their pre-service teacher training programmes. They will also be expected to enable pre-service teachers to be sensitised to and practice the use of ICT.

7.2.2 All pre-service teacher education programmes will have a compulsory ICT component The existing curricula for pre-service teacher's training will need to be revised for including the appropriate and relevant ICT course. All teacher trainees passing out of teacher education programmes will have obtained adequate levels of competency in ICT and ICT enabled education. This proficiency will form a part of the eligibility criteria for teacher appointments.

7.2.3 National Council for Teacher Education (NCTE) has already laid down guidelines about availability of ICT infrastructure in each such training institution. NCTE would prescribe appropriate curriculum in ICT, to be revised periodically, for such teachers.

7.3 Capacity building of Schools Heads

7.3.1 School heads will play an important role in establishment and optimal utilisation of ICT and ICT enabled education practices in the school. All school heads will undergo appropriate orientation in ICT and ICT enabled education training programmes.

7.3.2 School heads will also be trained in processes leading to automation of administration, management and monitoring of the school system and will play a proactive role in the implementation of School Education Management Information System (SEMIS).
7.3.3 School heads will be oriented to ensure the upkeep and safety of the ICT infrastructure and the optimum use of the ICT facilities.

7.4 Capacity building of State / District Education Department Personnel

7.4.1 States / Districts Education Department personnel at all levels will be oriented to infuse ICT into their work. They will also be oriented to various aspects related to the ICT implementation at the school level, SEMIS and sustenance of the ICT infrastructure.
7.4.2 School clusters encompassing neighbourhood schools should be established for sharing and learning from each other aiming to hasten the process of integration of ICT into all aspects of the school system.

8. ICT for other Areas of School Education

8.1 ICT for Children with Special Needs

8.1.1 Use of ICT will catalyse the cause and achieve the goals of inclusive education in schools.
8.1.2 ICT software and tools to facilitate access to persons with disabilities, like screen readers, Braille printers, etc. will be part of the ICT infrastructure in all schools.
8.1.3 All teachers will be sensitised to issues related to students with special needs and the potential of ICT to address them. All capacity building programmes will include components of ICT enabled inclusive education.
8.1.4 All web based interfaces developed for the programme including digital repositories, management information systems, etc. will conform to international guidelines for accessibility.
8.1.5 Accessibility norms will be adopted as per W3C guidelines to enable the content to be accessed by children with special needs. Web based digital repositories with W3C compliance will address the lack of availability of resources for persons with disabilities. Digital content and resources, for the exclusive use of persons with disabilities, talking books for example, will also be developed and deployed.

8.2 ICT for Skill Development (Vocational Education)

8.2.1 Job oriented courses in ICT will be developed and established for students of the vocational stream at the higher secondary level by linking them with the need of ICT enabled industries/establishment in the neighbourhood.
8.2.2 The courses will be modular and students will be provided a wide range of choices, catering to a variety of job options, hardware and software platforms, tools and resources. Appropriate mechanisms to counsel students in selecting career paths and courses will be developed simultaneously.

8.2.3 The courses will be frequently revised and updated in order to maintain relevancy to changing requirements of the job market and emerging trends in technology. Hence it will also be imperative to conduct such courses in close liaison with industry.
8.2.4 The institutions offering Vocational courses will be required to integrate ICTs in their teaching-learning process.
8.2.5 An open learning system will be developed permitting students to continue to reskill themselves. Conventional restrictions of age and previous qualifications will be suitably reworked to facilitate an open system. Where feasible, online and distance modes will also be explored. Lateral and vertical mobility needs to be established amongst the courses available with multi entry and multi exit.
8.2.6 A system of On-demand evaluation and certification, to enable students to obtain timely qualifications will be developed.
8.3 ICT for Open and Distance Learning
8.3.1 Open and Distance Learning with the use of ICT opens out alternate possibilities for students who have dropped out, cannot continue formal education or are students of the non-formal system of education. Existing formal systems of Education will be strengthened with ICT based instruction available in Open and Distance Learning System so as to cater to the needs of such learners referred herein.
8.3.2 Present Open Schooling systems (e.g. National or State level Open Schools) will be strengthened by harnessing ICTs innovatively. Access to e-books, e-content, Digital Repositories (with relevant learning resources) etc. could be developed by these institutions as student support services. This will also be used for online capacity building for open and distance teacher training.
8.3.3 National Institute of Open Schooling (NIOS) has effectively used ICT to bring about a major transformation in its basic operations under the project known as NIOS Online <Ni-On>. Online registration facility is provided for Admission, Examination, e-Accreditation, fixation of Examination centres and Payment gateway, which is available through out the year (24X7). Under the project a user friendly, convenient Learner Support Centre (LSC) was made functional to sort out the grievances of the learners on toll free numbers and through e-mail.
NIOS has also implemented the On-Demand Examination System (ODES) where by learners can appear in the examination as and when they are ready for it. This system will be strengthened and extended to its State counter parts for the benefit of learners from the non-formal sector.
8.3.4 A Broadcast Server for digital storage, retrieval and transmission of broadcast quality educational audio-video programmes will be deployed to enhance access to information and resources.
8.3.5 The proposed mentoring system for students involving expert teachers will be extended to these students also. Online courses, online on demand exams, and digital repositories and content, media broadcasts planned through DTH/Satellite based, open learning systems allowing multiple entry and exit points, opening out the school resources to non-formal students, guidance and counselling.
9. ICT for School Management

9.1 Automated and ICT managed school processes

States will adopt or adapt an e-governance and automated school administration programme for schools, build capacities for its implementation and deploy school based Management Information Systems (MIS). These MIS will be integrated with the proposed state wide web based School Education Management Information System.

A school wide local area network enables automation of a variety of processes. Beginning with library automation, locally cached offline access to internet resources, office automation, maintenance of records, student tracking, resource planning, using the existing ICT infrastructure will increase efficiencies. At the same time, savings in cost, time and effort will also accrue. The school wide local area network will be used to facilitate this automation.

At the system level, the policy envisages a web enabled networked environment, in which schools, teachers, students, school managers, and the community at large participates. This implementation will include the School Education Management Information Systems (SEMIS); digital repositories of tools, content and resources; professional development and continuing education platforms; and guidance, counselling and other student support services.

States will define norms for automation of school processes for administration and management. Development of an MIS system will be undertaken and implemented in both offline and online modes. The scope of information to be collated by the MIS will be broad and include student and teacher tracking, particularly from their academic needs.

9.1.1 States will adopt an e-governance and automated school administration programme for schools, build capacities for its implementation and deploy school based Management Information Systems. These MIS will be integrated with the proposed national level web based School Education Management Information System (SEMIS).

9.2 School Management Information System (School MIS)

9.2.1 A nation wide network will be established in which schools, teachers, students, school managers, and the community at large participate. This implementation will include the School Management Information Systems (School MIS); digital repositories of tools, content and resources; professional development and continuing education platforms; and guidance, counselling and other student support services.

9.2.2 School MIS will emerge as a single window clearing house on all information related to the secondary school system. The information will facilitate research and analysis activities and guide decision making at different levels in the education system, contributing to enhanced efficiencies.

9.2.3 States will define norms for automation of school processes for administration and management. Development of an MIS system will be undertaken and implemented in both offline and online modes. The norms will also define standards of technology including language fonts, word processors, technical dictionaries, etc. Where such standards exist, they will be adopted as is. Care will be taken to ensure open standards facilitating universal access to information, content and resources.

10.Implementing and Managing the Policy

10.1 Programme Monitoring and Evaluation Group (PMEG)

10.1.1 Programme Monitoring and Evaluation Group (PMEG) of the Department of School Education & Literacy will be tasked with the overall responsibility of guiding the implementation of the ICT programme in schools across the country. The PMEG may set up task groups and invite institutions or established professionals with substantial expertise in that sector to develop norms, specifications, evaluation reports, white papers etc. to guide the States in implementing the ICT programme.

10.2 Inter-ministerial Group

10.2.1 An Inter-Ministerial Group consisting of members from the Ministry of HRD, Ministry of Communications and Information Technology, Ministry of Information and Broadcasting, Department Of Space, Ministry of Power, Ministry of New and Renewable Energy, Ministry of Labour and Ministry of Rural Development etc. will be set up and tasked with the responsibility of guiding technological choices and specifying cost effective and optimum infrastructure and connectivity.

10.2.2 The group will also review the state of the art technology, connectivity and inter sectoral convergence based on its relevance to educational ICT goals, feasibility of implementation in the school sector, appropriateness in terms of finance, environmental footprints, need for training and learning curves for use and managing the system. The group will regularly review technological choices and guide the states in making informed investments, maximising the educational benefits.

10.2.3 Technology choice reviews will include standards and norms for computer configuration, input and output devices like scanners, printers and projectors, operating systems and system software applications including virus scans, productivity applications and educational software, power conditioning equipment, and other digital equipment like camera and audio recorders. It would also include norms for Edusat terminals. Norms for pricing of enabling infrastructure like telephone, internet, and electricity will also be considered and states guided in establishment and management of the infrastructure.

10.3 National and State level Agencies

10.3.1 National and State level agencies, like the National Council of Educational Research and Training, the Central Institute of Educational Technology, the National Institute of Open Schooling, the State Councils of Educational Research and Training, and the State Institutes of Educational Technology will develop curriculum, resources, and capacity building programmes, which will serve as models for adaptation and implementation across the system.

10.3.2 All public funded National and State level agencies will partner in developing, compiling and making available digital content, resources and tools. Norms for quality, universal open access for different types of digital content will be defined.

10.3.3 Public funded broadcast agencies at the National and State level, agencies managing the EDUSAT networks will be engaged with to ensure wider dissemination of support services and resources.

10.4 Role of the States

The States will have a two fold task:

- Define norms, standards, guidelines and frameworks to enable various aspects of the programme
- Facilitate and monitor the implementation of various aspects of the programme

These tasks will include:

- A programme of action, an appropriate road map and a feasible time line
- Guidelines based on national standards and norms for infrastructure, implementation

processes at various levels, capacity building programmes, monitoring and evaluation criteria, targets, etc.

- Framework for procurement, development, selection, evaluation, deployment in repositories, and use of digital content
- Facilitation of wide spread participation of all stake holders, including community and private partners in various aspects of the ICT programme
- Development, deployment and maintenance of infrastructure and digital repositories
- Development and phased implementation of an appropriate capacity building framework
- Mobilisation of resources including from private and community sources
- Development of an appropriate legal and regulatory framework
- Monitor and evaluate the implementation

10.5 Programme of Action

10.5.1 The States will draw up a Programme of action to inform and guide various aspects of the ICT programme, viz., development of infrastructure, management of the programme, development of digital resources, capacity building, monitoring and evaluation of the programme.

10.5.2 Based on a suitable road map and time line, the States shall ensure coverage of all Government and Government aided secondary and higher secondary schools by the end of XI plan. It will also ensure similar development in all unaided schools through the respective State Boards of affiliation. The time line will be broken up into appropriate phases and suitably monitored. The programme will be expanded to the upper primary stage, covering all the schools by the end of the XII plan.

10.5.3 The States will set up an institutional mechanism for implementing the ICT programme under the existing educational system, suitably delegating responsibilities up to the school level. States may experiment with different models based on past experience and appropriateness.

10.6 Advisory Group

10.6.1 The States' Department of Education will spear head an advisory group to guide the implementation of the ICT programme , its monitoring and evaluation. The advisory group, will be consist of the concerned Departments, a reputed engineering Institute of the State, University, etc taking into consideration the variety of technical, educational, financial and administrative tasks involved.

10.6.2 The States' Department of Education will synergise with the appropriate departments and state level agencies to ensure the establishment of connectivity and electricity in all schools. This will include negotiated norms for pricing, quality of service and maintenance.

10.7 Norms, Standards and Procedures

10.7.1 In order to ensure uniform and high standards of ICT, optimum utilisation and cost effective implementations, States will adapt standards and norms suggested by the inter ministerial group at the national level for all aspects of the ICT implementation, in particular the technology mix, specifications of equipment, selection of software – when publicly owned software is mandated, there is no need to have restrictions on software use – all educational tools can be freely used. and connectivity,
selection and deployment of digital resources and capacity building programmes.
10.7.2 Prevailing norms in the State will be utilised to phase out, dispose of or exchange old and obsolete equipment. Care will be taken to minimise avoidable upgradation and generation of electronic waste.
10.7.3 States will draft SLA for procurement and draw up appropriate agreements with the vendor/agency. The MoUs/ agreements will involve strict compliance clauses to ensure quality of equipment and service and minimum downtime. Appropriate Guidelines for SLA are developed and are placed in Annexure II.

10.8 Models for ICT Infrastructure

10.8.1 Build, Own, Operate and Transfer (BOOT) models for ICT infrastructure will be preferred. Different combinations of services like equipment only, equipment + manpower, equipment + manpower + software will be tried out and appropriate combination, based on feasibility and cost effectiveness, adopted by the States. Based on prevailing depreciation and obsolescence norms, the State may also choose to use a Build, own and operate (BOO) model.

Software should be free software, hence need not be part of BOOT. BOOT should be restricted to hardware purchase and maintenance.
Learning resources (software and 'content') should not be outsourced since it is detrimental to educational aims and principles

10.8.2 States will explore the possibilities of sharing the infrastructure partly or wholly with the community to extend education or train youth after school hours or similar purposes. The BOOT agency and/or the school may also utilise it for augmentation of resources. States will try out and establish appropriate community partnership models for optimum utilisation of infrastructure and resources, while ensuring safety of school property.

10.8.3 States will evolve mechanisms for bulk purchase, rate contracts based on dynamic pricing, and school wide licensing of software in order to ensure a low total cost of operation. Upgradation of software, where applicable, will also be built into the pricing models.
School wide licensing not acceptable. In no other case would we allow such privatisation of educational resources.
Only digital resources which can be publicly owned (even if procured at a cost)

10.9 Regulatory Measures

10.9.1 Access to the Internet enhances the risk of inappropriate content reaching children. Appropriate advisories for regulating access, monitoring internet activity and education of teachers and children will be taken up at the instance of the Advisory Group. Heads of schools and teachers will be trained in appropriate security and regulatory measures.

10.10 Incentives

10.10.1 The States twill draw up an appropriate incentive scheme for teachers, students and schools to recognise, showcase and promote initiative and talent. Easy loan schemes for procuring ICT equipment and resources, awards, professional support packages, and a variety of similar incentives, will be considered. States will also explore the possibility of partnerships and sponsorships with Government and Private agencies like Banks,

Corporations and Charitable Institutions.

All states should provide interest free loans to all teachers to purchase inexpensive laptops for themeselves (netbooks now available which weigh 1 kg, give 8 hours power backup and cost less than 15000). Kerala has scheme for laptop purchase by teachers and has tie up with vendors to privide netbooks at less than 13000 per piece

11.Financing

The procurement and utilisation of the ICT infrastructure requires appropriate allocations through both Centrally Sponsored as well as State schemes. These can be supplemented through public private partnerships and as part of corporate social responsibilities. The States will make adequate allocations in their budgets to ensure uninterrupted support to the ICT programme

11.1 Infrastructure

Financial assistance should provide for:

11.1.1 Enabling infrastructure viz. proper room (s), power supply, telephone connection, furniture, etc.

11.1.2 ICT infrastructure viz. hardware, software and connectivity.

11.1.3 Recurring costs for maintenance of the equipment with proper planning to enable cost effective use and servicing

11.2 Content

Development and updation of e-content, capacity building of teachers to enable effective teaching in the classroom and capacity building of officials for use of ICT in school administration should be strengthened.

11.3 Sustainability

11.3.1 Each school may develop an ICT plan, based on locale specific requirement, to optimally utilise the infrastructure established in a cost effective manner. This should be based on the learning needs of the students and training requirements of all staff, including teachers.

11.3.2 The school level plans may be reviewed at the district/ State to make available adequate resources for raising the quality of education imparted.

11.3.3 The States will adapt appropriate models of infrastructure, procurement, maintenance to keep the total cost of operation low and optimising investments. It will also ensure optimum utilisation and minimise renewal and upgradation.

11.4 Total Cost of Ownership (TCO)

11.4.1 TCO analysis of the programme should be done to gauge its viability and guide corrections in future implementation strategies. An analysis may be done of the total costs of acquisition and operating to the accruing tangible as well as intangible benefits.

12. Monitoring and Evaluation

A mechanism for regular monitoring and evaluation will be made an integral part of the ICT programme. The State advisory group will function as the nodal agency for this process.

12.1 Monitoring

12.1.1 The Advisory Group constituted by the States will identify criteria, performance measures, periodicity of monitoring/ measurement, methodology to be adopted and reporting mechanism.

12.1.2 Monitoring of progress and achievement of physical targets will be an ongoing activity built into the ICT programme. In addition to the national level monitoring of targets and objectives, the respective States would have an internal mechanism for overseeing the implementation of the programme through a monitoring committee constituted for the purpose. While the School Education Management Information System (SEMIS) and DISE would be a part of the monitoring tool, the State Govt. shall develop and undertake a monitoring mechanism, mapped at each level i.e. local, district, and State level to feed into the national web based MIS for the progression of ICT in the schools and to suggest mid course corrections.

12.2 Evaluation

12.2.1 An independent third party evaluation of the programme will be undertaken at appropriate stages in the project. The States will identify a suitable agency to carry out the evaluation as per the requirements of the project.

12.2.2 The criteria for evaluation will include various aspects related to each of the segments of the policy, viz., the ICT programme, infrastructure, digital resources, capacity building and the overall management of the programme. A framework for evaluation criteria would be developed.

12.2.3 University Departments of Education, Educational Technology or ICT related departments will be encouraged by the States to take up research studies on various aspects, like impact assessment studies of the ICT programme, in order to inform and correct the process.

12.3 Sharing of Results and Findings

12.3.1 The results and findings from the monitoring, evaluation and research will be widely disseminated and used to make mid course corrections in each aspect of the ICT programme.

13. Public Private Partnership

13.1 States and local bodies will encourage the participation of individuals and institutions from the private and non-governmental sectors, particularly through their corporate social responsibility programmes in development of infrastructure, development and/or supply of software and content, informing technology choices and capacity building. Their participation will be guided by standards and norms evolved by the Department of School Education & Literacy as well as by the States.

13.2 States and local bodies will create the mechanisms to utilise the talents and facilitate the utilisation of voluntary services of professionally qualified youth in the school ICT programme, development of e-content and software tools, and research and evaluation.

13.3 States will maintain a directory of volunteers, resource persons and support institutions for facilitating their participation in the ICT programme.

14. Policy Review

14.1 The ICT Policy for School Education recognises the need for frequent review of its provisions. A suitable mechanism to revisit each segment of the Policy will be evolved. The policy should ideally be revised every two years.

14.2 A broad mechanism for consultations with all stake holders will be evolved. Inputs from the inter ministerial group, the State advisory groups, the monitoring and evaluation findings, the programme monitoring and evaluation group will be utilised for informing the revision.

15. Time Line

Activity	Action by	Time frame
1. Implementation and Management		
Constitution of inter Ministerial Group at GOI	MHRD	1 month*
Constitution of advisory group by the States	State/UTs	2 months*
Drawal of a national plan of action through inter sectoral consultations	MHRD	3 months*

Drawal of programme of action by the States	States/UTs	4 months*
Creation of School MIS	States/UTs	4 months*
2. ICT Infrastructure (2010-11)		
Coverage of all Govt and Govt aided secondary and senior secondary schools through change in affiliation bye-laws.	MHRD/States/UTs	XI Plan
Coverage of all private secondary and senior secondary schools	States/UTs/respective Boards	XI Plan
Roll out & Implementation for all Govt and Govt aided upper primary schools	MHRD/States/UTs	2010-11 to 2013-2014
3. Digital Resources		
Development of IMMP for Sciences, Maths, Geography, languages for Classes IX -XII	CIET/SIETs/ RIEs/ States/NIOS	XI Plan
Establishment of national repository for e content	MHRD/CIET/NIC	2010-11
Establishment of state level repositories	States/ UTs/SIETs/SCERT/ NIC	2010-11
4. ICT Literacy and competency		
Basic IT literacy to students of Classes IX -XII	States/UTs	XI Plan
IT related electives in higher secondary classes	CBSE/State Boards	XI Plan
Basic IT literacy to students of upper primary classes	States/UTs	XII Plan
Capacity building of teachers		
i) Induction training	States/UTs/NCTE	XI Plan
ii) Refresher trainings	States/UTs/NCERT/SCERT/RCI	Annually
Capacity building of officials and staff	States/UTs	Annually

5.	Policy Review	Inter ministerial group in association with State advisory boards	Every 2 years

*With reference to the date of notification of this Policy

Annexure I Infrastructure Options for the school

Preamble:

The design of infrastructure in a school presupposes a definite plan for its utilisation. The principles on which such a system is based are:

- Universal and equitable access to all
- Appropriate tools and increased efficiencies
- Optimal utilisation and minimum cost of operation

The above principles are best realised if the plan for utilisation explicitly outlines an ICT curriculum, defining a grade wise breakup of content, which in turn will help identify the syllabus, the time table, the nature and range of software applications needed and the outcomes expected. It will also help define the specifications of hardware, its distribution and access.

The optimal utilisation of the ICT infrastructure will also be facilitated if a plan for automation of processes are drawn up and implemented. School administration, stores inventory, library and laboratories can improve their operation if appropriately supported by automation. A general management information system, which incorporates students and teachers data, monitoring and evaluation of performance and institutional planning, would also be an enabler.

In general, the overall plan defines the nature of tasks to be realised using ICT, which in turn will define the various software applications, and accessories, such as printers, projectors, or cameras. The need to operate these software and devices define the specifications and distribution of hardware, such as computers, networking and the supply of electricity. A planned system for education of the users and maintenance support will ensure optimal utilisation, uptime and longevity of the infrastructure.

The plan for ICT infrastructure:

The overall plan for ICT infrastructure will define the following:

- Number and nature of access points, for example, which and how many locations will have internet access;
- Appropriate hardware, software, accessories and devices, their specifications and numbers, for example, how many printers and whether they would be network enabled or how many locations will access the digital content available from the server;
- The layout of the infrastructure in the school building, facilitating appropriate access
- Provisioning of electricity, network, safety and security of users as well as the equipment

Options for the infrastructure:

Computers: Use of computers could be envisaged in three broad scenarios, viz, a laboratory consisting of multiple computers in one location; a distributed environment with one or two computers in each location, for example, office room, teachers common room or library; a mobile environment, where the units have to be moved, for example from classroom to classroom, or to make presentations elsewhere. There may exist a need to simultaneously provide of one or more of these scenarios.

The options available are:

Individual desktop computers at each station	Server and thin clients	Virtual Machines
Strengths – Individual stations are not affected by rest of network; optimised to run all installed software applications	Strengths – Low cost (clients do not have hard disks, CD/DVD drives, etc, eliminating need for UPS); low power consumption, no software installations on clients; maintenance restricted to server only; highly suitable for most commonly used computer applications.	Strengths – Four to six stations share a computer; each station requires a monitor, keyboard and mice connected through a KVM switch; lower cost of ownership and maintenance;
Limitations – Maximum maintenance (each station has to be maintained separately); maximum cost (each station has all peripherals – hard disks, CD/DVD drives, UPS, etc.); separate software licenses for each station.	Limitations – Dependent on network (embedded operating system and software on client allows limited independent functionality); not suitable to run multiple instances of software applications which require high memory or computing power as that would necessitate large resources on the server.	Limitations – Distance between virtual machine and computer about 5 metres; does not save cost of software licenses;

Laptops and netbooks are affordable solutions, where mobility is a major consideration. Though netbooks have lower resources (slower processor and graphics) they score high in terms of lower cost, lower weight and size, and better battery life. Connected to a projector/LCD monitor, they can be a valuable aid to teaching learning.

Software Applications: Three classes of software applications are envisaged.

- The operating system, for instance Windows or Linux, supported by security software like firewalls and virus scans which requires management (configurations, periodic actions and updations).
- Software applications which allow users to create and manage data and content. Word processors, browsers and e-mail clients, data base applications, graphics and animation applications, audio and video applications, programming tools, management information systems, inventory systems, etc.
- Containers of digital content, ranging from simple documents and images to websites, learning management systems, web repositories, online libraries – they may require supporting software like pdf viewer, media plugins, archive managers (eg., zip – unzip) or even specific fonts to view languages which do not use the roman script.

Each software application requires a specific hardware environment to function. The memory (RAM) requirement, hard disk space, the operating system, and in some cases other software (for example, Java runtime environment). This has implications

for the choice of hardware specifications. Deciding in advance the range of software

applications, a particular computer is expected to run, will inform the choice of hardware. Making choices between proprietary, proprietary-freeware, or Free and Open Source applications will also affect upgradability, initial costs of licenses and total cost of operation.

Peripherals and accessories: Accessories extend the functionality of the computers. Printers, scanners, still and video cameras, web cameras, audio players and recorders, and a variety of storage devices are commonly used with computers. In the context of schools, digital microscopes, interactive science experiment devices, and digital telescopes have also been developed. Equipped with such devices, the range of activities that can be undertaken gets significantly enhanced.

- Printers: Dotmatrix printers, inkjet printers and laserjet printers are common. Multifunction devices, which perform the functions of a photocopier, printer as well as a scanner are also available. The printing load and the need for individual computers to print would form the basis for the choice of particular types of printers. For example, the general office, which handles the photocopier could also double up as a central printing station for the administration network. As use of printers result in increased paper use, rules facilitating universal but controlled access may have to be established.
- Scanners: As a basic digitising equipment, a scanner can perform roles in a variety of situations. Flat bed scanners, usually supporting an A4 size of paper (bigger ones are also available at higher costs) can provide very high resolution colour scanning. Apart from the scanning density (denoted in dots per inch), the capabilities of the OCR software should be used as an essential criterion while making a choice of scanner. At least one scanner for the laboratory and one for the office could be considered.
- Digital media devices: Still and video cameras have become increasingly popular and can serve a variety of purposes. While users may require some orientation for effective use, they can perform a much needed role in documentation. Working with media will also equip students with skills necessary for the digital age. Like the cameras, digital audio recorders can also be used to record and re-purpose speeches, functions, interviews, commentaries, etc. and enable students and teachers to enrich the documentation of activities, projects and events. Choice of cameras and audio recorders are a function of their capabilities (optics, capacity of the digitising device (CCD or CMOS), size and quality of the image produced, sound quality and the storage capacity) and consequently their cost.
- Projectors: Placed on a table or mounted on the roof, a projector can display a computer screen or a video source to a large audience. The resolution of the projector (vga, svga, or xga), brightness and availability of bulbs apart from costs will form the criterion for selecting an appropriate model. Modern versions of an OHP use a small camera which looks down on the object placed and trasmits the image to a computer and/or a projector, doubling up as an epidiascope.
- LCD televisions are becoming increasingly common. As they take an input from video as well as computer sources, an LCD television can become a multifunctional device, supporting a variety of inputs. In terms of ease of use, quality of picture, initial cost and manageability, LCD televisions could be preferred.

- Microscopes, telescopes, etc: Interfaced through the USB port, digital microscopes and telescopes can extend the capability of a teacher (or even a student). They can store the results on a computer or project the same to a larger audience. Optics, sturdy material and construction, ease of use and cost may be used as the criterion for selection. Associated software and the

ability to use the images in a variety of other software applications may also be considered. Digital telescopes are not so common. Further a telescope has to be used outdoors and generally in the dark. If the requirement of the school infrastructure includes a telescope, one with a digital interface may be preferred.

- Kits for interactive science experiments have been developed. Supported by a variety of probes, measuring, electrical, light, sound and other physical variables, they can facilitate a variety of experiments in the science laboratory. Interfaced with computers, they allow for not only plotting the data and measurement, but also repurposing the data in other software applications. As an extension to the science lab, these devices can enhance the range of experiments currently carried out. Cost of the device, the variety of probes, the capabilities of the associated software may be used as selection criteria.

Internet Connectivity and Networking: As a general principle, it would be highly desirable that all computers and accessories are networked. This would not only ensure sharing of resources, but also reduce the total costs.

- Internet Connectivity: The choices for internet connectivity in a given physical area may be limited. A broadband connectivity with adequate bandwidth (minimum 2 Mbps for 10 Computers through Server) is suitable. If the number of computers increase, progressively the increase in the bandwidth is advisable.
- Choice of provider and plan will depend on initial and recurring costs, equipment to be installed (shifting to a wireless from wired, for instance will require network cards on all computers to be changed), reliability of connections and response to complaints, bandwidth usage in the school, and security of the connections (internet connectivity is prone to virus attacks, mail spamming, stealing of data and damage to software and equipment)
- Networking within the school: A school wide network is desirable to facilitate data sharing, and management of computers. If the system proposes to use thin clients or virtualisation, then a network is essential. Simultaneously, it eliminates the need for multiple licenses of software and a drastic reduction in hardware like hard disks, CD/DVD drives on individual computers etc.

If the school has an already established wired network, changing over to a wireless network would involve a very high initial cost (replacement of network cards on each node). If the school is establishing a network for the first time, a wireless network, if feasible, would be the best option.

- Networks are prone to security issues. Protection and appropriate restriction of data transfer, protection of the individual computers from viruses, and ensuring adequate bandwidth to all users would require the use of firewalls, password protections, updated virus scanners and scanning regimes, and procedures to restrict data flow on the network would become essential.

Electrical Conditioning, backup and electrical wiring and safety: The ICT infrastructure may be the largest consumer of electricity. Also, components of this

infrastructure are most sensitive to variations in electrical supply and consequent break downs or burning. Designing the electrical supply and appropriate safeguards therefore become an essential part of the design of the school infrastructure.

- Electrical Supply: The first step would be to adequately safeguard the

installations (wires, switches, outlets) with the use of circuit breakers, current limiters and if feasible (cost wise) a voltage regulator. This must be implemented at the inlet (immediately after the electricity meter)

- Wiring, electrical fittings and earthing: Ensuring the quality of wires used, quality of electrical outlets and switches, and earthing of the whole circuit will not only safeguard the equipment but also human lives. Periodic checks for faults and broken installations must be carried out and a routine established for it. Any faults detected must be attended to promptly and rectified. Education of all users with regards to safe use of electrical fittings and outlets is a must.
- Use of gadgets consuming higher power like motors, air coolers or room heaters on the same circuit as the ICT infrastructure must be avoided. Designating electrical outlets for such use is a must to protect the ICT equipment.
- Voltage regulators and UPS designed for use in low voltage and low frequency conditions are becoming available. Identifying such situations and making appropriate choices of voltage and current conditioning devices will ensure safety and longevity of the infrastructure. In the case of UPS, whether online or offline, the discharge time of the battery, the delay before the equipment switches over to battery, and the voltage range over which the UPS operates are critical factors to be considered. Batteries degrade after a definite number of charge-discharge cycles and will have to be replaced, typically once in about two years. Absence of backup time can be used an indicator for this replacement.
- There are two options available in providing UPS support. One could provide a separate UPS for each individual computer. Alternatively, one could provide a common UPS for the entire circuit. While cost considerations may be used to make such choices, the support available for repair or replacement also should be considered. A breakdown in one of the separate UPS will affect only that computer.
- Use of low power and battery driven equipment like laptops eliminates the need for UPS. Use of thin clients also reduces the demand for UPS on the node. Only the server needs to be supported. Judicious choice keeping in mind the requirements of the system would make the system safe and economical.

Manageability and Support: Schools are generally not equipped with personnel well versed in the maintenance and upkeep of ICT or electrical equipment. Dependence on outside support also leads to recurring expenses, delay in repair, down time of equipment. Non-availability of infrastructure reduces teacher confidence in technology. A system of management and support of the total system is therefore an essential part of the infrastructure design.

- Outsourcing maintenance: An annual maintenance contract with a service agency is the most common form resorted to. This may become unreliable in far flung areas (for example rural places far removed from cities). Where the ICT infrastructure is supported or run by a BOOT agency, an expectation for a resident engineer/technician, well versed in all aspects of day-to-day repair and maintenance of the infrastructure should be incorporated into the agreements. Telephonic or e-mail based support to such engineers from the vendor/service agency must be ensured.

- Remote service support: Online service support mechanisms, whereby service engineers can connect to computers online and rectify most software faults, diagnose and report hardware faults and suggest mechanisms for replacement or repair. Designing provisions for and entering into appropriate agreements for such support will ensure maximising the use and longevity of the ICT infrastructure.

- Extending Warranties: Comprehensive onsite warranty is provided for hardware. While computers are normally covered for three years, accessories and peripherals like printers, scanners or projectors and spares are covered for one year. Manufacturers have developed models of extension of warranties. Keeping in view the life time of this infrastructure and absence of a refresh (replacing older or non-functional equipment with newer ones regularly) mechanism, working out appropriate state level agreements with manufacturers for maintenance support for extended periods will be desirable. While developments and advances in technology may necessitate upgradation earlier, typical life of ICT equipment can range from five to seven years.
- Software related issues: A wide majority of break downs or faults can be attributed to software related issues. Corruption of files, cluttering of data on hard disks, and virus attacks lead to slowing down, and sometimes, break down of the computer. A regular system of cleaning of all computers and education of the user in safe handling of computers will help avoid problems. Virus scanner software are constantly updated to help protect from newer and newer viruses. These upgrades (referred to as patches) are regularly released online. Access to the internet, regular downloading and patching of virus scans, and scanning of all storage devices (hard disks and memory sticks) is a must. Firewalls can be used to protect computers from unauthorised access and data Educating all users on protection from viruses and safe practices to avoid virus transmission is essential. As timely action is very important, constant vigil and reporting mechanisms will have to be established.
  Updates and patches for operating system and other software applications are also released regularly. Downloading these and patching the software to keep it up to date is also essential to ensure smooth functioning of all the equipment.
  Thin clients and virtual computers reduce maintenance tasks to the server alone. All software and virus protection tasks need to be carried out on the server alone.

Annexure II

Software Licensing and its implications

Various laws of the country protect the interests of the producers, manufacturers, the distributor and the end users against issues arising out of the distribution and use of IT products – hardware and software. The issue is relatively straightforward when it pertains to hardware. For instance, a manufacturer could declare that the product conforms to specifications and standards and is “free from manufacturing defects” and offer to repair or replace the product if found defective. In the case of software, complications arise due to the very nature of the development process. While it is required to conform to standards

and specifications, a software is also a creative work, like literature or a piece of art. Two distinct schools of thought have emerged regarding the distribution of and the rights with regards to software, referred to generally as the copyright and as opposed to it, the copy left.

End User License Agreements and Proprietary Software:

When a proprietary software is bought, an agreement between the manufacturer and the user, ensues. Known as the End User Licence Agreement (EULA), it is a contractual agreement, making both parties liable to each other. Commonly, this agreement includes the following conditions:

The software is not sold to the user, but a copy licensed for use on a defined number of computers subject to other defined conditions or restrictions.

The software includes only the binary applications and related files. It does not include the source code.

The software remains the exclusive property of the manufacturer and cannot be modified or reverse-engineered in any manner, whether to adapt it to different working environments /hardware, or to improve its functionality by way of removing bugs, or to improve its efficiency of performing specific tasks, etc. Manufacturers may release patches and corrections to update the software at their discretion.

The user is not permitted to redistribute copies of the software. In fact the user may only make backup copies of the software as protection against failure of the media or the installation.

The EULA also defines the limitations of the liability of the manufacturer against defects arising out of workmanship, design, etc. offering to provide a replacement copy or a refund.

Software Licenses in the Free and Open Source Domain:

As opposed to this agreement, the Free and Open Source initiatives have developed alternate license agreements, which are intended to provide the user enhanced freedoms. They define four freedoms that every user should have:

the freedom to use the software for any purpose
the freedom to share the software with others
the freedom to change the software to suit one's needs, and
the freedom to share the changes made

To ensure these freedoms, the license agreement:

binds the manufacturer/producer to make available to the user both the source code and the compiled binary, either free or for a consideration. While the user may choose to use the software as is within its limitations, the right to modify it (for example, translate it into another language, adapt it to function in another environment, or increase functionality) is also transferred to the user.

permits the user to make as many copies of the software as is and redistribute it to others. If the software is modified, then rights for the modified versions are claimed by the modifier, and is obligated to release the original and modified versions with similar freedoms to next user. The original author continues retaining the copyright for the original work.

releases the software with no warranties, implying that the collective wisdom of the developer community will rectify the defects, benefiting the larger user community.

Copyright and Sharing of Digital Content:

Digital content, for example to support teaching-learning, are also subject to copyright. While they may be deployed on the web or made available through print or electronic media, the ownership of the original content remains with the author. This automatically lays restrictions on its use, distribution and modification. While normal copyright laws of a

country provide for protection of the rights of the author, proponents of the copyleft school subscribe to the view that author may choose to hand back the content to humanity for further improvement if possible and there should be no legal hurdle for the same. A license created exclusively for sharing of digital content within the scope of Free and Open Source is the Creative Commons License. Like the other licenses of the Open Source kind, it offers unlimited or sometimes with some limits, rights to the user to share as is (make copies and distribute), and to adapt the work into a new work (modify, copy portions, etc.), ensuring at the same time the original author's moral rights.

Implications for the Policy:
Very large investments are being made in the school system to promote ICT enabled teaching learning, ICT literacy, and ICT supported administration and management. A large number of State-funded as well as community initiatives are developing software applications, ICT enabled practices and digital content. Much of these are in English.
To enable widespread availability and to catalyse its penetration in the school system, it is essential that software and content are made available at affordable prices, and where feasible, free to the end user. Development costs being the major investment in such software and content development, avoiding duplication of effort and free access to the source code and right to modify as needed, will go a long way in increasing returns on investment manifold. Adoption, adaptation, translation and distribution will be greatly facilitated.