NEC Space Business Overview

The 2nd Japan-Arab Economic Forum @Tunis, Tunisia

December 12, 2010

NEC Corporation
NEC Profile

Company Name: NEC Corporation
Address: 7-1, Shiba 5-chome, Minato-ku, Tokyo, Japan
Established: July 17, 1899
Chairman of the Board: Kaoru Yano
President: Nobuhiro Endo
Capital: ¥ 397.2 billion - As of Mar. 31, 2010 -
Consolidated Net Sales: ¥ 4,215.6 billion
- Fiscal year ended Mar. 31, 2009 -
  ¥ 3,581.3 billion
- Fiscal year ended Mar. 31, 2010 -
Operations of NEC Group: IT Services, Platform, Carrier Network,
Social Infrastructure, Personal Solutions, Others
Employees: NEC Corporation
  24,871 - As of Mar. 31, 2010 -
NEC Corporation and Consolidated Subsidiaries
  142,358 - As of Mar. 31, 2010 -
Consolidated Subsidiaries: 310 (Japan:118, Oversea:192) - As of Mar. 31, 2010 -

Financial results are based on accounting principles generally accepted in Japan.
Business Domains and Their Chief Products and Services

**IT Services**
- Cloud-Oriented Service Platform Solutions

**Platform**
- Super Computer
- Integrated Operation Management Middleware
- Unified Communication

**Personal Solutions**
- Personal Computers

**Carrier Network**
- Long Term Evolution Network Systems
- Unity Cable Systems
- WiMAX Network Systems
- Compact Microwave Communications Systems

**Social Infrastructure**
- Digital Terrestrial TV Transmitters
- Asteroid Explorer "HAYABUSA"
- High Performance Small Standard Bus "NEXTER"

**Others**
- Electron Devices
- Lithium-ion Batteries
- Liquid Crystal Displays

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Empowered by innovation

Page 2

NEC Confidential
NEC Worldwide: “One NEC” formation in 5 regions

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Countries</th>
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<tbody>
<tr>
<td>Marketing &amp; Service affiliates</td>
<td>57</td>
<td>30</td>
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<tr>
<td>Manufacturing affiliates</td>
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<tr>
<td>Liaison Offices</td>
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<td>8</td>
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<td>Branch Offices</td>
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<td>7</td>
</tr>
<tr>
<td>Laboratories</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

(As of Apr. 1, 2010)
NEC in The League of Arab States

(As of Apr. 1, 2010)
NEC Supply Record to Arab in Africa

(As of Apr, 2008)
# Heritage: Satellite Systems

## Communication / Broadcast
- **YURI** (BS)
- **YURI-2a,2b** (BS-2a,2b)
- **FUJI-1,2,3** (JAS-1,2,3)
- **YURI-3a,3b** (BS-3a,3b)
- **KAKEHASHI** (COMETS)
- **KIRARI** (OICETS)
- **KIZUNA** (WINDS)

## Engineering
- **OHSUMI**
  - Japanese 1st Satellite launched in 1970
- **TANSEI-IV** (MS-T4)
- **KIKU-4** (ETS-III)
- **SAKIGAKE** (MS-T5)
- **KIKU-6** (ETS-VI)
- **KIKU-7** (ETS-VII)
- **TSUBASA** (MDS-I)

## Earth Observation
- **HIMAWARI** (GMS)
- **HIMAWARI-2** (GMS-2)
- **HIMAWARI-3** (GMS-3)
- **MOMO-1** (MOS-1)
- **HIMAWARI-4** (GMS-4)
- **MOMO-1b** (MOS-1b)
- **HIMAWARI-5** (GMS-5)
- **DAICHI** (ALOS)

## Science / Astronomy
- **AKEBONO** (EXOS-D)
- **YOHKÔH** (SOLAR-A)
- **ASCA** (ASTRO-D)
- **HALKA** (MUSES-B)
- **NOZOMI** (PLANET-B)
- **HAYABUSA** (MUSES-C)
- **SUZAKU** (ASTRO-EII)
- **AKARI** (ASTRO-F)
- **KAGUYA** (SELENE)
Heritage: Satellite Marker Share in Japan

- NEC: 64 (7)
- A: 39 (7)

* Under Development

Future Satellites:
- GCOM-W1 (2011) © JAXA
- GCOM-C1 (2012) © JAXA
- SPRINT-A (>2011) © JAXA
- MMO (2013) © JAXA
Heritage: RF Equipment Supply Record

NEC has Supplied Equipment for over 200 satellites

- **Luxembourg**
  - ASTRA-2B
  - ASTRA-1K
  - ASTRA-1KR/1L
  - ASTRA-1M
  - ASTRA-3B
  - ASTRA-1N*

- **Northern Europe**
  - BSB (SIRIUS-1)
  - SIRIUS-2
  - SIRIUS-4

- **Europe**
  - HOTBIRD-2
  - HOTBIRD-3
  - HOTBIRD-4
  - HOTBIRD-5
  - HOTBIRD-8
  - HOTBIRD-9
  - KaSat*
  - EUTELSAT W1
  - EUTELSAT W3A
  - EUTELSAT W4
  - HOTBIRD-6
  - EUTELSAT W2M
  - HOTBIRD-10

- **Russia**
  - YAMAL
  - EXPRESS-AM1
  - SPECTR-R
  - EXPRESS-AM33
  - Express-MD1
  - KAZSAT-2
  - LOUTC5A/5B*
  - YAMAL-200
  - KAZSAT-1
  - ELECTRO-L
  - EXPRESS-AM44
  - Express-MD2
  - YAMAL-300
  - EXPRESS-AM4*

- **China**
  - DFH-3B
  - DFH-3 F/O (C)
  - DFH-3 F/O (L)
  - FY-2C
  - DFH-3 F/O (Ka)
  - SINOSAT-2
  - CE-1
  - DFH-3 F/O
  - CBERS
  - DFH-3 Ka SAT
  - CE-1 F/O
  - HY-1C
  - SINOSAT-2 F/O
  - SINOSAT-6*
  - SINOSAT-3 F/O*
  - SINOSAT Series*

- **North America**
  - MSAT
  - Galaxy8iR
  - Galaxy-13
  - ANIK-F1R
  - TELSTAR-5
  - TELSTAR-6
  - DTV
  - Newskies-8
  - XTAR
  - AMC14
  - ANIKF3
  - DTV-10
  - DTV-11
  - DTV-12
  - Echo-10
  - ECHO-11
  - CASCADE
  - Pass-11
  - Galaxy-18
  - Horizons-2
  - X-M
  - SIRIUS-FM5
  - ECHO-14
  - NSS-9
  - Protostar-2
  - PAN
  - MSV
  - SIRIUS-FM6*
  - ECHO-15*

- **UK**
  - HYLAS

- **Spain**
  - HISPASAT
  - SPAINSAT
  - SPAINSAT-R
  - SPAINSAT-R

- **Japan**
  - JCSAT-3
  - JCSAT-4
  - JCSAT-5
  - JCSAT-6
  - JCSAT-8
  - N-STAR-a/b
  - N-STAR-c
  - SUPERBIRD-A/B
  - SUPERBIRD-E/F
  - CS
  - CS-2a/b
  - CS-3a/b
  - BS-2X
  - BS-3a/b
  - BS-3H
  - BS-3N
  - BSAT-2c
  - WINDS
  - QZSS
  - ETS-V
  - ETS-VI
  - ETS-VII
  - ETS-VIII
  - JERS-1
  - MOS-1
  - MOS-1b
  - TRMM
  - COMETS
  - DRTS a/b
  - ADEOS
  - ADEOS-II
  - OICETS
  - ALOS
  - JEM ICS
  - SUPERBIRD-6
  - JCST-9
  - DPR (Ku,Ka)*

- **Thailand**
  - THAICOM-3
  - IPSTAR-1

- **Taiwan**
  - ROCSAT-1

- **Australia**
  - OPTUS-B

- **Indonesia**
  - AcEs-1

- **Malaysia**
  - MEASAT-3
  - MEASAT-1R

- **International**
  - INMARSAT-2
  - INMARSAT-4
  - INMARSAT-4
  - INMARSAT-4-A
  - INMARSAT-7V
  - INMARSAT-AM-9
  - INMARSAT-15
  - INMARSAT-16

- **Nigeria**
  - NIGCOMSAT

- **Singapore**
  - ST-1

- **Singapore**
  - Aces-1

- **Brazil**
  - BRASILSAT
  - EdS
  - AMAZONAS
  - AMAZONAS-2

- **Luxembourg**
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  - INMARSAT-4-A
  - INMARSAT-7V
  - INMARSAT-AM-9
  - INMARSAT-15
  - INMARSAT-16

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- **Singapore**
  - ST-1

- **Singapore**
  - Aces-1

- **Brazil**
  - BRASILSAT
  - EdS
  - AMAZONAS
  - AMAZONAS-2

(*) under manufacturing
Our Target: Provide Space Solutions

Ubiquitous Use of Information Obtained through Space

- Systems
- Disaster Prevention
- Remote Sensing (Resource)
- Scientific Observation
- Environmental Monitoring
- National Security
- Grid Computing
- Modeling & Simulation
- Security
- Data Center
- Information NW
- Distributed DB
- Information Collection
- Communication Broadcasting
- Observation and Monitoring
- Multipurpose Software Satellite
- Meteorology
- GPS
- Indication and Warning
- Research Institute
- Crime Prevention
- Crime Prevention
- Rescue
- Life
- Industrial Activities
- Government Officials
- Ministries Agencies
- Anytime
- Anyone
- Anywhere
- Anything

The 2nd JAEF 2010

Ubiquitous Use of Information Obtained through Space

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Empowered by Innovation
NEC’s Total Solution through Satellite Remote Sensing

Case of “Flood Monitoring & Alarm System”

NEC’s Total Solution includes:
- Satellite, Ground Station, Processing Center, GIS, Ground Sensors, and its Communication Network
- Operation, Data Distribution, Business Support and Training for Capacity Building

GIS database
- GIS information
- Precipitation
- Water level
- Monitor vision

Observation request & Real-Time Data
- Emergency observation
- Data receiving & processing
- Flood area detection

Local remote sensing center
- Flood area data (Real-Time)

Remote sensors
- Flood alarm
- Evacuation instructions

Local government & Residents
- Broadcast
- Mobile phone
- Community radio

Evacuation & Lessen damage

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"ASNARO" Optical Observation Small Satellite with NEXTAR

ASNARO: Advanced Satellite with New ARchitecture for Observation being Promoting by METI

In-orbit Configuration

To be launched in 2012

Performance and Characteristics

- **Mission**
  - Optical sensor: Pan / Multi (6-bands)
  - Data transmission: GSD: < 0.5m/2m (Pan/Multi), Swath: 10km

- **Coverage**
  - ±45deg/±45deg (Cross/Along track)
  - 45deg/45sec. (Average 1deg/sec)

- **Launch Orbit**
  - Compatible to major commercial launchers
  - SSO (Sun Synchronous Orbit)

- **Life**
  - < 3 years (Capability: <5 years)

- **Mass**
  - Bus: 295 kg (incl. 45kg fuel)
  - Mission: 150 kg
  - <TOTAL>: 445 kg

- **Power**
  - Generation: > 1300 W (EOL)
  - Payload: > 400 W (EOL)

- **Dimension**
  - 2.5 x 3.5 x 3.2m (in orbit)
ASNARO Optical Sensor Image

Resolution: < 0.5m
S/N: > 200

S/N: Signal-to-Noise Ratio
SAR Observation Small Satellite with NEXTAR

SAR: Synthetic Aperture Radar

Performances and Characteristics

| Mission            | X-band
| SAR Sensor         | Deployable mesh type parabola antenna
|                    | GSD: ~1m in spotlight mode
|                    | Swath: 10km in spotlight mode
| Data Transmission  | X-Band: 16QAM, App. 800Mbps
| Coverage           | ±45deg/ ±45deg (Cross/Along track)
| Agility            | 45deg/45sec. (Average 1deg/sec)
| Orbit              | LEO
|                    | SSO (Sun Synchronous Orbit)
|                    | Low Inclined Orbit
| Life               | < 5 years
| Mass               | Bus 250kg (without Propellant)
|                    | Mission 200kg
|                    | Propellant 45kg
|                    | <Total > 495kg
| Dimension          | 2.6 x 3.5 x 3.0m (in orbit)
| Electrical Power   | Generation: 1290 W (EOL)
|                    | Payload: 300W(avg)(EOL)
High Resolution SAR Sensor Image

Resolution: < 1m

Kansai International Airport, Japan
Comparison between Optical and SAR sensor

Optical Sensor Image

SAR Image

Mt. Merapi volcano, Indonesia

Thick smoke
Recent Activities in Arab: MisrSat-2 (EgyptSat-2) Project

Partner
- NARSS (National Authority for Remote Sensing and Space Sciences), Egypt

Project Outline
- NARSS has launched EgyptSat-1 as the first Egyptian remote sensing satellite in April, 2007 and plan to implement MisrSat-2 (EgyptSat-2) which would be more advanced as the second program. Egypt wants to acquire Technology Transfer relating satellite development as well as major Facilities of AIT (Assembly, Integration and Test) in Egypt eagerly.
- NEC have been promoting the Advanced High Resolution Earth Observation Satellite of 500kg-class for MisrSat-2, based on both our NEXTAR standard bus and IT&NW technologies.
Recent Activities in Arab: DubaiSat-3 Project

<table>
<thead>
<tr>
<th>Partner</th>
</tr>
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<tbody>
<tr>
<td>EIAST (Emirates Institution for Advanced Science &amp; Technology) of Dubai Government, UAE</td>
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</table>

<table>
<thead>
<tr>
<th>Project Outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Goal of EIAST Space Program is supposed to Design, Develop their own satellite in the next 5 – 10 years. Splendid success of DubaiSat-1 will pave the way for more advanced remote sensing satellite project in the future, DubaiSat-3 which is scheduled to be launched in 2015.</td>
</tr>
<tr>
<td>NEC is proposing the Advanced High Resolution Earth Observation Satellite of 500kg-class for DubaiSat-3, based upon NEXTAR standard bus technologies.</td>
</tr>
</tbody>
</table>
Various types of remote sensing satellites such as High Resolution Optical, SAR and Hyper Spectral will be launched by Japan and other countries within next 5-10 years. Arab can use such variety, enormous and real time data & information collaborating with Japan and other countries.
HAYABUSA  Light mass, Small, Autonomy and Robustness

Launched in May 9, 2003

Re-entry to the Earth in June, 13 2010

Touch-down on ITOKAWA in Dec. 2005

Total 6 Billion km
Space Voyage for 7 years

Thank you very much for your attention
Appendix

What can we use satellite remote sensing for?
Diversified Applications

- Satellite Remote Sensing
- Mapping
- Disaster
- Environment
- Fishery
- Security
- Forestry
- Agriculture
- Mineral Exploitation
Agriculture

Crop vitality


Precision farming

http://www.agri.pref.hokkaido.jp:center/syuppan/handbook/handbook_p05.htm
Forestry

Damage assessment

Forest fire detection


http://visibleearth.nasa.gov/view_rec.php?id=2868

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© CNES 1997. 29 July 1997

Dense forest
Burned areas (June)
Burned areas (July)
Burned areas
Drainage network
Fishery

Sea surface temperature


Chlorophyll monitoring

NASA Remote Sensing Tutorial
Image samples of OCTS ADEOS (MIDORI)

Density Distribution of Chlorophyll in the Sea around Japan
(Using Visible & Near Infrared Data)

Surface Temperature of the Ocean
(Using Thermal Infrared Data)

Presented By JAXA
Environment monitoring
Sediment from rivers (Rio Grande, Brazil)

Credit Provided by the SeaWiFS Project,
NASA/Goddard Space Flight Center, and ORBIMAGE

NASA Visible Earth
http://visibleearth.nasa.gov/view_rec.php?id=742
Examples of Water Pollution and sediments Monitoring by ASTER

Water Pollution and Sediments Around the Polder in Japan
By ASTER VNIR Image Data

Presented by ERSDAC
Mineral Exploitation
Geological map generation

NASA Remote Sensing Tutorial
Map generation

DEM: Digital Elevation Model

ASTER Digital Elevation Model
http://igskmncnwb001.cr.usgs.gov/aster/ast14dem.asp

Map update

Bird view

Santiago, Chile © Spot Image
http://www.i-space.fr/applic_imagerie_observation_eng.htm
Stereoscopic Image Data By PRISM

「ALOS」
Sample of Stereoscopic Image Data by PRISM
Resolution 2.5m

3D Image Data of Mt. Fuji
Feb. 14  2006
Civil Engineering

City planning and construction monitoring

The Palm Islands, UAE - Construction
IKONOS Image
(Image Credits: Left: Copyright © 2008 GeoEye/SIME. All Rights Reserved. Right: Copyright © 2008 GeoEye/EUSI. All Rights Reserved.)
http://www.satimagingcorp.com/svc/engineering_and_construction.html
Disaster monitoring

Volcano eruption (Mt. Etna, July 11 – 31, 2001)

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Flood

Sample of MESSR IMAGES FROM MOS-1

![Image showing usual and flood conditions in Bangladesh](image)

**Usual** May 9, 1989

**After Flood** Oct. 17, 1988

BANGLADESH
Eruption of Volcano

After Eruption of Mt. Pinatubo in Philippines
Jan. 5 1991

Mountain Fire
In Mongol
Apr. 16 1996

Before Eruption of Mt. Pinatubo in Philippines
Nov. 25 1989

Sample of MESSR IMAGES from MOS-1

Mountain Fire
Examples of Eruption Monitoring by ASTER (Mt. Usu in North Area of Japan)

TERRA ASTER VNIR 15m Offered by METI ERSDAC