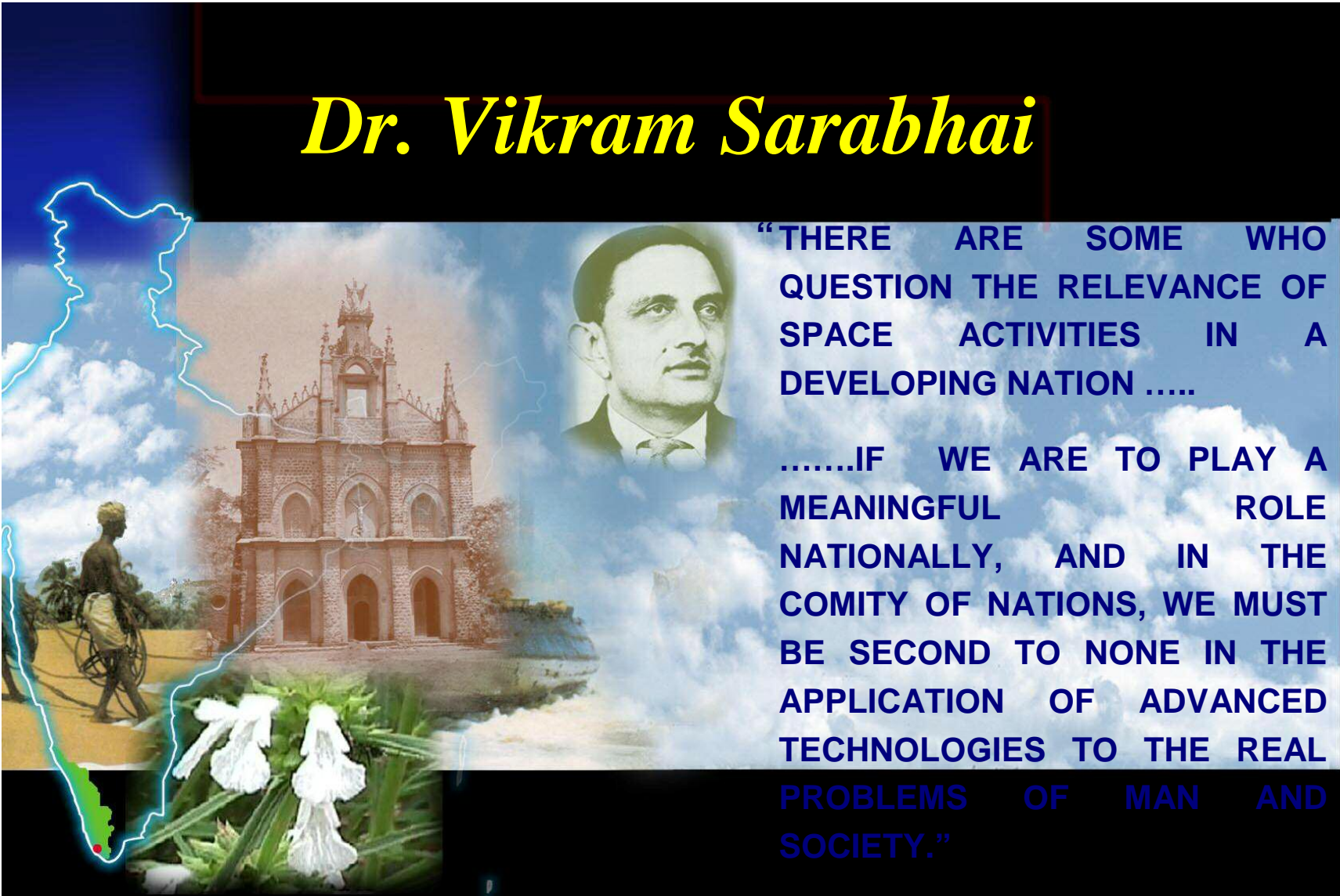


Dr. Vikram Sarabhai

The background of the slide is a collage. On the left, there is a glowing blue outline of India. In the center, there is a portrait of Dr. Vikram Sarabhai. To the right of the portrait is a quote in blue text. Below the portrait, there is a painting of a large, ornate brick building with a central tower and arches. In the foreground, there are white flowers and a statue of a person in a wheelchair. The sky is blue with white clouds.

“THERE ARE SOME WHO QUESTION THE RELEVANCE OF SPACE ACTIVITIES IN A DEVELOPING NATION

.....IF WE ARE TO PLAY A MEANINGFUL ROLE NATIONALLY, AND IN THE COMITY OF NATIONS, WE MUST BE SECOND TO NONE IN THE APPLICATION OF ADVANCED TECHNOLOGIES TO THE REAL PROBLEMS OF MAN AND SOCIETY.”

The beginning



Aravamudan and Kalam work on a rocket payload at Thumba in 1964



Indo-US Cooperation in Civil Space

- Dates back to the beginning of the Indian Space Program
- On Nov 21, 1963 the Nike-Apache rocket was launched from Thumba in Southern India

The famous SITE experiment

- NASA repositions ATS-6 satellite over Indian Ocean in mid 1970s
- ISRO deployed TV sets across 2400 villages to receive educational programs
- It was a grand success-first taste of what space technology could do for societal benefit



The first MOU

- 1997-MOU signed between Department of Space, Govt. of India, DST and NASA/NOAA
- Joint research in earth and atmospheric sciences
- Scientific Data sharing

The INSAT-1980s



- Indian National Satellite System
- Geostationary communication Satellites
- First four satellites built by then-Ford Aerospace to ISRO specifications on commercial basis
- Launched by US launchers-including INSAT-1B by the shuttle Challenger

US places sanctions on ISRO

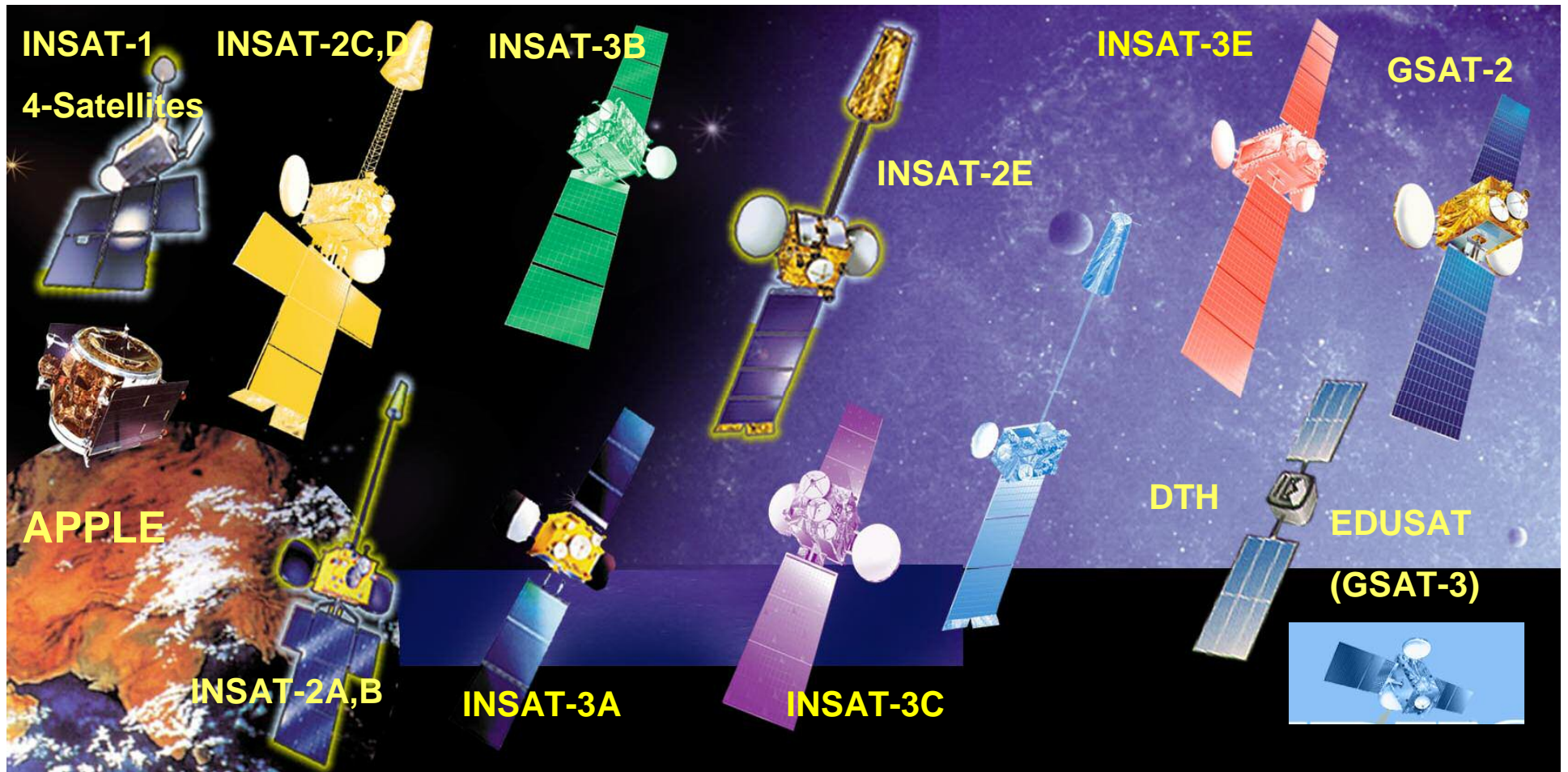
- US restrictions were imposed on nearly all ISRO entities in 1998
- ISRO - NASA/NOAA relations continued to be cordial
- Indirectly benefited ISRO-spurred to develop indigenous capabilities



INSAT SYSTEM

- ***ONE OF THE LARGEST DOMESTIC SATCOM SYSTEMS - Ku, C, S BANDS***
- ***MULTI-PURPOSE : TELECOM, TV, METEOROLOGY***
- ***160 TRANSPONDERS, GLOBAL/DOMESTIC BEAMS***
- ***TO ACHIEVE 250 TRANSPONDERS CAPACITY BY 2007***

EVOLUTION OF THE INSAT FAMILY



Earth observation Systems

- India was one of the first countries to establish receiving station from NASA's Landsat Satellite
- Number of joint programs undertaken

The Indian Remote Sensing -IRS system

- Today-one of the biggest system
- Provides data in variety of spatial resolutions and spectral bands
- Data being received all over the world, including US

1995/1997

IRS-1C/1D LISS-3 (23/70M,
STEERABLE PAN (5.8 M);
WiFS (188M)

1999

INSAT-2E CCD
(1KM RESOLUTION;
EVERY 30 MNUTES)

2003

RESOURCESAT-1
LISS3 - 23 M; 4 XS
LISS4 - 5.8 M; 3-XS
AWIFS - 70 M; 4-XS

1994

IRS-P2
LISS-2

IRS-P3
WiFS MOS
X-Ray

IRS-P4
OCEANSAT OCM, MSMR

20

CARTOSAT
PAN - 2.5
F

IRS-1A/1B LISS-1&2 (72/36M,
4 BANDS; VIS & NIR)

INDIAN IMAGING SYSTEMS

2005-2006
CARTOSAT
PAN - 1M

1982

RS-D1

IMAGING IMPROVEMENTS

1979

BHASKARA

- ◆ 1KM TO 1.0 M RESOLUTION
- ◆ GLOBAL COVERAGE
- ◆ APPLICATION-SPECIFIC

MEGHA-TROP
SAPHIR
SCARAB
MADRA

LAUNCH VEHICLE FAMILY





The NSSP

- In January 2004 U.S. President George W. Bush and Indian Prime Minister Atal Behari Vajpayee announced the Next Steps in Strategic Partnership (NSSP)
- It is a bilateral initiative
- Covers expansion of cooperation in the areas of civilian space activities, civilian nuclear programs
- Joint working group on civil space cooperation was set up
- High-technology trade
- Expand discussions on missile defense



Bilateral Partnership further nurtured

- The visit of Indian Prime Minister Dr. Manmohan Singh to US in 2005
- The follow on visit of President Bush to India



Visit of NASA Administrator to India

- Took place in May 2006
- Highly successful
- Two MOUs were signed for having two NASA payloads into the Indian Lunar mission- Chandrayaan-1

PSLV FOR A LUNAR MISSION



PERFORMANCE CAPABILITY
LEO 3.5 TONNES

LUNAR MISSION
PSLV: 275 kg

MISSION STRATEGY

1. INJECTION TO LUNAR TRANSFER ORBIT ;
2. MIDCOURSE MANOEUVRE;
3. INSERTION TO LUNAR POLAR ORBIT;
4. DEORBIT ;
5. LUNAR LANDING

CHALLENGE

SCIENCE GOALS

DEEP SPACE TRACKING & CONTROL

ORBIT DETERMINATION

TECHNOLOGY SYSTEMS :NGC, POWER & THERMAL
MANAGEMENT



Future Missions

Basically five types of future missions are being envisaged (Not yet sanctioned projects).

- Follow on mission to Moon: Considered time frame- 2011 (Chandrayaan-2)
- Asteroid / Comet flyby mission: Possible time frame- 2015
- Mission to Mars :Timeframe- 2019
- Human Mission to moon: Timeframe 2020
- Missions to other planets (Venus, Mercury...Vision beyond 2020)