

**CHAPTER-1**  
**MINISTRY OF COMMUNICATIONS AND INFORMATION**  
**TECHNOLOGY**

**Department of Telecommunications**

**Centre for Development of Telematics (C-DOT)**

**Performance Audit on Development of Telecommunication Technology by C-DOT and transfer thereof for manufacturing and commercialisation**

**Highlights**

- **Non-adherence of original project implementation plan was observed in 18 projects out of 23 projects selected. This had resulted in time overrun ranging from 6 months to 70 months in 16 projects and cost overrun ranging from Rs. 0.85 crore to Rs. 22.48 crore in 11 projects.**  
(Paragraph 1.6.3)
- **Out of 23 projects, technology was developed only in 11 projects. While it was partially developed in four projects (Rs. 55.17 crore), technology was not developed in five projects (Rs. 34.69 crore).**  
(Paragraph 1.6.4)
- **Of the technologies developed under 15 projects (including partially developed in four projects), technologies could be transferred and commercialised fully only in three projects.**  
(Paragraph 1.6.5 & 1.6.6)
- **Internal revenue generation of C-DOT has declined by 78.5 per cent from Rs. 33.11 crore in 2000-01 to Rs. 7.12 crore in 2005-06. The sharp decline in royalty was by 96.1 per cent from 28.65 crore in 2001-02 to Rs. 1.12 crore in 2005-06. Revenue from TOT declined by 95.73 per cent from Rs. 3.98 crore in 2000-01 to Rs. 0.17 crore in 2005-06.**  
(Paragraph 1.6.1)
- **An amount of Rs. 37.66 crore was outstanding on account of TOT and royalty as on 31 December 2006 from 12 industries including ITI and BEL. In addition, an amount of Rs. 42.11 crore was not received from BSNL and MTNL under three reimbursement projects.**  
(Paragraph 1.6.1.1)

### **Summary of Recommendations**

- *C-DOT should plan for increase in its internal revenue generation in order to become self-financing.*
- *DOT needs to review the manpower constraint of C-DOT in the context of the future relevance of C-DOT in the fast changing field of telecom technology development.*
- *In the absence of any protective clauses to promote indigenous technologies, C-DOT needs to develop cost effective technologies providing services and features at par with those being offered by other global players.*
- *Projects should be taken up after conducting thorough and focused market survey of demand and supply. C-DOT should actively involve industry while taking up and during implementation of the project.*
- *In the absence of notable success of C-DOT in development, transfer and commercialisation of technology, DOT may review the relevance of C-DOT in today's global competitive scenario.*

### **1.1 Introduction**

The Centre for Development of Telematics (C-DOT) is the Telecom Technology Development Centre of the Government of India. It was established in August 1984 for a period of three years as an autonomous body. In May 1988, C-DOT was made as a permanent society and placed under the Department of Electronics and subsequently placed (June 1989) under the Department of Telecommunications (DOT), Ministry of Communication (now Ministry of Communications and Information Technology).

The key objective was to build a centre for excellence in the area of telecom technology. While the initial mandate of C-DOT in 1984 was to design and develop digital exchanges and facilitate their large scale manufacture by the Indian industry, the development of transmission equipment was also added to its scope of work in 1989. The primary objectives of C-DOT are to:

- Work on telecom technology products and services.
- Provide solutions for current and future requirements of telecommunication and converged networks<sup>1</sup> including those required for rural applications.
- Provide market orientation to R&D activities and sustain C-DOT as a centre of excellence.

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<sup>1</sup> Networks which carry data, voice and video services together

- Build partnerships and joint alliances with industry, solution providers, telecom companies and other development organisations to offer cost effective solutions.

The management of C-DOT has a three-tier structure consisting of the Governing Council, Steering Committee and the Project Board. The Governing Council provides policy guidelines and approves the annual budget of C-DOT. The Steering Committee is headed by Chairman (Telecom Commission) and alongwith its members has the role of reviewing and monitoring the performance of C-DOT.

A Project Board is responsible for the implementation of C-DOT's projects and the day-to-day functioning of the Centre. An Executive Director heads the Project Board and all directors of C-DOT constitute its members. The four support Divisions of the Project Board are Project Monitoring & Process Management Division, Technology Development & Technical Support Division, Finance Division and Administration & Purchase Division.

## 1.2 Scope of audit

The projects implemented by C-DOT during 2000-06 were divided into three categories (completed, dropped and on-going projects) based on the information provided by C-DOT. Out of a total of 46 projects, 23 projects (*Annexure A*) were selected for audit scrutiny on the basis of continued relevance and resources deployed. The sample selected was as given below:

<b>TABLE 1</b>				
<b>Sl. No.</b>	<b>Particulars</b>	<b>Total number of Projects</b>	<b>Number of projects selected</b>	<b>Selection per cent of total projects</b>
1	Projects dropped <sup>#</sup>	15	8*	53.33
2	Projects completed	21	10 <sup>^</sup>	47.62
3	Projects ongoing	10	5	50.00
<b>Total</b>		<b>46</b>	<b>23</b>	<b>50.00</b>

<sup>#</sup> including one project merged.

\*including one project commenced from 1997-98 and dropped in March 2004.

<sup>^</sup> including five projects commenced from 1996-2000 and completed by March 2003

## 1.3 Audit objectives

The projects implemented by C-DOT were studied to assess whether:

- Projects are completed timely in a cost effective and efficient manner;

- The objectives proposed under each project are achieved;
- The developed technology is transferred for manufacturing; and
- The transferred technology is successfully commercialised.

#### **1.4 Audit Criteria**

The following audit criteria were fixed to assess the projects:

- Adherence to procedures for selection and approval of projects;
- Formulation of project proposals after conducting feasibility study and market survey for assessment of demand;
- Implementation of projects as per implementation plan and sanctioned cost;
- Adherence to system of periodic monitoring and preparation of progress reports including completion report; and
- Development and transfer of technologies to industry/user agencies for manufacturing/ commercialisation and generation of revenue.

#### **1.5 Audit methodology**

The audit scope, criteria and objectives were discussed with C-DOT in the Entry Conference held on 15 June 2006. 23 projects selected by Audit were analysed in detail during June-September 2006. Findings were communicated to C-DOT for verification of facts and figures and an Exit Conference was held on 24 January 2007. The replies of C-DOT and DOT have been incorporated wherever relevant and necessary.

##### **1.5.1 Acknowledgement**

The co-operation of C-DOT during the entry conference, course of audit and exit conference was satisfactory and the same is acknowledged with thanks.

#### **1.6 General audit findings**

The general audit findings relating to financial management and manpower management for C-DOT and delay in implementation of projects, non-development, transfer and commercialisation of technology in respect of 23 projects selected by Audit are given below:

##### **1.6.1 Financial Management**

C-DOT receives grants mainly from DOT. It generates the major share of its internal revenue from transfer of technology (TOT) and royalty earned by

successful commercialisation of technology developed. The position of year-wise receipt and expenditure for the period 2000-2006 is given below:

(Rupees in crore)

<b>TABLE 2</b>							
Year	Receipt			Expenditure			
	Grants from DOT (grants as a % of total expenditure)	Other receipts*	Total receipts	Capital	Revenue	Total	
2000-01	110.66 (88.34)	38.81	149.47	26.56	98.70	125.26	
2001-02	108.00 (109.95)	52.70	160.70	30.40	67.83	98.23	
2002-03	108.80 (111.98)	63.21	172.01	33.65	63.51	97.16	
2003-04	47.66 (37.75)	21.67	69.33	57.40	68.86	126.26	
2004-05	56.50 (58.73)	33.53	90.03	31.15	65.06	96.21	
2005-06	78.98 (76.16)	11.41	90.39	41.36	62.33	103.69	

\*Other receipts include receipts towards TOT, royalty, field support activities, reimbursement projects, interest on fixed deposit and other miscellaneous income.

The Tenth Five Year Plan document had envisaged that C-DOT needed to focus more on generating internal resources through consultancy, royalty etc., to reduce its dependence on Government support and become self financing. However, it was seen that the dependence on Government grants continued to be high. During the period from 2000-01 to 2005-06, the Government grant constituted 78.82 per cent of the total expenditure of C-DOT.

Year-wise details of internal revenue generated (excluding reimbursement projects and interest on fixed deposits) by the Centre during the last six years are given below:

(Rupees in crore)

<b>TABLE 3</b>							
Year	Actual Internal Revenue Generation					Projected Internal Revenue Generation	Shortfall (in percentage)
	TOT	Royalty	Field Support Receipts <sup>2</sup>	Other Misc. Income	Total		
2000-01	3.98	22.72	5.30	1.11	33.11	20.00	No shortfall
2001-02	3.16	28.65	6.99	0.67	39.47	35.55	No shortfall
2002-03	1.89	16.73	4.67	2.54	25.84	35.00	26.17
2003-04	1.16	10.13	2.29	3.35	16.93	35.00	51.6
2004-05	1.02	2.23	23.64	3.51	30.40	40.00	24
2005-06	0.17	1.12	3.93	1.90	7.12	40.00	82.2
<b>Total</b>	<b>11.38</b>	<b>81.58</b>	<b>46.82</b>	<b>13.08</b>	<b>152.87</b>	<b>205.55</b>	<b>25.63</b>

Source-Figures provided by C-DOT

<sup>2</sup> Field support receipts are inclusive of Technology support receipts and receipts from BSNL, card repair, card tester, SCSI cables, PCB cards and R&D retrofit reimbursements.

Thus, it can be seen from the figures of internal revenue generation that:

- There was a steep decline in revenue generation from Rs. 33.11 crore in 2000-01 to Rs. 7.12 crore in 2005-06 i.e. by 78.5 *per cent*.
- There was a continued shortfall in achievement of revenue generation during the last four years from 2002-03 to 2005-06. The shortfall during 2005-06 was 82 *per cent* i.e. Rs. 32.88 crore.
- Revenue from TOT declined by 95.7 *per cent* from Rs. 3.98 crore in 2000-01 to Rs. 0.17 crore in 2005-06.
- Royalty registered a sharp decline of 96.1 *per cent* during the period.

In January 2007, DOT and C-DOT stated that the income under TOT/royalty had come down mainly on account of paradigm shift in the telecom market from fixed line based products to mobile. Further, if the internal income is accounted for on accrual basis, the total revenue for the period 2000-06 would be close to Rs. 230.09 crore, as against the projected internal revenue generation of Rs. 205.55 crore, besides receipts of dues from other software intensive projects and field support receipts. Further, Memorandum of Understandings (MoUs) for the services rendered by C-DOT at Bharat Sanchar Nigam Limited (BSNL) sites for 2004-05 and 2005-06 were being finalised. In December 2006, BSNL released an ad hoc payment of Rs. 7.50 crore for each of the financial years of 2004-05 & 2005-06. If the above is taken into account, the total internal revenue of C-DOT during the period 2000-06 is expected to be around Rs. 280 crore.

The reply is not tenable in view of the fact that C-DOT has not been following the accrual policy uniformly for accounting of TOT/royalty receipts. Even if the receipt for internal revenue generation is accounted for on accrual basis, the actual internal revenue accrued during 2000-06 would have been Rs. 167.34 crore after excluding TOT/royalty pertaining to the years prior to 2000-01 (but received during 2000-06). Further, C-DOT should have finalised the MoUs with BSNL to recover its dues in time.

#### **1.6.1.1 Outstanding dues**

C-DOT had transferred technologies to various industries and also provided field and operational support to BSNL and Mahanagar Telephone Nigam Limited (MTNL) on payment basis. An amount of Rs. 37.66 crore was outstanding on account of TOT and royalty as on 31 December 2006 from 12 industries including Indian Telephone Industry (ITI) and Bharat Electronics Limited (BEL) for the last two to five years. In addition, an amount of

Rs. 42.11 crore was not received from BSNL and MTNL under three reimbursement projects.

In January 2007, DOT and C-DOT stated that (i) in adjustment of pending dues of Rs. 22.80 crore from M/s ITI, C-DOT has taken over land & building belonging to M/s ITI at Bangalore since August 2005. The Centre is awaiting valuation of the same. Once the value is ascertained by the competent authority, the dues could be formally adjusted in the books of account, (ii) C-DOT had been in regular correspondence with other licensees/ Public Sector Organisations, and (iii) on C-DOT's claim for Rs. 31.55 crore (IMPCS project) BSNL has constituted a committee to look into the pending payments.

However, as of January 2007, the dues outstanding to C-DOT are Rs. 79.77 crore.

#### Recommendations

- *C-DOT should plan for increase in its internal revenue generation in order to become self-financing.*
- *C-DOT should make efforts to recover the outstanding dues. MoUs with user organisations should be signed timely and a penalty clause should be incorporated therein for non-payment of dues on time.*

### 1.6.2 Manpower Management

The position of sanctioned manpower and persons-in-position as on 1<sup>st</sup> April for the period 2000-01 to 2005-06 is given below:

Year (Position as on 1 <sup>st</sup> April)	Sanctioned Manpower				Person-in-position				Vacancy
	Engineers	Technical	Administrative	Total	Engineers	Technical	Administrative	Total	
2000-01	1360	450	230	<b>2040</b>	903	279	130	<b>1312</b>	<b>728</b>
2001-02	1360	450	230	<b>2040</b>	732	323	123	<b>1178</b>	<b>862</b>
2002-03	829	334	131	<b>1294</b>	744	336	125	<b>1205</b>	<b>89</b>
2003-04	866	309	129	<b>1304</b>	843	308	124	<b>1275</b>	<b>29</b>
2004-05	765	282	129	<b>1176</b>	763	282	118	<b>1163</b>	<b>13</b>
2005-06	765	282	129	<b>1176</b>	571	243	118	<b>932</b>	<b>244</b>

Both sanctioned manpower and persons-in-position declined drastically during the last six years. Out of 23 selected projects, it was noticed that in 21 projects,

C-DOT could not deploy the planned manpower due to shortage. Further, a large number of employees (ranging from 94 i.e. 7.37 per cent to 286 i.e. 21.80 per cent each year), particularly engineers, involved in the project had left C-DOT during critical phases of implementation of the project, which hampered the project work and led to delays.

In October 2003, C-DOT submitted a 'White Paper' on 'Strategies for Managing Employee Turnover' to its Steering Committee including possible steps to be taken by it for managing the employee turnover. However, it was observed that despite the remedial steps, there has been a significant outflux of personnel (particularly engineers) during the period 2004 to 2006. The following reasons were given by DOT for manpower leaving C-DOT:

- (i) Monetary/financial reasons: Salary and perks in C-DOT are perceived to be lower in comparison to other competitor organisations in the industry within the country.
- (ii) Employees' inclination towards pursuing higher studies and desire for opportunities to work abroad for international exposure and career opportunities enhancement.

In the absence of an effective plan to retain talent, the completion and development of projects/technology continues to be adversely affected.

**Recommendation**

*DOT needs to review the manpower constraint in the context of the future relevance of C-DOT in the fast changing field of telecom technology development.*

**1.6.3 Delay in implementation of projects**

Out of 23 projects examined in audit, in 16 projects the original target dates for each activity of the project were not adhered to and these were revised subsequently (*Annexure A*). This resulted in time overrun ranging from 6 months to 70 months as detailed below:

<b>TABLE 5</b>	
<b>Time overrun</b>	<b>Number of projects</b>
Six months – one year	3
One to two years	6
Two to three years	3
More than three years	4
<b>Total</b>	<b>16</b>



The original sanctioned cost of 23 projects was Rs. 385.67 crore, which was revised to Rs. 554.92 crore. Against this, C-DOT had incurred an expenditure of Rs. 356.17 crore upto March 2006. The cost overrun ranged from Rs. 0.85 crore to Rs. 22.48 crore in 11 projects (*Annexure A*). The percentage of cost overrun is detailed in the table below:

<b>TABLE 6</b>	
<i>Percentage cost overrun</i>	<b>Number of projects</b>
Nil	12
Upto 50 per cent	4
Between 51 to 100 per cent	2
Between 101 to 300 per cent	3
Between 501 to 1200 per cent	2
<b>Total</b>	<b>23</b>

While accepting the facts, DOT stated in January 2007 the following reasons for time overrun and cost overrun:

- Change in the scope of the research projects during the development cycle and/or for field requirements,
- Initial estimates, especially those for timeframes involve some amount of uncertainty of work and hence prone to errors, and
- Attrition of experienced manpower in key positions.

DOT further stated that C-DOT has taken certain measures to narrow the gap between projected and the actual delivery. Positive results are expected from these measures during the Eleventh Five Year plan period.

However, the fact remains that C-DOT did not adhere to its original implementation plans in terms of time and cost which resulted in inordinate delays and huge cost overruns. The impact of delay in implementation was obsolescence of technology, availability of cheaper alternatives in the market leading to reduction in market demand and revision of scope.

**Recommendation**

*C-DOT should ensure that the scope and implementation plan of projects should be framed after due consideration and milestones should be set for each project to ensure timely completion.*

#### **1.6.4 Non-development of technology**

The objectives for development of envisaged technology/product are specified in all the projects undertaken by C-DOT. On examination of 23 projects selected by Audit, it was observed that:

- Technology was not developed in five projects despite incurring an expenditure of Rs. 34.69 crore as four of these projects were dropped and one merged.
- Technology was developed in 11 projects (including project 'Operation Support System', which is ongoing to provide required enhancements). However, in one project (expenditure of Rs. 19.05 crore) inordinate delay led to loss of relevance and obsolescence of the technology developed.
- Technology was partially developed in four projects (expenditure of Rs. 55.17 crore) including the project 'IN enhancements & IN Based Services' where certain deliverables were already developed although the project was still ongoing to provide new services as per the emerging market requirements.
- The remaining three projects were still under implementation.

Details are given in *Annexure B*.

#### **1.6.5 Non-transfer of technology**

Out of 23 selected projects, technology was developed in 15 projects (including partially developed in four projects). Of these, TOT was done in three cases, partially done in five cases and not yet done in six cases. In the remaining one case, signing of TOT agreement was under process (*Annexure B*). Thus, C-DOT was not successful in transferring technologies to the end users.

Regarding non-transfer of developed technology, DOT stated in January 2007 that:

- The L<sub>1</sub> scenario of the present day tenders does not foster indigenous manufacturing,
- Certain restrictive clauses in the tender, regarding provenness of technologies to be deployed, discourage the prospective indigenous manufacturers to enter into TOT agreements for C-DOT technologies, and
- C-DOT had taken certain steps to address the above issues.

The Tenth Plan document had envisaged C-DOT to make efforts for development of cost effective technologies providing services and features at par with those being offered by other global players. However, the reply of DOT on the L<sub>1</sub> scenario not fostering indigenous manufacturing is a tacit acceptance of C-DOT's inability to be competitive in the market.

#### **1.6.6 Non-commercialisation of transferred technology**

Out of 23 selected projects, technology was transferred in eight projects. Of these transferred technologies, in three cases, manufacturing/commercialisation was started and in two cases, commercialisation was done partially (*Annexure B*).

Regarding non-commercialisation of transferred technology, DOT stated in January 2007, that certain technology developments, though completed and successfully transferred to the manufacturers, were not being commercialised due to the restrictive clauses in the tender regarding the provenness of the technology to be manufactured.

The reply is not tenable as C-DOT should have made efforts for development of cost effective technologies providing services and features at par with those being offered by other global players as envisaged in the Tenth Plan document. In the absence of significant success of C-DOT in commercialisation of technology, the very purpose of development and transfer of technology is defeated.

#### **Recommendation**

*In the absence of notable success of C-DOT in development, transfer and commercialisation of technology, DOT may review the relevance of C-DOT in today's global competitive scenario.*

#### **1.6.7 Inadequate documentation of projects**

There was no prescribed proforma for submission of Project Completion Reports. In six out of ten completed projects, C-DOT submitted the extract from its Annual Plan and Budget instead of a Project Completion Report. Although there was an approved format for projects discontinued midway, no such report had been prepared in respect of the seven discontinued projects. DOT stated in January 2007 that in future, efforts would be made to submit Project Completion Report in a certain prescribed format as suggested by Audit.

## **1.7 Detailed audit findings: Project Analysis**

The 23 projects selected by Audit were examined and significant findings in respect of seven projects are discussed below:

### **1.7.1 Fibre Access System**

In 1994, C-DOT undertook a project “Fibre Access System” (FAS) to develop fully optical fibre access networks. The prime motivation of FAS was the proven cost effectiveness over traditional copper and DLC (digital loop carrier) access and the future-proof nature of investment in fibre. While initiating the project, C-DOT estimated that during 1995-2000, India would have a vast growth in the network of about 3 to 4 crore lines from a present seventy lakh (September 1993). To exploit the advantages of fibre and cost-effectiveness of Fibre in the loop (FITL) systems, most of the access lines would use FITL systems. As the market of FAS was directly linked with the rapid expansion of the telecom network, a good and growing market would absorb these systems (FAS). In addition to improved performance, wide coverage, rapid provisioning for widespread subscribers, long repeater span, single ended maintenance and universal interface were other potential benefits of FITL equipment.

The project cost was Rs. 2.67 crore and the project was to be completed (including initiating TOT) by January 1998. The objectives of the project were to design and develop FITL equipment for telephony service, which should be upgradeable for digital TV and broadcast services and distribution.

The audit findings with regard to this project are given below:

**(i)** The project was completed only in March 2003 with a time overrun of five years and two months. The sanctioned cost was revised five times and it escalated from Rs. 2.67 crore in 1994-95 to Rs. 17 crore in 2001-02. The total expenditure finally incurred on the project was Rs. 19.05 crore resulting in an overall cost overrun of Rs. 16.39 crore, i.e 614.84 *per cent*.

**(ii)** By March 2003, the technology was developed and its internal validation was in progress. However, it was observed that neither internal validation of the FAS was completed nor was it offered to Telecommunication Engineering Centre (TEC) for obtaining Technological Approval Certificate till January 2007.

**(iii)** In spite of the estimated good and growing market of FITL as assessed by C-DOT while initiating FAS, the technology developed under the FAS

project was neither transferred nor commercialised. In October 2003, C-DOT reported to its Steering Committee that FAS had not found applications in Indian network and also in the global network as anticipated earlier mainly due to other broadband alternatives and need of mobility in subscriber access part. Hence, as FAS has lost its relevance due to its narrow band set and availability of parallel technologies in the market, the technology developed under FAS has not been transferred.

C-DOT stated (August 2006) the following reasons for the delay in implementation of project:

- (a) Under-estimation of the magnitude of the project and amount of time required;
- (b) Lack of clear-cut specifications;
- (c) Non-availability of sufficient experienced manpower;
- (d) Coordinating Engineers left the project at its critical stage;
- (e) Non-availability of some important components from outside vendors and expertise;
- (f) Non-improvement of the architecture envisaged since 1994-95; and
- (g) Lack of thorough review process especially in software.

Thus, the technology developed under FAS could not be utilised. Lack of proper planning and adequate monitoring including midcourse correction resulted in:

- Time overrun for more than five years.
- Cost overrun of Rs. 16.39 crore; and
- Obsolescence and loss of relevance of technology developed due to several other parallel technologies already being there in the market.

While accepting the facts, C-DOT intimated in January 2007 that parallel technologies viz. Asymmetrical / High Speed Digital Subscriber Loop – copper-enhancement basic technology and Enhanced Data rates for GSM Evolution / CDMA wireless technology for narrow band access arrived in the market in 2000. DOT stated that inspite of it taking long time to develop FAS technology, it did not miss the market as no other vendor could also find its application in the market. Even as on date, fibre access from any source has not found significant place in the BSNL network.

However, the fact remained that by the time C-DOT developed the FAS technology, it was no more relevant as there were several other cheaper

alternatives in the market. Therefore, finding a place in the market for FAS by the time it was developed did not have any meaning. Thus, the expenditure of Rs. 19.05 crore incurred on this project by C-DOT did not yield the desired results.

### **1.7.2 Radio Access Network based on WCDMA for IMT 2000**

During 1997-98, C-DOT initiated a project entitled “CDMA Technology Development”. The original objectives of the project were to develop CDMA access technology with a view to utilise the same for Wireless Local Loop/Wireless LAN products. In 2001-02, the objectives were revised to develop CDMA access technology for Broadband Wireless International Mobile Telecommunication (IMT)-2000<sup>3</sup>. The project was renamed (2002-03) as Radio Access Network (RAN<sup>4</sup>) based on WCDMA for IMT 2000 and included under the scheme Second & Third Generation Mobile Communication in 2003-04.

As per the original project plan, the project was to be completed by May 1998. However, the project was discontinued after March 2004. The original sanctioned cost of the project was Rs. 1.92 crore.

The audit findings with regard to this project are given below:

(i) The objectives and targets of the project were revised several times and C-DOT could not adhere to the targeted time schedule resulting in considerable delay (five years and ten months). The cost of the project was revised thrice from Rs. 1.92 crore to Rs. 37 crore between 1997-98 and 2002-03.

(ii) The project was discontinued after March 2004 after incurring an expenditure of Rs. 23.22 crore. The reasons cited for closure of the project were:

- The system dimension for 3G-RAN decided by C-DOT (due to several limitations) was not enough to cater to the competitive market requirements. Even if C-DOT came out with a solution in the year 2006, there might not be any market relevance.

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<sup>3</sup> IMT-2000 is an initiative of the International Telecommunication Union popularly known as third generation (3G) mobile systems. 3G networks provide access to a wide range of telecommunications services supported by the fixed telecommunication networks and to other services which are specific to mobile users.

<sup>4</sup> RAN is a transmission system in the 3G network. The RAN comprises of two elements namely, Node-B which connect mobile station (user) to the 3G network and the Radio Network Controller for the management of Node-B terminal.

- The spectrum for 3G operations was not clear and the spectrum regulatory body's intention as well as the operators' intention was not known.
- C-DOT was not working on GSM, which was required under 3GPP standards (release 6).
- The 3G handsets and the multi-standard handsets were quite highly priced with respect to their GSM and CDMA counterparts, which may be a hindrance for their mass acceptance.
- There was a lot of pressure from the funding agencies as well as Finance Ministry to develop a solution for rural mobile application that would be able to cater for Voice, Tele-medicine, Multimedia, e-Governance, Distance education and other socially beneficial programmes for the vast rural masses of India. The basic voice service with SMS and mobility with a standard handset and C-DOT RAX<sup>5</sup> had to be proven within one year.
- Overlay on the existing GSM and CDMA infrastructure as well as utilisation of the massive installed base of RAX will be commercially more viable rather than deploying fresh 3G infrastructure.

Hence, C-DOT decided to discontinue the project and switch over to 4G and Rural Wireless projects, so that no further time would be lost in entering the new markets along with other competitors.

Thus, it is clear that:

- The project was taken up without ascertaining the actual requirement of the technology/ product in the country.
- C-DOT could not foresee the required system dimension and scope of the project; and
- As a result, the project was discontinued midway resulting in an unfruitful expenditure of Rs. 23.22 crore.

In January 2007, DOT replied that at the time of project conception, ITU-Telecom was developing new standards for the next generation of wireless access systems under IMT 2000 program for 3G network and therefore, the efforts in initial years of the project had been towards studying and understanding the basic CDMA standards. The development activity was started only in 2000-01. Further, since the project commencement timing was almost in parallel to choice of standards being evolved, the project outlays had

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<sup>5</sup> Rural Automatic Exchange

to increase progressively. DOT also stated that this discontinuation may be viewed as shifting the emphasis of technology development towards priority sectors like rural areas requiring a cost-effective mobile technology.

The reply was not tenable as at the time of initiation of the project, C-DOT should have made realistic time and cost estimates taking into account the fact that the required standards were still evolving. Moreover, C-DOT undertook the Second and Third Generation Mobile Communication scheme keeping in alignment with the shift to mobile technology. However C-DOT could not foresee the sluggish demand of 3G technology and the scheme had to be foreclosed within one year of its initiation.

The fact remains that the RAN project was discontinued after seven years and after incurring 62.76 per cent of the sanctioned cost.

### 1.7.3 Wireless Access System

Subsequent to closure of Second and Third Generation Mobile Communication Scheme and due to pressure from the funding agencies, C-DOT initiated a project entitled “Wireless Access System (WAS)” during 2004-05. The objective of the project was to develop a cost effective “Rural Wireless Solution (RWS)” for improving rural tele-density, providing broadband services and facilitating mobility services for the rural subscribers at affordable prices. The application was to be for tele-medicine, disaster management, educational and vocational courses and setting up internet kiosks for rural masses. This project was taken up since the traditional high capacity large-scale wireless networks were not cost effective in remote and low-density areas. The total sanctioned cost of the project was Rs. 19 crore. As per the original project plan, the project was to be conducted in two phases over 18 months:

- In the first phase (10 months) RWS was to be developed with the help of outsourced components and sub-systems.
- In the second phase (additional eight months), the outsourced components/ sub-systems had to be replaced with their indigenous equivalents to gain the low cost advantage of an in-house design.

During 2006-07, the objective was revised to develop a Software Defined Radio (SDR)<sup>6</sup> based mobile wireless and cognitive radio based broadband

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<sup>6</sup> A software defined radio system is a radio communication system, which can tune to any frequency band and receive any modulation across a large frequency spectrum by means of a programmable hardware, controlled by software.



(fixed) wireless access with specific focus on rural applications. In this regard C-DOT had signed MoU/ agreements with strategic partners for procurement of components. During 2006-07, the sanctioned cost was revised from Rs. 19 crore to Rs. 25 crore. C-DOT had incurred an expenditure of Rs. 15.58 crore on the project till 31 March 2006.

The audit findings with regard to this project are given below:

(i) The goals of this project (WAS) were to be set by BSNL's rural planning cell. However, no record of any communication between C-DOT and BSNL was available. Moreover, it was envisaged that the funding agency for this program would be USO (Universal Services Obligation) Fund, an attached office of the DOT, Ministry of Communications & Information Technology. However, no evidence of C-DOT having provided such proposal to USO was available on record.

(ii) As per the original (2004-05) targeted implementation plan, the project was to be implemented by the fourth quarter of 2004-05. However, C-DOT could not adhere to these targets and these were postponed twice during 2005-06 and 2006-07. In April 2006, the equipment procured had been moved to Vallalkundam, Salem in Tamil Nadu. However, since C-DOT did not have necessary approval of statutory/ government authorities for conducting trials in the desired frequency band, the pilot trials could not take place till date (January 2007). In July 2006, C-DOT applied to Wireless Planning Commission (WPC) for experimental wireless licence but the same was still awaited as of January 2007.

Thus, due to the delay in implementation of the scheme by more than one and half years, C-DOT is yet to fulfill its primary objective of providing affordable mobile and internet services to the rural masses. As the project was still ongoing, the impact of this delay towards loss of market share/ obsolescence of technology could not be ascertained.

In January 2007, DOT stated that C-DOT has sought special permission from WPC for conducting trials in a band, which is presently occupied by Indian Space Research Organisation (ISRO) in India. C-DOT is in discussions with WPC and ISRO for permission to conduct trials, which is a tedious process.

The reply is not tenable as C-DOT applied to WPC for experimental wireless licence only in July 2006 although it had originally planned for pilot trial (GSM and Broadband System) in March 2005. The delay in pilot trials could have been avoided if C-DOT had anticipated and taken prior approval from

the statutory/ Government authorities. Moreover this project was taken up on a priority basis after discontinuation of 3G scheme as discussed above in paragraph 1.7.2.

#### **1.7.4 Asynchronous Transfer Mode<sup>7</sup>**

By mid 1990s, Asynchronous Transfer Mode (ATM) was an emerging technology, which was recommended by International Telecommunications Union for setting up a very high-speed broadband integrated services digital network (B-ISDN). Having assessed the promise of ATM, C-DOT decided to develop a new generation of switching systems based on packet technology as an upgrade for its ageing circuit switched solutions. The replacement market alone amounted to more than 50 lakh lines of equipment.

Accordingly, C-DOT sanctioned a project 'ATM' in 1996-97 with the objectives of developing an ATM based Broadband Integrated Digital Switching Platform. The project was to be implemented during 1996-2000 in four phases. In 1998-99, all the four phases were merged and the project was to serve as the first roadmap. The deliverables were ATM Switch (CAX 16 technology with 2.5 Gbps i.e. Giga bytes per second), frame relay and network management. After completion of first roadmap by end of year 2000, the second roadmap was estimated (2000-01) to develop CAX 32 technology (starting with 5Gbps, 40 Gbps and expandable upto 160 Gbps) by 2003. The sanctioned cost for the two roadmaps was Rs. 65 crore.

The audit findings with regard to this project are given below:

- (i) The original sanctioned cost of project for the first roadmap was Rs. 35 crore and was revised to Rs. 65 crore for both roadmaps. The first roadmap was completed by end of year 2000 with an expenditure of Rs. 33.79 crore against the sanctioned cost of Rs. 35 crore. The second roadmap was also completed by the end of year 2003 with an expenditure of Rs. 33.21 crore against the sanctioned cost of Rs. 30 crore (second revised cost). As such, there was a cost overrun of Rs. 2 crore (3.07 per cent) under both roadmaps of the project.
- (ii) By March 2003, C-DOT completed the development of 2.5 Gbps ATM switch and Multiplexers (first roadmap), which were installed for field

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<sup>7</sup> ATM is a high-bandwidth switching and multiplexing technology that combines the benefits of circuit switching (ensuring minimum transmission delay and guaranteed bandwidth) with the benefits of packet switching (providing flexibility and efficiency in handling intermittent traffic).

trials at five cities (Delhi, Bangalore, Mumbai, Kolkata and Chennai) as part of the national broadband network. TEC validation of the product was completed and service trials were in progress. The CAX 32 (second roadmap) was architecturally designed in such a way that the first delivery was made for 5 Gbps switch that is scalable upto 40 Gbps in multi-module configuration. However, integration work of ATM Switch for 40 Gbps of CAX 32 technology expandable upto 160 Gbps was left midway due to reduced demand for high capacity ATM switches.

**(iii)** The products (ATM core switch with 2.5 Gbps and Multiplexers) were not transferred for civil telecom networks as envisaged, though the market for replacing traditional PSTN alone amounted to more than 50 lakh lines of equipment. It was utilised only for defence application, after customisation of developed ATM technology. In October 2003, C-DOT reported to its Steering Committee that the product developed under ATM project had not found commercial success in the telecommunication networks of BSNL and MTNL etc. for which the project was originally conceived because of availability of cheaper alternative technologies to ATM. By the time C-DOT came out with the ATM, it had a promise only in the defence market and not in the civil telecom networks.

**(iv)** To transfer the developed ATM technology to the defence sector, C-DOT signed two agreements with Bharat Electronics Limited (BEL) in July 2001 and March 2002. Accordingly, C-DOT undertook two new projects for ATM customisation in the defence and naval telecom network and incurred an expenditure of Rs. 7.63 crore (2003-05) and Rs. 2.20 crore (2005-06) respectively. C-DOT received Rs. 1 crore as first and second installment of TOT fee (till July 2006) under both the agreements and subsequent installments (Rs. 3.75 crore) were still pending as the minimum required numbers of system were yet to be manufactured by BEL. The product developed still remains to be fully commercialised.

Since its initiation of the project in 1996-97, there was lack of proper planning, assessment of the market demand, and timely and effective monitoring. As a result:

- Integration work of ATM switch for 40 Gbps and expandable upto 160 Gbps of CAX 32, which was one of the key deliverables, was discontinued midway due to reduced demand.

- The 2.5 Gbps ATM switch could not be utilised for civil telecom networks as envisaged due to availability of cheaper alternatives in the market.
- The technology could be transferred only partially for defence applications, that too after customisation at an additional expenditure of Rs. 9.83 crore.
- The cost overrun involved was Rs. 2 crore (3.07 per cent).

DOT stated in January 2007 that during the course of development, the fast changes in internet technology led to cheaper alternatives to ATM and the ATM market share declined.

However, the fact remained that C-DOT took seven years to develop the ATM technology. Moreover, it could not assess the market scenario during the course of project implementation, thus, resulting in only partial commercialisation of its product.

#### **1.7.5 Single Base Module Exchange<sup>8</sup> catering up to 4000 subscribers**

During 1998-99, C-DOT initiated the Single Base Module Exchange (SBM) 4K project by merging two of its ongoing projects (i) '256 Port Terminal Unit' since 1994-95 and (ii) 'Compact Digital Trunk BM' since 1997-98. SBM-4K project was primarily for enhancing the connectivity and performance of existing SBM- XL (which could cater up to 2000 subscribers) to cater to 4000 subscribers. It also addressed the obsolescence of some components and reduced the floor space of the existing MAX switches by 50 per cent with enhanced processing capacity.

The original sanctioned cost of Rs. 10.50 crore of the above two projects and their expenditure of Rs. 5.69 crore for the year 1997-98 were also merged with the new project. The project was due to be completed (including commencement of validation of technology) by March 1999. The estimated demand of the SBM-4K technology was quite high as C-DOT's existing technology was deployed in 21.72 lakh lines as on March 1998, which could be upgraded to SBM-4K.

The audit findings with regard to this project are given below:

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<sup>8</sup>A Single Base Module is a stand-alone exchange that can be deployed for rural local switch applications to service a number of subscribers.

(i) The project was completed only in March 2003 with a time overrun of four years. The cost of the project was revised to Rs. 20 crore in 1998-99 and Rs. 25 crore in 2001-2002. Total expenditure incurred was Rs. 22.51 crore involving a cost overrun of Rs. 12.01 crore (114.38 *per cent*) including cost of two merged projects.

(ii) The development of the technology under the project was completed and it was internally validated. TEC testing of the technology in the laboratory was started from July 2002 for different phases and successfully completed in the field between March 2003 and January 2004.

(iii) Prior to TEC testing of the technology, C-DOT signed (between December 2001 and February 2002) separate agreements with 12 industries (manufacturers) for transfer/manufacture of the developed technology. As per agreements, C-DOT received first installment of know-how fee of Rs. 1.85 crore on signing of agreement. However, the second installment of know-how fee of Rs. 1.85 crore which was due between December 2002 and February 2003 from all the industries is still outstanding. As there was no production/sales, royalty at the rate of four *per cent* on net sales was also not received till January 2007.

Though the technology was developed at a cost of Rs. 22.51 crore and transferred to 12 industries, it could not be manufactured /commercialised in the wake of reduced demand of fixed landline switches. No royalty could be generated as a result of non-commercialisation of the product.

In reply, C-DOT stated in October 2006 that SBM-4K technology required up-gradation of both existing hardware and software. Hardware upgradation required capital expenditure for which the operator (BSNL) had not yet taken a decision. Further, due to reduced requirement of landline switches in BSNL network, the SBM 4K technology could not be proliferated in the field.

While accepting the facts, DOT stated in January 2007 that the estimated demand of the SBM-4K technology was quite high at the stage of commencement as C-DOT's existing technology was deployed in 49.89 lakh lines (includes MAX- L / XL and SBM - RAX). However, the shift of focus from fixed lines to mobile lines was unprecedented.

The reply needs to be viewed in light of the fact that the product development was delayed by four years by which time the market demand had reduced due to shift to mobile technology.

**Recommendation**

*Projects should be taken up after conducting thorough and focused market survey of demand and supply. C-DOT should actively involve industry while taking up and during implementation of the project.*

**1.7.6 C-DOT 32 Channel Dense Wavelength Division Multiplexing System**

During 2000-01, C-DOT initiated a project “Wavelength Division Multiplexing (WDM)” to provide a solution to increase the transmission capacity of transport networks. With Dense Wavelength Division Multiplexing (DWDM) technology, multiple data signals using different wavelengths of light could be transmitted through a single fibre increasing the total data rate on one fibre to one terabit ( $10^{12}$  bits) per second.

The original sanctioned cost of the project was Rs. 10 crore and the project was to be completed (including offer for validation) by February 2002. The objective of the project was to develop DWDM equipment that would transport simultaneously 32 wavelengths (channel) each carrying data up to 2.5 Gbps rate on single fibre to provide a throughput of 80 Gbps on the fibre.

In January 2005, the system had been offered to TEC and in July 2006, TEC issued Technology Approval Certificate to C-DOT for CDWDM 3200.

The audit findings with regard to this project are given below:

- (i) The system was offered to TEC for validation in January 2005 against the targeted date of February 2002 after a delay of about three years. In October 2006, C-DOT replied that the original objectives were enhanced and after considering this, the actual delay in execution of the project was around six months.

The sanctioned cost of the project was revised to Rs. 15.70 crore during 2003-04 due to enhancement of its scope. Till completion of the project in March 2005, C-DOT had incurred an expenditure of Rs. 17.77 crore i.e. Rs. 2.07 crore (13.18 *per cent*) more than the sanctioned cost. The total cost overrun involved was Rs. 7.77 crore, i.e. 77.69 *per cent*.

In March 2006, BSNL proposed to retain the CDWDM 3200 system installed for field trial by C-DOT on its New Delhi – Jaipur route. C-DOT agreed to BSNL’s offer of Rs. 2.30 crore (its earlier purchase price) for the equipment although the actual production cost of C-DOT was higher by Rs. 85 lakh at a

cost of Rs. 3.15 crore. Thus, the commercial viability of CDWDM 3200 system developed by C-DOT could not be ascertained due to its higher pricing. In October 2006, C-DOT replied that it was interacting with various vendors to get the prices of critical components reduced for making the system commercially viable. Simultaneously, C-DOT was also trying to replace some of the high-end optical components from alternative vendors by way of testing the same in the laboratory. In January 2007, DOT replied that the cost gets substantially reduced and can be negotiated with component vendors if there is a significant requirement for the finished system in the field.

(ii) In September 2005, C-DOT had accepted BEL's request for TOT for CDWDM 3200. However, the TOT agreement was yet to be signed with BEL. In October 2006, C-DOT replied that BEL's management was actively considering taking up the TOT. As such, successful transfer and commercialisation of CDWDM 3200 system was yet to be made. In January 2007, DOT replied that the restrictive clause in the tender, with respect to provenness of technologies, discourages the prospective indigenous manufacturers to enter into TOT agreements.

In this regard, C-DOT should have made efforts to develop cost effective technologies and associate manufacturing industries for commercialisation of its developed technology. Thus, the DWDM technology developed at a cost of Rs. 17.77 crore was yet to be transferred and successfully commercialised. Also, the economic viability of the technology in the open market was uncertain due to its higher pricing.

**Recommendation**

*In the absence of any protective clauses to promote indigenous technologies, C-DOT needs to develop cost effective technologies providing services and features at par with those being offered by other global players.*

**1.7.7 Next Generation - Synchronous Transport module 1/ 4<sup>9</sup>**

C-DOT had earlier undertaken the following projects and developed CSTM-I<sup>10</sup>, which had been field tried successfully.

<sup>9</sup> Synchronous Digital Hierarchy forms the platform for the future transport networks to provide connectivity in the trunk, junction and local networks. NG-STM1/4 is multiplexing equipment based on SDH technology and constitutes a Network Element.

<sup>10</sup> CSTM I was a 155 Mbps Multiplexer ( Compact version) for efficient transmission in the access loop as well as in the trunk lines.

(Rupees in crore)

<b>TABLE 7</b>				
<b>Sl. No.</b>	<b>Name of the project</b>	<b>Year of start</b>	<b>Year of completion</b>	<b>Total cumulative expenditure</b>
1	SDH Programme	1992-93	2001-02 end	41.36
2	CSTM-1	2002-03	2002-03 end	0.91
3	STM-1 Support	2003-04	Not applicable	3.96

However, for complete TEC approval, compliance to the amendment 3 to Generic Requirement was required which involved re-engineering of the CSTM-1. Hence in continuation of these projects, C-DOT initiated another project entitled Next Generation - Synchronous Transport module 1/4 (NG-STM1/4) during the Revised Estimates (RE) stage of 2003-04.

The original sanctioned cost of the project was Rs. 2.25 crore. The key deliverables under the project were the development of products STM-1 (155.52 Mbps) and STM-4 (622.08 Mbps). During the year 2003-04, the projected demand of BSNL for STM-1 and STM-4 were 2370 and 2172 respectively. Further, in the coming years it was expected that requirements would remain same or decline gradually which would still be a substantial number.

The audit findings with regard to this project are given below:

The project did not progress as per the targeted time schedule resulting in time overrun of nine months in implementation of the project. The project was discontinued from 2005-06 onwards, after completing NG STM-1 part of the project. The system integration, testing and offer for internal validation was not taken up. C-DOT had incurred an expenditure of Rs. 3.10 crore i.e. Rs. 0.85 crore more than the sanctioned cost till 31 March 2005.

In September 2006, C-DOT replied that the technology of CSTM-1 was transferred to three manufacturers. There was no separate TOT for NG-STM1/4. The product had not been deployed till date (September 2006). However, one of the manufacturers (M/s VXL Technologies Limited) had got an educational order from BSNL for Type-1 of the equipment.

Thus, it was seen the STM-4 technology, which was envisaged as one of the deliverables in the project was not required and hence not developed. Though



the STM-1 technology was developed and transferred, it could not be commercialised as stand alone equipment.

In January 2007, DOT stated that although the demand for STM-1 and STM-4 from BSNL existed at the commencement of the project, during the course of development in 2004-05, the STM-4's requirement was considerably reduced due to higher capacity systems like STM-16, DWDM etc. Consequently, the NG-STM 1/4 system with stand alone STM-1 functionality did not appear to be cost effective system for commercialisation.

The reply was not tenable as it illustrates that projections regarding market requirements of STM 1 and 4 made by C-DOT during RE stage of 2003-04 proved off target in the very next year (2004-05).

**1.8** In response to the above audit findings, DOT stated in the Exit Conference (January 2007) that C-DOT has adopted a more aggressive approach for commercial exploitation of its technologies in cognizance of challenges arising from the changed telecom scenario in the country, including liberalisation and increased global competition. They further stated that C-DOT is entering into strategic alliances and partnerships with other technology organisations and industries both in the public and private sector and providing technical consultancy to clients. Further, current and near future programmes of C-DOT are of shorter duration (18-24 months) and they being market focused, are expected to generate sufficient internal revenues during the next 2-3 years.

The reply of C-DOT needs to be viewed in the light of the fact that C-DOT has not enjoyed notable success in commercialisation of the technology in the recent past.

## **1.9 Conclusion**

The management of projects was not cost effective and efficient as time and cost overrun were observed in 70 *per cent* of the projects selected by Audit for scrutiny. There was time overrun ranging from 6 months to 70 months and cost overrun ranging from Rs. 0.85 crore to Rs. 22.48 crore. These delays resulted in obsolescence of technology in one project and reduction of market demand in five projects. Further, a continuous attrition of technical manpower adversely impacted the timely completion of projects.

The objectives as envisaged in the projects were not achieved in more than 50 *per cent* of the projects. Eight projects out of the 23 selected by Audit were dropped after incurring an expenditure of Rs. 36.89 crore.

Technology developed could not be transferred in more than 50 *per cent* of projects due to reduction in market demand by the time of development and presence of cheaper alternatives.

Commercialisation of the technology was made fully in 27 *per cent* of the projects due to lack of sufficient response from industries/users and cost ineffectiveness of the developed technology with respect to other global players in the market. As a result, C-DOT failed to generate any royalty from these 23 projects. Thus, C-DOT could not develop cost effective technologies providing services and features, as envisaged in the Tenth Plan document, at par with those being offered by other global players.

The revenue generation by C-DOT has declined significantly from Rs. 33.11 crore in 2000-01 to Rs. 7.12 crore in 2005-06, i.e. by 78.5 *per cent*. The sharp decline in royalty was by 96.1 *per cent* from 28.65 crore in 2001-02 to Rs. 1.12 crore in 2005-06. Although it was envisaged in the Tenth Five Year Plan that C-DOT needed to focus more on generating internal resources through consultancy, royalty etc. to reduce its dependence on Government support, it has still not become self financing.

In the context of the fast changing field of telecom technology development and the presence of global competition, DOT needs to review the future relevance of C-DOT particularly considering its performance with respect to the projects taken up in the recent past.

## ANNEXURE- A

(Referred to in para 1.6.3)

**Delay in implementation of projects (Time/ cost overrun)***(Rupee in lakh)*

Sl. No.	Name of Project	Year of Sanction	Year of closure (dropped/ completion)	Time overrun	Original Sanctioned Cost	Revised Sanctioned Cost	Expenditure up to closure/ 31 March 2006	Cost overrun*	Percentage cost overrun
<b>PROJECTS DROPPED (including one merged)</b>									
1.	Radio Access Network based on WCDMA for IMT 2000 (3G RAN)	1997-98	31 March 2004 (dropped)	Five years and Ten months	192.00	3700.00	2322.09	2130.09	1109.42
2.	Internet Point of Presence	2000-01	31 March 2002 (dropped)	One year and two months	500.00	-	113.32	-	-
3.	Voice Messaging System (VMS) & Unified Messaging System (UMS)	2002-03	31 March 2004 (dropped)	One year	150.00	500.00	91.54	-	-
4.	Multi Protocol Label Switching (MPLS)	2003-04	31 March 2004 (merged with NGN)	No as merged with NGN	700.00	-	114.14	-	-
5.	Fixed SMS	2003-04	31 March 2004 (dropped)	No	600.00	-	91.86	-	-
6.	2G NSS Enhancements, 2.5G & 3G circuit switched NSS	2003-04	31 March 2004 (dropped)	No	10000.00	-	810.13	-	-
7.	2G & 3G Packet Switched NSS (GPRS)	2000-01	31 March 2004 (dropped)	Two years and eleven months	1000.00	-	109.77	-	-

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Sl. No.	Name of Project	Year of Sanction	Year of closure (dropped/ completion)	Time overrun	Original Sanctioned Cost	Revised Sanctioned Cost	Expenditure up to closure/ 31 March 2006	Cost overrun*	Percentage cost overrun
8.	NG-STM1/4	2003-04	31 March 2005 (dropped)	Nine months	225.00	-	309.95	84.95	37.76

**PROJECTS COMPLETED**

9.	SBM Exchange Catering up to 4K Subscribers	1997-98	2002-03	Four years	1050.00	2500.00	2250.91	1200.91	114.37
10.	ATM	1996-97	2002-03	No	6500.00	6500.00	6699.56	199.56	3.07
11.	Development of Personnel Communication System (PCS)	1998-99	2002-03	Two years and five months	1500.00	4000.00	3747.68	2247.68	149.85
12.	Fibre Access System	1994-95	2002-03	More than five years	266.51	1700.00	1905.13	1638.62	614.84
13.	Intermediate Data Rate-VSAT	2000-01	2002-03	Two year and eight months	1944.00	2540.00	559.74	-	-
14.	C-DOT 32 Channel Dense Wavelength Division Multiplexing System (C-DWDM 3200)	2000-01	2004-05	Six months	1000.00	1570.00	1776.94	776.94	77.69
15.	IMPCS Project	1999-2000	2002-03	One year and five months	4380.00	7127.00	5863.00	1483.00	33.86
16.	ATM Customisation for Defence	2003-04	2004-05	Three months	409.00	1000.00	762.73	-	-
17.	Multi Technology Network Management System (MTNMS)	2003-04	2004-05	No	200.00	-	348.23	148.23	74.12

Sl. No.	Name of Project	Year of Sanction	Year of closure (dropped/ completion)	Time overrun	Original Sanctioned Cost	Revised Sanctioned Cost	Expenditure up to closure/ 31 March 2006	Cost overrun*	Percentage cost overrun
18.	Network Reliability Optimization for AISDN-17 Navy	2005-06	2005-06	Three months	450.00	-	219.62	-	-

**PROJECTS ONGOING**

19.	Broad Band Transport Via Satellite (BBTS)	2001-02	Ongoing	Three years and six months	950.00	1400.00	1052.12	102.12	10.75
20.	IN Enhancements & IN based Services	2002-03	Ongoing	One year and eight months	350.00	2050.00	1367.96	1017.96	290.85
21.	Operation Support System (OSS)	2003-04	Ongoing	One year and six months	1800.00	2230.00	1691.27	-	-
22.	Next Generation Network (NGN)	2004-05	Ongoing	One year and six months	2500.00	-	1851.55	-	-
23.	Wireless Access System	2004-05	Ongoing	One year and six months	1900.00	2500.00	1557.79	-	-
				Total	38566.51	55492.00	35617.03	11030.06	

\* Cost overrun is worked out by subtracting Original Sanctioned Cost from Progressive expenditure.

**ANNEXURE- B**

(Referred to in para 1.6.4)

**Status of development of technology, transfer of technology and commercialisation thereof**

S. No.	Name of Project	Status of development of technology	Transfer of technology (TOT) status	Present commercialisation status	Remarks
1.	Radio Access Network based on WCDMA for IMT 2000 (3G RAN)	Not developed as dropped	No	No	-
2.	Internet Point of Presence	Not developed as dropped	No	No	-
3.	Voice Messaging System (VMS) & Unified Messaging System (UMS)	Partially developed (UMS not developed)	TOT not done	No	Due to availability of similar products in competitive market, project development closed.
4.	Multi Protocol Label Switching (MPLS)	Not developed as merged with NGN	No	No	-
5.	Fixed SMS	Developed	TOT not done but solution deployed on trial basis in BSNL site at Kolkata	No	AMC for use of solution not yet finalized as BSNL had not shown any interest to replace the required server.
6.	2G NSS Enhancements, 2.5G & 3G circuit switched NSS	Not developed as dropped	No	No	-
7.	2G & 3G Packet Switched NSS (GPRS)	Not developed as dropped	No	No	-

S. No.	Name of Project	Status of development of technology	Transfer of technology (TOT) status	Present commercialisation status	Remarks
8.	NG-STM1/4	Partially developed (NG-STM 4 not developed)	TOT done partially (TOT done for STM 1 and not for STM 4)	Not done	During the course of development, the STM-4's requirement was considerably reduced.
9.	SBM Exchange Catering up to 4K Subscribers	Developed	TOT done	Not done	Not commercialised due to reduced market demand.
10.	ATM	Developed	TOT done partially	Commercialisation started and manufacturing for three ships done	TOT not done for civil applications and TOT done for defence only
11.	Development of Personnel Communication System (PCS)	Partially developed	TOT not done	The technology was partially developed & implemented in the field as IMPCS project.	-
12.	Fibre Access System	Developed	TOT not done	No	Not commercialised due to obsolescence/ non relevance of technology.
13.	Intermediate Data Rate- VSAT	Developed (Modem 8Mbps not developed due to non requirement)	TOT done	Not done	Not commercialised due to restrictive clauses in BSNL's Tender
14.	C-DOT 32 Channel Dense Wavelength Division Multiplexing System (C-DWDM 3200)	Developed	TOT not done	No	Deployed in BSNL's New Delhi – Jaipur route

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S. No.	Name of Project	Status of development of technology	Transfer of technology (TOT) status	Present commercialisation status	Remarks
15.	IMPCS Project	Developed	TOT not done	Turn key pilot project completed to launch GSM services for BSNL in 13 cities. However, C-DOT's services were subsequently withdrawn by BSNL within a period of 14 months to 29 months.	-
16.	ATM Customisation for Defence	Developed	TOT done	Commercialisation started and manufacturing for three ships done	-
17.	Multi Technology Network Management System (MTNMS)	Developed	TOT done partially	Commercialisation started	MoU signed in June 2006 for 'C-DOT GNMS solution' and signing of MoU for 'NNMS solution' was under progress.
18.	Network Reliability Optimization for AISDN-17 Navy	Developed	TOT under process	No	TOT agreement yet to be signed
19.	Broad Band Transport Via Satellite (BBTS)	Ongoing	Not applicable as it is an ongoing project	Not applicable as it is an ongoing project	-



S. No.	Name of Project	Status of development of technology	Transfer of technology (TOT) status	Present commercialisation status	Remarks
20.	IN Enhancements & IN based Services	Various deliverables developed. However, the project was ongoing to provide new services as per the emerging market requirements.	TOT partially done	Partially done	Deployed in MTNL Mumbai and Delhi. Also deployed in BSNL network but subsequently withdrawn.
21.	Operation Support System (OSS)	Developed but ongoing to provide required enhancements	TOT partially done	Partially done	Deployed in BSNL site (Bangalore) and MTNL, (Mumbai)
22.	Next Generation Network (NGN)	Ongoing	Not applicable as it is an ongoing project	Not applicable as it is an ongoing project	-
23.	Wireless Access System	Ongoing	Not applicable as it is an ongoing project	Not applicable as it is an ongoing project	-

**List of Acronyms**

<b>Abbreviations</b>	<b>Explanation</b>
<b>3G</b>	Third Generation
<b>3GPP</b>	Third Generation Partnership Programme
<b>ABP</b>	Annual Business Plan
<b>ATM</b>	Asynchronous Transfer Mode
<b>BBTS</b>	Broadband Transport via Satellite
<b>CAX</b>	C-DOT ATM Switch
<b>CDMA</b>	Code Division Multiple Access
<b>CSTM</b>	Compact Synchronous Transport Module
<b>CWDM / DWDM</b>	Coarse / Dense Wavelength Division Multiplexing
<b>EMI/EMC</b>	Electro Magnetic Interference/ Electro Magnetic Compatibility
<b>FAS</b>	Fibre Access System
<b>FITL</b>	Fibre in-the-local-loop
<b>FSMS</b>	Fixed Short Message Services (SMS)
<b>Gbps</b>	Giga byte per second
<b>GPRS</b>	General Packet Radio System (Related to 3G Program)
<b>GSM</b>	Global for System Mobile
<b>IDR VSAT</b>	Intermediate Data Rate VSAT
<b>IF &amp; RF</b>	Interface & Radio Frequency
<b>IMPCS</b>	India Mobile Personal Communication Services
<b>IMT</b>	International Mobile Telecommunication
<b>IN</b>	Intelligent Network
<b>IPOP</b>	Internet Point of Presence
<b>ITU-T</b>	International Telecommunication Union - Telecom
<b>MAX/ XL</b>	Main Automatic Exchange/Extra large
<b>Mbps</b>	Mega byte per second
<b>MPLS</b>	Multi Protocol Label Switching
<b>NG SDH</b>	Next Generation SDH

<b>Abbreviations</b>	<b>Explanation</b>
<b>NGN</b>	Next Generation Network
<b>NMS</b>	Network Management System
<b>NSS</b>	Network Sub-System (Related to 3G Program)
<b>OSS</b>	Operation Support System
<b>PCS</b>	Personal Communication System
<b>PMT</b>	Project Management Team
<b>PSTN</b>	Public Switching Telephone Network
<b>R&amp;D</b>	Research and Development
<b>RAN</b>	Radio Access Network (based on WCDMA standard for IMT 2000)
<b>SBM-XL</b>	Single Base Module- Extra Large
<b>TEC</b>	Telecommunication Engineering Centre
<b>TOT</b>	Transfer of Technology
<b>VMS / UMS</b>	Voice / Unified Messaging System
<b>VSAT</b>	Very Small Aperture Terminal
<b>WPC</b>	Wireless Planning Coordination