MeLTs; A new approach to delivery of e-learning in remote and un-served rural areas in India

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Abstract

Education system in India has witnessed considerable expansion & development in the last two decades. The benefit of various IT enabled services in education, have, however remained restricted to urban and semi-urban areas.

A Need Assessment Survey (NAS) was conducted in a limited geographical area (within a radius of ~40 kms from our Institution) in Jammu & Kashmir, India recently. In this survey we covered a total of over ~22000 students in 55 institutions. The survey covered students of higher secondary and above and we found that there are too many people without access to ICT enabled education. Limited ICT infrastructure is available but the same is available only to centrally funded institutions which are very few in number.

*To address these issues, we have joined hands with IIT Roorkee to deploy V-SAT Enabled Mobile e-Learning Terminals (MeLTs) in this area. This tool shall be used to deliver ICT enabled educational content and services. Under this initiative, IIT Roorkee has been assigned the task of designing, developing and deploying MeLTs to provide data connectivity to under-served educational institutions, particularly in rural areas. In this gigantic task of great national importance, IIT Roorkee has involved a number of institutions of higher learning. This project is funded by Ministry of Human Resource Development, Government of India under "**National Mission on Education through Information and Communication Technology**". The prime objective of the project is to make available to the students e-lectures and knowledge e-contents of their interest free-of-cost using MeLTs. By providing data connectivity in remote areas through MeLTs, this project is expected to help in reducing the digital divide between the urban and the rural areas.*

This paper presents the results and our analysis of NAS. Further, it describes the idea of MeLTs and the technological design aspects and systems of e-content delivery available on MeLT.

1. Introduction

Prior to independence, and thereafter, major contributor to our GDP was agriculture; with further development the contribution of manufacturing sector started increasing. In the early 90s with the opening up of the economy the service sector started booming. The initial boost was based on the fortuitous circumstance of a numerically large educated English knowing population segment in the age group 15 to 40. Over a period of time the service sector has now started moving up into a higher, value added segment. This again is based on the fact that there is a numerically fairly large population segment which is educated, proficient in English and

having fairly sophisticated skills in computers. This segment comes mainly from the educated middle class of the urban and semi urban centers. The total urban population as of now is about 40% and the relevant segment between 15 to 40 years, is about 40%. Thus the total manpower pool on which the service sector and the overall GDP are being driven is numerically large, but still limited. An overall Gross Enrollment Ratio (GER) in higher education of over 12% and we aim to make it 15% by the year 2012. Although we are coming up with new institutions however, this is expected to put a lot of pressure on the available infrastructure. One can see intense competition in urban centers to acquire knowledge and skill sets which can equip them to compete at National and International levels to have access to the global market. This is possible as urban centers are relatively better equipped in terms of information and communication infrastructure and the same is undergoing continuous up-gradation and expansion thereby making this job easier by the day. If India has to continue on the growth path then the large population pool in the rural segment has to be galvanized and readied (equipped with the necessary skill sets) for playing its part in the economic development cycle. This would ensure their effective participation in the market driven economic growth and uplift their living conditions. For a country of the size of India in situ capacity building for these areas would require herculean efforts and vast investments if the traditional modes of education and training are to be followed.

India presently has over 400 universities and close to 17000 colleges and the same are catering to a tiny segment of our youth (10 to 12% GER) compared to the need capacity building as already stated. Faculty shortage is another problem area and, even if available, the differential skill set is another gray area. Since we have to reach out to a large number of students who are spread over in geographically sparse areas, to maintain low operating costs we need to come up with distance e-learning initiatives, and modes of delivery which can bring in data connectivity in such areas.

Whether at the National, the State or the Sub-State level, there is not only vast scope for, but also an urgent need, to quantitatively expand and qualitatively upgrade education and one of ways of achieving this could be by the use ICT. There already have been several efforts made by the state and other agencies to tackle this himalayan task. Some of the schemes initiated by our government include:

1.1. Sarva Shiksha Abhiyan (SSA)

SSA is Government of India's flagship programme to universalize elementary education in a time bound manner. This scheme covers over 192 million children in 1.1 million habitations thereby making education for children in the age group of 6 to 14 years free and a fundamental right. In addition to SSA the mid day meal scheme was initiated to attract the child from such strata where two square meals a day are also a struggle. This scheme has resulted in effective reduction of the drop out rates: 2000-01, 2001-02, 2002-03 and 2003-04 at 40.7%, 39.0%, 34.9% and 31.5% respectively. Apart from this in order to upgrade and disperse quality education government has established Navodiya Vidayalayas/ Sarvodaya Vidayalayas. Apart from this post globalization private sector has been mainly responsible for large scale growth of education in the country although quality assurance is not up to the mark in majority of them.

1.2. Community Information Centre (CIC).

Under the e-governance initiative of Government of India at the block level, interventions like CIC have been initiated in Jammu & Kashmir and North Eastern states, however, these have not been able to make a mark due to lack of adequately trained personnel and awareness among the general public. Although in the area of e-governance some states like Maharashtra, Karnataka, Jharkhand etc are reported to have done well however J&K has remained behind due to lack of awareness and lack of investment in this domain.

1.3. National Mission on Education through Information and Communication Technology (NMEICT) for higher education

This Mission has an ambitious vision of catering to the learning needs of more than 50 crore Indians (working population) and of providing a one stop solution (Sakshat) to all the requirements of the learning community. It aims to support the conventional approach by technological interventions through ICT so as to make available the knowledge resources to every learner as per his / her convenience and just in time. A similar initiative has been launched at the school level by the Ministry of Human Resource Development recently.

These are some of the initiatives being taken by the state and other actors to address this urgent national need. But much more is needed to be done.

2. Our group

Our group is a part of an Institution (Shri Mata Vaishno Devi University: SMVDU) which was conceived in 1999 by the government of Jammu & Kashmir. It is an initiative of a public pilgrimage trust (SMVDSB) to provide higher educational facilities in an area contiguous to the pilgrimage route but which was till then totally un-serviced by educational facilities, particularly, at college and university levels. It seeks to generate awareness and motivate the local population to utilize the educational facilities not only within the University but also outside for economic development. Incidentally, the setting up of this University would and is acting as an economic growth driver for the hinterland. On a personal note, we may add that our University has come up in a backward area similar to the childhood situation of a few members of the group vis-à-vis hinterland area which is surrounded by villages. The group has, very humbly, felt that they have, perhaps unconsciously and fortuitously, become part of an initiative which has far reaching consequences. In this initiative, we are constantly working to have more people/ institutions on board.

2.1. Our Intervention

Most of the members of the group belong to similar strata of the population and came together over a period of time. The authors at their individual levels had been always keen to

contribute to those sections of the society to which they belonged. After deliberation and brainstorming a model was conceived for which SMVDU provided the organizational opportunity and platform for, the objectives of SMVDU include: the development of intellectual faculties, cultivation of discipline, righteous conduct and service to society. This allowed us to use our internal drives to mould our role in the University to some extent to ensure that our ideas could find an outlet for implementation. This was possible by advancement of our own know how and by gaining organizational acceptability. We got involved in building up the institution by executing ICT infrastructural projects within SMVDU. This included establishment of Campus wide LAN, setting up of a telephone exchange, bringing in leased line connectivity for internet for the University community. **This also allowed us to make provision for telecom facilities (landline and mobile) in the surrounding villages which were un-served till then**. Thus SMVDU & surrounding areas developed a fairly robust ICT infrastructure.

Further over and above the assigned academic and other duties, the authors (SMVDU) took personal initiative in interacting with, and initiating dialogue with the local village populations, in general, and schools and colleges in particular to try and seek their active involvement to enable us to understand the ground situation. We devised an approach which after some initial ground study and deliberations was converted into a model comprising of three stages:

The model thus conceived was initiated in the following manner to evolve a holistic and robust solution in a finite span of time.

Stage I (2 years)

- Gaining credibility
- Local & Institutional acceptability (within the 12 schools in catchment area and our own University)

- **Stage II (2 years)**
  - Enlarge external activity
  - Include other Institutions from surrounding Districts.
- **Stage III (3 years)**
  - More people, more resources more tools
  - Develop/ adapt technological tools to cover this larger canvas

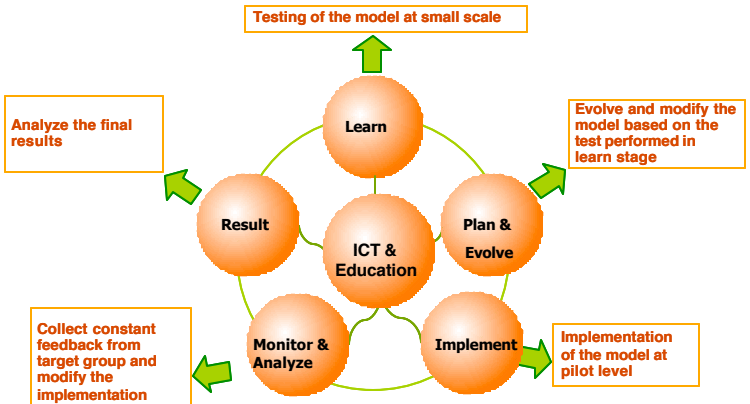


Figure1: Our Model

In all the stages care was taken to ensure that all the components work on a constant feedback mechanism so that corrective action could be taken.

2.2. Children in the neighborhood (Stage I)

The idea had to be tested through small experimentation to check if our idea would work or not. In order to formulate a possible strategy we had to begin by learning from the neighborhood. This allowed us to look at the existing situation that could be used to test the model. In the

beginning we made use of various virtual learning resources on a trial basis and were encouraged by the response.

Thus stage I was initiated under the banner of this programme. This was primarily meant to understand the situation at the ground level. Under this initiative we identified 12 schools around the University in its catchment area. The overall student population thus covered has been over 1000. Various activities that have been organized under this banner include:

Science talent search programme Lectures by eminent scholars
Access to the computer labs and other basic science labs within the university
Screening of audiovisuals on science Science fairs and fun games etc

Under all the above heads special attention was devoted to female students. We were encouraged by the response of the teachers and the taught; the thirst for knowledge, the innate talent amongst the youngsters being evident. What was also evident however, was the lack of adequate infrastructural resources, awareness and access available to the schools. Nurturing of this potential population segment is very critical and requires right kind of educational opportunities and facilities.

2.3. Expansion (Stage II)

Based on the experience gained in the learn stage particularly the vast difference and access divide, we resolved to organize activities in which we would be able to mix students from the catchment area with the students from towns of this region and the reach of this programme was expanded. It has now increased to over 30 institutions (5^{th} std. to University level). Our University attracts students from over 23 states of India that also helped us in the sense that we could ensure a truly diverse collection, to which the children/ students of the rural segment were exposed.

2.4. Lessons learnt so far:

- There is a gap which needs to be bridged
- Local community showed lot of enthusiasm
- Till date over 1000 children have been reached
- National Science Day became an organizational opportunity and event
- Public lectures by eminent persons are useful to attract the students
- There is a great need for access to information
- Technology (ICT) is the only way to reach out to larger section
- We also need to build a movement (intellectual force) as we alone can not reach out to everyone out there
- Different sections of the society need to be onboard
- A common virtual platform has to be created. For that Government support/ collaboration is essential to have access to various available resources which are not being used effectively
- Socio political dynamics of J&K have to be taken and kept in consideration all along

- There has already been a great deal of destruction in the state not only physically but also in terms of intellectual drain
- We need to divert youth from hatred for each other to opportunities for development
- International organizations working in the field of education do not have appreciable direct presence in J&K
- We envisage to build up a social/ intellectual forum which can act as a vehicle for any such agency to reach out to different sections of the society
- Study larger area to come up to a level which would enable us to design a robust & suitable solution.

2.4. Technology enabled expansion (Stage III)

Based on the above stages and lessons learnt, we resolved to make an attempt to try and provide mobile infrastructure and training to a small segment as a pilot and if the same was successful then it could be replicated at a bigger scale. This required initiation of e-learning interventions as otherwise it would be difficult to reach out to the geographically sparse population. Fortunately, ICT as a tool in education has gained both international and national acceptability and we decided to fully utilize it to our advantage. Based on our ground assessment of the CIC initiative we had to devise an approach which would have least direct dependence on the school personnel for maintenance. We therefore decided to develop mobile ICT enabled laboratories (information on wheels) which could go to the field and come back in the evening. Ultimately we could activate the local ICT infrastructure at the block level.

As a fortuitous circumstance Government of India simultaneously decided to launch NMEICT. Under this initiative present authors (IIT Roorkee) came up with a similar idea of mobile e-Learning Terminals, (MeLTs), and Government of India agreed to fund this project.

Under this initiative, IIT Roorkee has been assigned the task of designing, developing and deploying MeLTs to provide data connectivity to under-served educational institutions, particularly in rural areas. In this gigantic task of great national importance, IIT Roorkee has involved a number of institutions of higher learning. Being a logical/ natural fit we (authors from SMVDU) joined hands with IIT Roorkee to develop a strategy and to deploy these V-SAT Enabled Mobile e-Learning Terminals (MeLTs) in this area. This tool shall be used to deliver ICT enabled educational content and services. MeLT is a mobile data delivery unit which is primarily designed to provide data connectivity in remote areas as the same is not satisfactory in terms of bandwidth and/or reliability. Sparse population (46 persons in a square km in J&K) in many areas does not encourage us to go immediately for stationary e-learning terminals. Another area of concern is the lack of awareness among the masses in these areas. *Mobile e-learning terminals* using VSAT data connectivity, it is expected, will therefore be more effective and make better utilization of investment. MeLTs are expected to play a vital role in reducing the

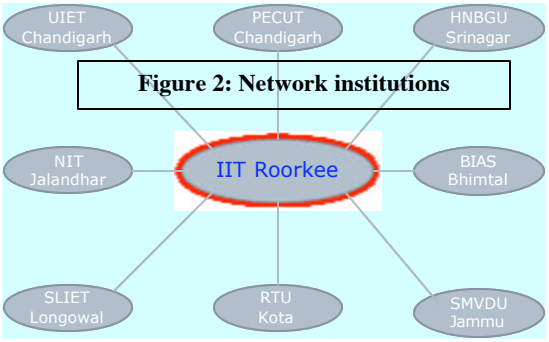


Figure 2: Network institutions

digital-divide and educational-divide between urban and rural areas. With the help of these MeLTs we shall now be able to cover over ~5000 students in our state and overall number during the pilot phase is expected to close to over 50,000 to 60,000 students spread over 6 states. Under the pilot of this project (MeLTs) six states of north India are being covered in which eight institutions are involved apart from Indian Institute of Technology Roorkee. Ultimately we hope to use technology to assist the available manpower in these institutions as in any case technological pedagogical model would not be a continuingly motivating mode which a physical teacher can be. So as a part of MeLTs we shall constantly endeavor to enable the trainer.

3. Need Assessment Survey for MeLTs

A need assessment survey was carried out in 515 institutions in the six states covered under the pilot to identify the areas in which the MeLTs need be deployed on the following broader parameters.

Physical access
Teacher student ratio
Infrastructure availability
Availability of the relevant e-content
ICT access
Computer student ratio
Willingness to participate in our initiative

Table 1: Summary of the NAS carried out by the Network intuitions in 6 states

Network Institution (NI)	Districts covered	States	Total institutions covered
National Institute of Technology, Jalandhar	02	Panjab	42
Sant Longiwal Institute of Engineering and Technology	02	Panjab	50
University Institute of Engineering & Technology, Panjab University	06	Panjab & Haryana	117
HNB Gharwal University, Srinagar	04	Uttarakhand	64
Birla Institute of Applied Sciences, Bhimtal	02	Uttarakhand	50
Rajasthan Technical University, Kota	03	Rajasthan	66
Panjab Engineering University of Technology, Chandigarh	02	Chandigarh	71
SMVDU, J&K	03	Jammu & Kashmir	55
08 Network Intuitions	24	06 States	**515**

These 515 institutions that have been surveyed by the NIs include various levels as given in the figure 3. All these beneficiary institutions are supposed to be covered by the corresponding NI.

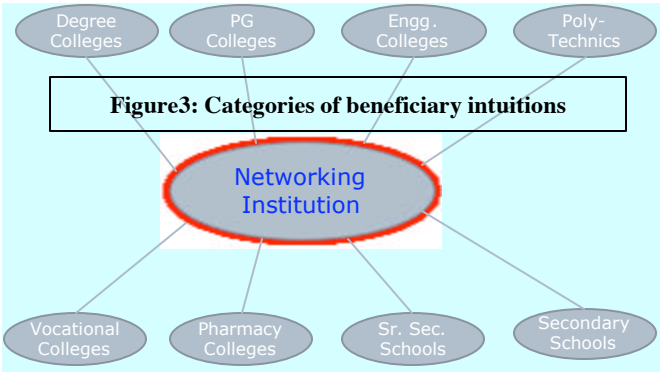


Figure3: Categories of beneficiary intuitions

4. Results & Observations of NAS (J&K)

We shall discuss the survey findings in greater detail for J&K

where present authors (SMVDU) were directly involved.

In Jammu & Kashmir a total of three districts bordering each other have been covered for the pilot under NAS. The selection of three districts was convenience (contiguity) based. However, in the overall developmental/ availability of educational (relevant) infrastructure and other pertinent parameters, these three districts are in the upper half of the total 22 districts in the state. The districts in the lower half are, of course, much more deficient in all surveyed parameters. The districts surveyed are: Jammu [covering 22 institutions], Udhampur [covering 17 institutions] and Reasi [covering 16 institutions]. The institutions that have been covered include 19 High Schools, 27 Higher Secondary Schools, seven Degree Colleges & two Polytechnics. While conducting this survey a GPS device was utilized to create a track map (Figure 4) of the area under consideration and this map shall be made available in the MeLTs so that they are able to reach the intended destination with ease.

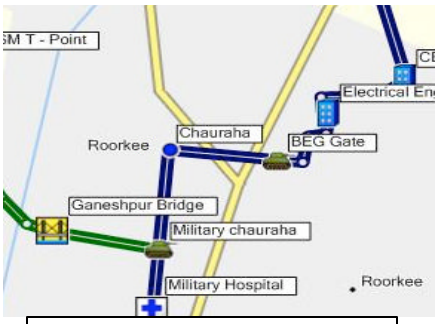


Figure 4: GPS generated map

Table 2: Summary of the NAS carried out by SMVDU in Jammu & Kashmir

District/ Institution type	High Schools	Hr. Sec. Schools	Degree Colleges	Total
Jammu	3	13	4+2	22
Udhampur	6	9	2	17
Reasi	10	5	1	16
	19	27	7+2	**55**

Table 3: District wise student teacher ratio

Level/ District	Jammu	Udhampur	Reasi
High	16:1	14:1	18:1
Higher Secondary	13:1	19:1	22:1
College	12:1	52:1	20:1
Overall	12:1	22:1	20:1

In the three districts covered in J&K, the average distance from SMVDU is ~30 km; the average travel time is 75 min in Reasi district, 58 min in Jammu and 62 min in Udhampur, with an overall average travel time of 65 minutes. Nearly 75% of the target institutions covered lie in the hilly areas. Two schools were located at such a place that we had to walk 2 kms each to cover them.

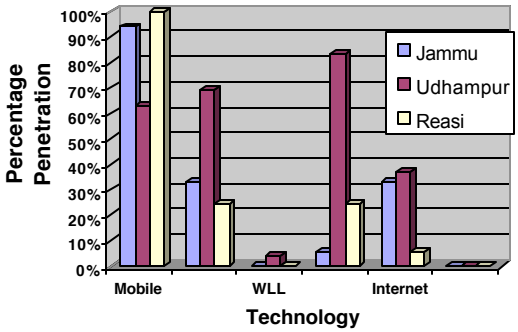
Table 4: District wise availability of computer faculty and overall student computer teacher ratio

Level/ District	Jammu	Udhampur	Reasi
High	77%	33%	10%
Higher Secondary	77%	69%	20%
College	Nil	Nil	23%
Overall	357:1	558:1	237:1

Out of 55 institutions, only three require alternate locations for deployment of MeLTs as they do not have adequate road access. A total of ~22000 (5000 would actually be covered by MeLTs) students are being covered under pilot.

Table 5: District wise Student computer ratio and (on paper) percentage schools having access to computers

Level/ District	Jammu	Udhampur	Reasi
High	23:1 (67%)	14:1 (17%)	84:1 (30%)
Hr. Sec.	31:1 (100%)	35:1 (89%)	103:1 (100%)
College	74:1 (100%)	129:1 (100%)	29:1 (100%)
Overall	43:1 (88%)	59:1 (65%)	72:1 (56.25%)



Out of 55 institutions, eight schools are funded by the central government. All of them have basic ICT infrastructure with some Internet connectivity. All of them have computer teachers however the ratio is not very encouraging. If these eight institutions are not considered then the ICT scenario in the other schools is extremely poor.

Figure 5: %age penetration of communication technologies

In most of the schools having computers, either the PCs have not been fully utilized or some of them are not working. In one case, the PCs are yet to be used as they do not have offline UPS since last one year. Power scenario adds to the woes.

Overall student teacher ratio is good and stands at 18:1. However student computer teacher ratio is very poor and stands at 384:1. On paper, 70% students have access to computers. However student computer ratio stands at 58:1. Twenty institutions have computer faculty however, eight out of them do not have computers.

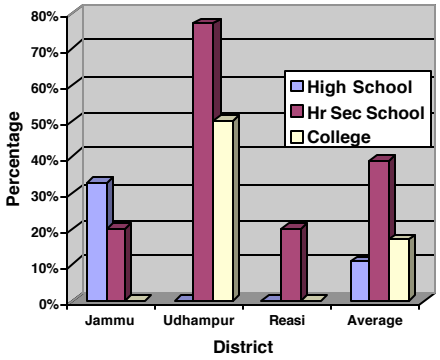


Figure 6: District wise %age penetration of internet

To summarize, there was high appreciation and interest, but low ICT availability. ICT enabled education is supposed to be part of the curriculum in schools but there is lack of qualified teachers. Some schools did have ICT infrastructure but lack of educational resources and e-content is a serious concern.

Considering the ground reality it was felt that versus stationary infrastructure, MeLTs would be a realistic solution. Resources on it can be delivered and retrieved synchronously or asynchronously, and in spite of the fact that the resource provider and the user are separated physically. Moreover, the same resource can be used as many times as required.

5. VSAT Enabled Mobile e-Learning Terminals

The prime objective of the MeLTs is to make available to the students, e-lectures and knowledge e-contents of their interest free-of-cost. By providing data connectivity in remote areas MeLTs are expected to help in reducing the digital divide between the urban and the rural areas. It is evident that data connectivity in several remote areas is not satisfactory (as is verified by NAS) in terms of bandwidth and/or reliability. Sparse population in many areas also motivated us to go for mobile rather than stationary e-learning terminals, as the same would remain under-utilized and would invite higher initial and maintenance costs. MeLT based data connectivity will be more effective and make better utilization of the investment. MeLTs shall be physically present at the destination side so thereby providing of physical presence feeling while undergoing e-Learning experience. MeLTs can provide access to e-learning to anyone, anytime and anywhere. This would ensure standardization of quality of the contents which is pre tested/ verified and it is no longer a static closed door student teacher interaction. MeLTs shall have two technical assistants on board to provide local assistance to students and teachers.

5.1 Types of MeLT

A. Van-Based MeLT

1. Class in conventional class-room *2. Class in open space / room*

3. Wireless LAN

B. Bus-Based MeLT

1. Class inside the bus *2. Wired LAN*

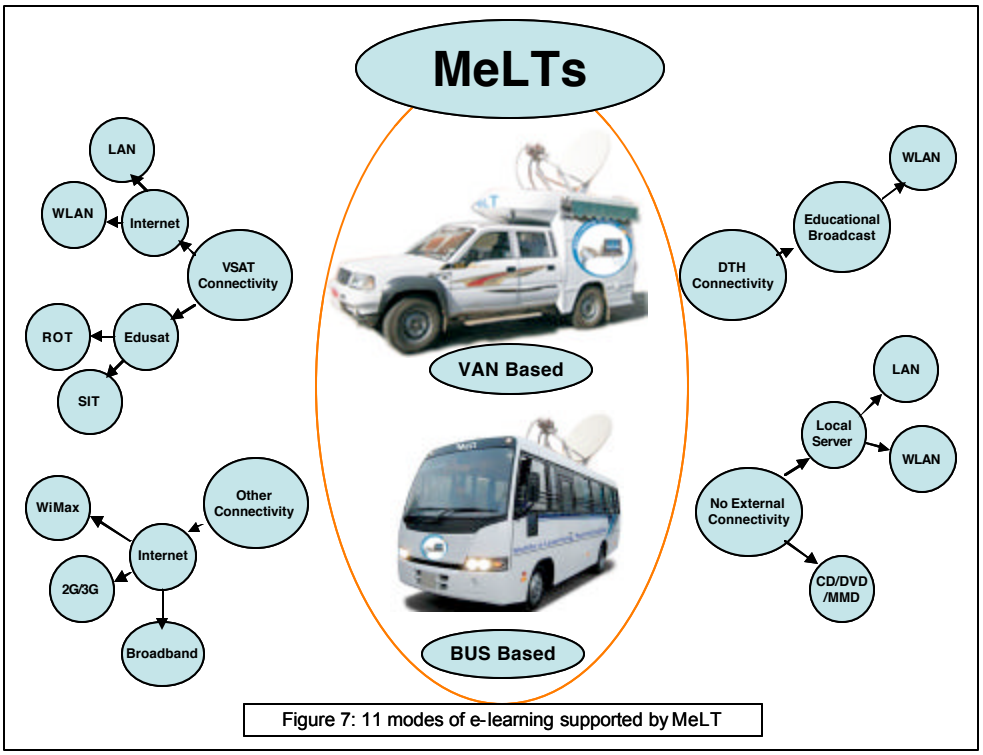


Figure 7: 11 modes of e-learning supported by MeLT

5.2 Equipment on board MeLT

Content Server	*01*	*Laptops*	*20*
WiFi Router/ Ethernet Switch	*01*	*VSAT Antena & ODU*	*01*
VSAT IDU	*01*	*DTH Antenna & LNB*	*01*
DTH Receiver	*01*	*LCD Monitor*	*01*
SIT Computer	*01*	*Video Cammera*	*01*
Cordless Microphone	*01*	*GPS*	*01*
UPS	*01*	*Battery Bank*	*01*
Alternator	*01*		

5.3. Technologies on board MeLT

Edusat (Educational Satellite launched by India) and VSAT connectivity,

Direct to Home connectivity	*Multi-Media Drive (MMD)*
Local Server and LAN	*Local Server and WLAN*
CD/DVD	*Internet and Mobile Modem/ WLL/ WiMax*

6. Future directions

The immediate future scope is to assess the viability of this approach full scale for the entire country and to come up with a Detailed Project Report for the purpose. As a part of this project we would be assessing the impact of the delivery of the e-content on the students and teachers and to suitably amend the same to suit the local needs through an Impact Assessment Survey which is an important dimension of this project. Behavioral response among the students to check if MeLTs are able to fulfill the learning needs would be an important area of study. MeLTs could become mobile study centers for distance learning and provide certifications at door step. Based on our initial survey we have found that there is a great dearth of e-content. We would like to access best practices being used in delivery and standardization of e-learning in other parts of the world and we consider LINC as an opportune platform. We may in future be setting up of e-content development centre. Another possibility could be to verify the feasibility of mobile community FM based e-learning platforms. It is felt that there would be a need to add virtual laboratory tools on MeLTs for the purpose of extending the reach and availability.

7. Conclusion:

This paper has presented the responses and our analysis of the Need Assessment Survey for deployment of MeLT's. Further, it has described the idea of MeLTs and the technological design aspects and systems of e-content delivery available on MeLT. It can be seen that MeLTs are expected to be a universal platform for delivery of e-contents through 11 different modes. We

are in the process of deploying these MeLTs (12 to begin with) shortly in 6 states of north India. MeLTs are expected to make effective use and delivery of the educational content via the TV channels that have been launched by the government. Ultimately we hope to use technology to assist the available manpower in these institutions as in any case technological pedagogical model would not be a continuingly motivating mode which a physical teacher can be. So as a part of MeLTs we shall constantly endeavor to enable the trainer. By providing a platform we may be able to gain expertise/ help the experts to build better linkages for better, e-contents and delivery modes.