Summary Record of Discussion of the Sixteenth Meeting of Scientific Advisory Committee to the Cabinet (SAC-C) held on 19th November, 2008, at New Delhi.

The sixteenth meeting of the Scientific Advisory Committee to the Cabinet (SAC-C) was held on 19th November 2008, under the Chairmanship of Dr. R. Chidambaram, Principal Scientific Adviser to the Government of India (PSA to GOI) and Chairman, SAC-C.

The agenda of the meeting and the list of participants are at **Annexure-I** and **Annexure-II** respectively.

M16A1 Opening remarks by the Principal Scientific Adviser to the Government of India & Chairman, SAC-C.

While welcoming the participants, the Chairman congratulated Dr. G. Madhavan Nair, Secretary, Department of Space & the Chairman, Indian Space Research Organisation (ISRO), for successful commissioning of India's first unmanned exploration mission, Chandrayaan-1 and desired that the achievements of ISRO should be highlighted in the forthcoming Science Congress to be held in January, 2009. The Chairman also informed that Dr. S.K. Sikka, Scientific Secretary, Office of the Principal Scientific Adviser to the Government of India and who is the Member-Secretary of SAC-C, is superannuating on 30th November 2008. He lauded the sterling contribution of Dr. Sikka in the field of Physics. The SAC-C applauded the achievements of Dr. Sikka and congratulated him on being conferred the Life Time Achievement Award by the Indian Nuclear Society.

M16A2P1 Significance of Chandrayaan-1, Dr. G. Madhavan Nair, Secretary, Department of Space

Dr. Nair thanked the Chairman, SAC-C for his appreciation of the work done by ISRO and appraised the SAC-C about the main objectives and specific areas of study of the mission:

The objectives of the mission are:

- To design, develop, launch and orbit a spacecraft around the Moon using an Indian-made launch vehicle.
- Conduct scientific experiments using instruments on-board the spacecraft which will yield the following results:
    - Preparation of an atlas (with high spatial and altitude resolution of 5-10 m) of both the near and far side of the moon.
    - Chemical and mineralogical mapping of the entire lunar surface at high spatial resolution, mapping.
    - The impact of a sub-satellite (Moon Impact Probe – MIP) on the surface on the Moon as a fore-runner to future soft-landing missions.

Specific areas of study

- High-resolution mineralogical and chemical imaging of the permanently shadowed north and south polar regions.
- Search for surface or sub-surface water-ice on the Moon, specially at the lunar poles.
- Identification of chemicals in lunar highland rocks.
- Chemical stratigraphy of lunar crust by remote sensing of the central uplands of large lunar craters, and of the South Pole Aitken Region (SPAR), where interior material may be expected.
- To map the height variation of the lunar surface features.
- Observation of X-ray spectrum greater than 10 keV and stereographic coverage of most of the Moon's surface with 5 m resolution
- To provide new insights in understanding the Moon's origin and evolution.

Dr. Nair said that ISRO is also planning a second version of the Chandrayaan named Chandrayaan-II. According to him, ISRO hoped to land a motorised rover on the Moon in 2012, as a part of its second Chandrayaan mission. The rover will be designed to move on wheels on the lunar surface, pick up samples of soil or rocks, do on-site chemical analysis and send the data to the mother-spacecraft Chandrayaan-2, which will be orbiting the moon. Chandrayaan-II will transmit the data to Earth.

Thereafter, on behalf of the ISRO three presentations were made by the following team members:

- Dr. K. Radhakrishnan, Director, Vikram Sarabhai Space Centre
- Dr. Mylswamy Annadurai – Project director,Chandrayaan-I
- Dr. J N Goswami – Director of Ahmedabad-based Physical Research Laboratory and Principal Scientific Investigator of Chandrayaan-1

In the above presentations, ISRO gave brief technical and other details of Chandrayaan-1 mission which are described below:

Chandrayaan-1 is India's first mission to the moon launched by its space agency the Indian Space Research Organisation (ISRO). The unmanned EXPLORATION mission includes a lunar orbiter and an impactor. The spacecraft was launched by a modified version of the PSLV on 22nd October 2008 at 6.22 am IST. The vehicle was successfully inserted into lunar orbit on 8th November 2008. After PSLV's maiden success on October 15, 1994 the Chandrayaan was PSLV's 13th successive successful flight.

The six strap-on solid motors of PSLV was augmented with increased propellant loading of 3.5 tonnes each thereby increasing a lift off mass of PSLV from 298 tonnes to 320 tonnes. This new vehicle configuration necessitated validation of aerodynamic and aerothermal loads through computational fluid dynamics and wind tunnel studies for higher dynamic pressure experienced during flight. The increased structural loading was validated by structural test on the new structures. The orbit to which the satellite launched was so precise, that only a few grams of satellite fuel were used in stabilizing

the satellite. This has been achieved using the indigenously developed inertial sensors, liquid stages and onboard computers. The precise orbit has ensured that the satellite will have sufficient fuel for more than its predicted two years.

The status of the present understanding of the moon, the need for further exploration, and the details of Chandrayaan-1 Mission was explained in detail. The study of the origin and evolution of the moon as well as the magnetic field and radiation environment will be done using the results of the data from Chandrayaan.

The Indian Deep Space network (ISDN) with the 32 m and 18m antenna has been established at Bangalore to cater for Chandrayaan-1 and future probes to deep space. The Indian Space Science Data Centre (ISSDC) has also been set up at Bangalore will serve as the primary data center for the payload data archives of Indian Space Science Mission.

The Chandrayaan satellite had a mass of 1,380 kilograms (3,042 lb) at launch and 675 kilograms (1,488 lb) at lunar orbit and carries high-resolution remote sensing equipment for visible, near infrared, and soft and hard X-ray frequencies. Over a two-year period, it is intended to survey the lunar surface to produce a complete map of its chemical characteristics and 3-dimensional topography. The Polar Regions are of special interest, as they might contain ice. Lunar mission carries five ISRO payloads and six payloads from other international space agencies including NASA, ESA, and the Bulgarian Aerospace Agency.

The Indian payloads were

1. Terrain Mapping Camara(TMC)
2. High Spectral Imager (0.4 to 0.9 lm) HySI
3. Lunar Laser Ranging Instrument (LLRI)
4. High energy X-ray (30 to 250 KeV) Spectrometer HEX
5. Moon Impact Probe (MIP)

The opportunity payloads of other countries were

1. Chandrayaan-1 X-ray Spectrometer(CIXS) ESA
2. Sub KeV Atom Reflcting Analyser(SARA) ESA
3. Radiation Dose Motor (RADOM) Bulgaria
4. Moon Mineratology Mapper (M3) NASA
5. Minature Synthetic Aperture Radar (Mini SAR) NASA

Near IR Spectometer (SIR-2) ESA

The Moon Impact Probe (MIP) impacted on the lunar surface on 14 November 2008, 15:01 UTC (20:31 Indian Standard Time (IST)) near Shackleton Crater at the South Pole. The MIP was one of eleven scientific instruments (payloads) onboard Chandrayaan-1. The MIP separated from Chandrayaan at 100 km from lunar surface and began its travel at 14:36 UTC (20:06 IST) going into a free fall for 25 minutes after the

firing of de-boost. As it fell, it kept sending information back to the mother satellite, which, in turn, beamed the information back to earth. The altimeter then also began recording measurements to prepare for a rover to land on the lunar surface during a second moon mission planned for 2012. The descent of MIP from the orbiter gave us an opportunity to verify the lunar gravity levels which will help in calculation of the deceleration required for the land rover. Following the successful development of MIP the other scientific instruments are being turned on one-by-one and have already started initially transmitting the data.

At the end following observations made by the SAC-C is as follow:

(i) The SAC-C opined that the commendable work done by ISRO team in commissioning Chandrayaan-1 may be used as a catalyst/ promoter to attract young people to careers in science, particularly space research.
(ii) The achievement should be highlighted to project the country's progress in capabilities to design and fabricate sophisticated equipments in high technology areas.
(iii) The success of the scientific community in India in various high-technology areas may be propagated through print and electronic media, including in Hindi and regional languages and the communication should be in terms easily understandable by the public.
(iv) Presidents of both INSA and the Academy of Sciences, Allahabad, agreed to take up the above tasks for which Secretary, Department of Science and Technology and the National Informatics Centre, also promised fullest financial and technical support.
(v) There was a suggestion to list out the materials/ technologies, which are coming under denial regimes and the mechanism for indigenous production /development of these materials / technologies, taking into account the existing potential of Indian industries.
(vi) The strategic technologies, which have been developed during the commissioning of such high-tech missions but which may have utility in the public domain, may be identified, and these can be further developed with the involvement of industries.

M16A2P2 On the importance of the National Knowledge Network (NKN) by Dr. S.V. Raghavan, IIT Madras & Dr. B.K. Gairola, DG, NIC.

The idea of creating NKN was mooted by the Office of the Principal Scientific Adviser to the Government of India and subsequently with the involvement of various experts/ departments/industry and National Informatics Centre (NIC) in February, 2006. The Planning Commission constituted a Steering Committee on Science and Technology for the formulation of the Eleventh Five Year Plan (2007-2012), chaired by the Principal Scientific Adviser to the Government of India (PSA). In order to accomplish the tasks assigned to it by the Planning Commission, the Steering Committee had constituted 17 Working Groups, one of which dealt with "Policies, Administrative Changes for Improvement in S&T Research Environment and Resources". That Working Group, in its

meeting held on the 25th of May, 2006, had recommended that a cyber infrastructure for science and technology be set-up in the country since modern-day research could not do without it.

On the recommendations of the Working Group, a brainstorming session to setup an e-infrastructure and grid computing in the country was held in the PSA's Office on the 20th of July, 2006. On the basis of the recommendations that had emerged in that session, the PSA's Office had setup a sub-group of scientific experts to study the issue of enabling the scientific and research community of the country with a world-class networking infrastructure. The report of that group was submitted to the PSA's Office in October 2006. In October 2006, the PSA's Office and the National Knowledge (NKC), which had also been thinking along similar lines, had joined hands to write a common report on the setting-up of the said networking infrastructure. That common report was prepared in November, 2006. The Common Report included e-Governance and societal applications through independent sideways utilizing the same National Highway.

The common report, on instructions of the Prime Minister's Office (PMO), had been remodeled about a year later by an expert group constituted by the Department of Information Technology (DIT), Ministry of communications and Information Technology. On instructions of the PMO, the DIT subsequently constituted, on the 30th of April, 2008, a High Level Committee (HLC) for the establishment of the NKN, with the PSA as the Chairman and the Secretary, DIT, as the Member-Convener. There is a Technical Advisory Committee (TAC), set-up by the HLC on the 26th of May, 2008, chaired Prof. S.V. Raghavan of the IITM. Content creation is being done by several Applications Committees. The initial phase of the NKN, connecting about 200 nodes across India, is likely to be completed by the end of December, 2008. The implementation of the NKN is being managed by the NIC.

Dr Chidambaram further stated that the genesis of National Highway. He explained how the creation of the high capacity and reliable network can aid the educational and research community in achieving their tasks. He also informed that, the same national highway can help grid computing in the medicine, weather, agriculture, drug discovery, physics and also e-governance, tele-medicine etc. in achieving their needs. He then requested Prof. SV Raghavan and Dr B.K. Gairola to explain in detail the National Knowledge Network to the members of SAC-C.

Prof. S.V. Raghavan started with the need of such a network and then explained how this network has been designed. He informed the members about the features of the NKN in terms of speed, quality of service, reliability and availability, which are all issues as on date. Once this network is in place, projects like countrywide classroom and distance learning and other grid applications can take shape and be realized.

Dr B.K. Gairola explained to the members the present status of the Network. The initial phase of the network will be in place by December 7th. This is being created by augmenting the infrastructure that is already in place in NIC centres across the country. He also informed that during the implementation of the final phase, a SPV (Special

Purpose Vehicle) will be formed. This SPV will run the National Knowledge Network under the guidance of the High Level Committee with chairman as Dr Chidambaram and Secretaries from various sectors being the members.

The summary of suggestions given by the SAC-C on NKN is as under:

(i) Interfacing and synchronization of existing internet/ intranet facilities towards creating a National Knowledge repository is still a difficult task. This needs special attention by a technically sound group of experts to upgrade existing hardware and software facilities in the country and develop/ acquire need based hardware and software keeping in view the future plan of increasing accessibility to the extent of 10 GBPS with proper security and encryption techniques to protect the centralized databases from hacking etc.

(ii) The fullest advantage of NKN can be derived only when a sound networking of academic institution, R&D labs, including other leading scientific organizations and university systems, with wider range spread in remotest and inaccessible areas of the country, backed up with the data on important key items including science and technology, economic development, agriculture and rural development etc., is accomplished.

The grid computing is an important component of NKN, which would facilitate working of specialized groups, including scientists, planners, NGOs etc. in single/multi user mode and economize the hardware and software resources. This requires an effective mechanism of classification and creating need based mutually compatible data structures and databases for use in single/ multi user environment at distributed locations.

In addition, SAC-C observed that the NKN should be used to disseminate information relating to scientific and economic strength of the country worldwide for which Dr. Ashok Misra, President, National Academy of Sciences (NAS), Allahabad, Dr. P.S. Goel, President, Indian National Academy of Engineering (INAE), sought the active participation of their academies in this activity. Dr. T. Ramasami, Secretary, Department of Science and Technology agreed to create a separate funding mechanism for this purpose. Hardware and software support is already existing in NIC.

In conclusion, the SAC-C appreciated the efforts put in for operationlisation of NKN. The SAC-C also felt that a large number of projects will immediately get a boost and will start showing results once they hook on to the NKN.

The meeting ended with a vote of thanks to the Chair.

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Annexure-I

Sixteenth Meeting of the Scientific Advisory Committee to the Cabinet (SAC-C)

Date : 19th November, 2008

Time : 10.30 A.M.

Venue : Lecture Hall (First Floor), CSIR Science Centre, Near Lodhi Garden, Gate No. 2, New Delhi – 110 003.

Agenda

M16A1 Opening remarks by the Principal Scientific Adviser to the Government of India & Chairman, SAC-C.

M16A2

M16A2P1 **Significance of Chandrayaan**.
Dr. G. Madhavan Nair, Secretary, Department of Space

M16A2P2 **On the importance of the National Knowledge Network.**
Dr. S.V. Raghavan, IIT Madras & Dr. B.K. Gairola, DG, NIC.

M16A3 Any other item with the permission of the Chair.

M16A4 Concluding remarks by the Chair.

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Annexure-II

List of participants of the Sixteenth Meeting of Scientific Advisory Committee

S. No.	Name, Designation and Organisation
1	Dr. R. Chidambaram, Principal Scientific Adviser to the Government of India, Office of the Principal Scientific Adviser to the Government of India, Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi – 110011.
2	Dr. (Mrs.) K.A. Dinshaw, Director, Tata Memorial Centre, Dr. E. Borges Road, Parel, Mumbai – 400 012.
3	Dr. B. K. Gairola, Director General, National Informatics Centre, Department of Information Technology, Ministry of Communications and Information Technology, A-Block, CGO Complex, Lodhi Road, New Delhi – 110003.
4	Dr. Rohini M. Godbole, Centre for High Energy Physics, Indian Institute of Science, Bangalore – 560 012
5	Dr. Jamshed J. Irani, Director, Tata Sons Limited Bombay House, 24 Homi Modi Street Fort, Mumbai-400001.
6	Prof. S.K. Joshi, Vikram Sarabhai Professor & Honorary Emeritus Scientist # 252, National Physical Laboratory, Dr. K.S. Krishnan Marg, New Delhi – 110 012.
7	Dr. Panjab Singh, Foundation for advancement of agriculture & Rural Development, Saraswati Kunj, Narainpur (Dafi), Varanasi – 221005.
8	Dr. V. Sumantran, Scientific Consultant, Office of the Principal Scientific Adviser to the Government of India, Door 7/1, Valli Ammai Aachi Road, Kotturpuram, Chennai – 600 085.
9	Dr. S. Sivaram, Director, National Chemical Laboratory, Dr. Homi Bhabha Road, Pune – 411008
10	Dr. Juzer Vasi, Deputy Director, Indian Institute of Technology, Bombay, Powai, Mumbai – 400076
11	Dr. Mangla Rai, Secretary, Department of Agricultural Research & Education, Room No.105, 1st Floor, Krishi Bhawan, New Delhi – 110 001.
12	Dr. V.M. Katoch, Director-General, Indian Council of Medical Research, V. Ramalingaswami Bhawan, Ansari Nagar, Post Box 4911, New Delhi – 110029.
13	Dr. T. Ramasami, Secretary, Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi – 110 016.
14	Dr. G. Madhvan Nair, Secretary, Department of Space, Antriksh Bhavan, New BEL Road, Bangalore-560094
15	Prof. M. Vijayan, President, Indian National Science Academy, 2, Bahadur Shah Zafar Marg, New Delhi –110 002
16	Dr. P.S. Goel President, Indian National Academy of Engineering, 6th Floor, Vishwakarma Bhawan, IIT Campus, Shaheed Jeet Singh Marg, New Delhi – 110016

17	Dr. P. Ramachandran, President, National Academy of Medical Sciences, Ansari Nagar, New Delhi.
18	Dr. Ashok Misra, President, National Academy of Sciences (Allahabad), National Academy of Sciences, India, 5, Lajpatrai Road, New Katra, Allahabad - 211 002.
19	Dr. S.K. Sikka, Scientific Secretary, O/o Principal Scientific Adviser to GOI, Vigyan Bhavan Annexe Maulana Azad Road, New Delhi – 110011
20	Shri R.P. Agarwal, Secretary, Ministry of Human Resource Development (Higher Education), Shastri Bhawan, New Delhi – 110001.
21	Sh. Amit Mitra, Secretary General, Federation of Indian Chambers of Commerce & Industry (FICCI), Federation House, Tansen Marg, New Delhi – 110001.
22	Dr. K. Radhakrishnan, Director, Vikram Sarabha Space Centre
23	Dr. J.N. Gowswami, Director, Physical Research Laboratory
24	Shri Mylswamy Annadurai, Project Director, Chandrayaan-I, ISRO Satellite Centre
25	Shri George M. Koshy, Project Director, PSLV, Vikram Sarabha Space Centre
26	Dr. S.V. Raghavan, Professor, Department of Computer Science and Engineering, Indian Institute of Technology, Madaras, Chennai – 600036.
27	Shri S. Chatterjee, Adviser, Office of the Principal Scientific Adviser to the Government of India, Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi – 110011
28	Dr. R.P. Gupta, Scientist 'E', Office of the Principal Scientific Adviser to the Government of India, Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi – 110011
29	Shri Neeraj Sinha, Scientist 'E', Office of the Principal Scientific Adviser to the Government of India, Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi – 110011
30	Dr. Ketaki N. Bapat, Scientist 'D', Office of the Principal Scientific Adviser to the Government of India, Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi – 110011