# Response Supporting System for Deterring Illicit Trafficking of Nuclear and Radioactive Materials


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# Contents


1 Korean Nuclear and Radiological Panopticon

2 Integrated Risk management system for Radioactive Material and Radiation Sources

3 Forensic Laboratory capability in KINS

# I. Korean Nuclear and Radiological Panopticon

## Nuclear Power Plant

ATOM CARE
국가 원자력 재난관리 시스템

## Radiation Sources and Radioactive Material

KINS 사이버방사선안전정보센터
RAdiation Safety Information System

GPS 방사선원위치추적 관리시스템
KOREA INSTITUTE OF NUCLEAR SAFETY

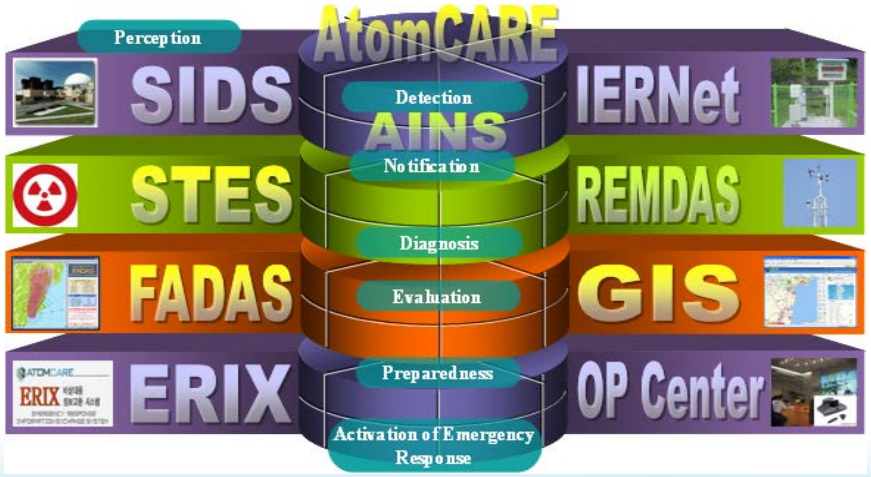
U-REST
Ubiquitous Regional Radiation Emergency Supporting Team

## Nuclear Test Monitoring

XeDaS
Xenon Monitoring Database System

# AtomCARE: National Nuclear Emergency Management System

- **A world unique**
- **full-spectrum real-time web based nuclear Emergency management system**
  - **from the prevention to protection of the general public & environment**
  - **Since 1995**
  - **Patent registered**




ATOM CARE
국가 원자력 재난관리 시스템

# Process chain of AtomCARE

**Monitoring and Detection**

- Safety Information Display System — SIDS
- Environmental Monitoring Network — IERNet

**Emergency Characterization**

- Accident Characterization and Source Term Evaluation — STES
- Meteorological Data Acquisition for target scene — REMDAS

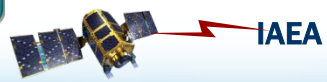
**Emergency Management**

- Consequence Assessment — FADAS
- Protective Action Planning — GIS

**Consequence Management**

- Cooperative Consequence Management — ERIX
- Commands and Control — OP Center

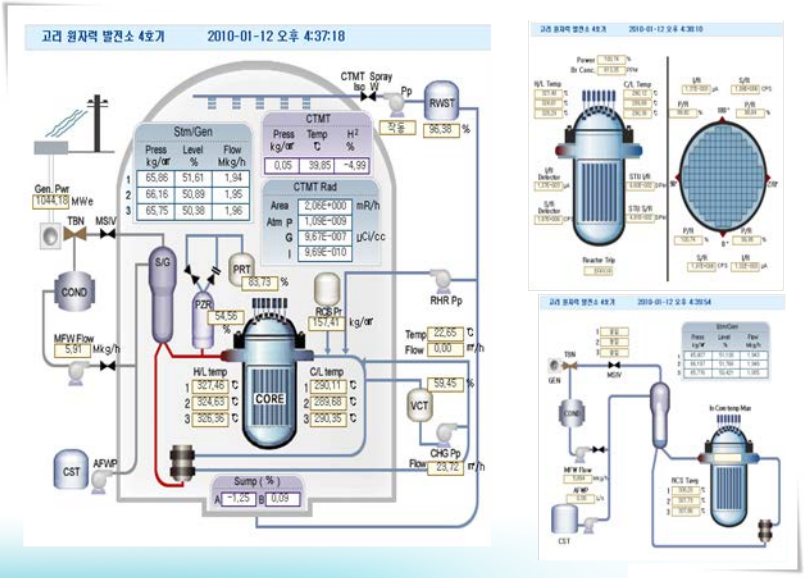
**IAEA early Notification convention**




# Monitoring and Detection

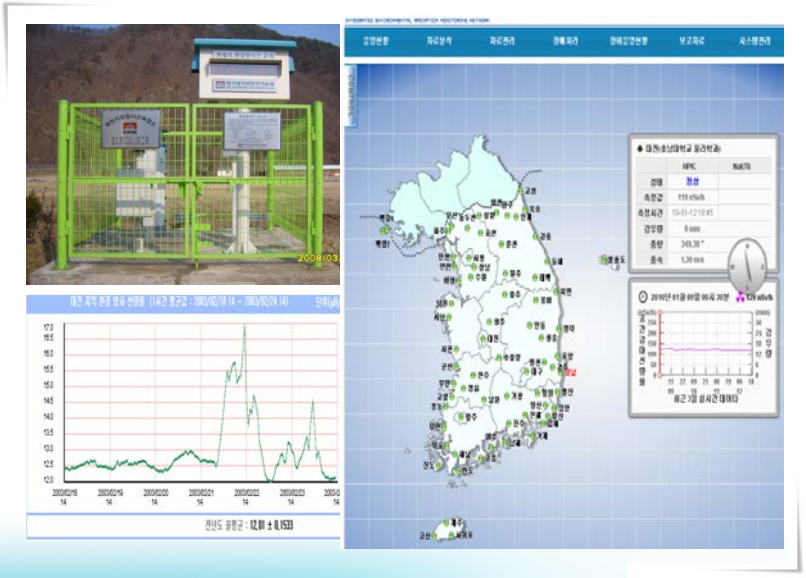
## Safety Information Display System

- System Safety Status Monitoring and Detection abnormal Condition
  - All Nuclear Reactors



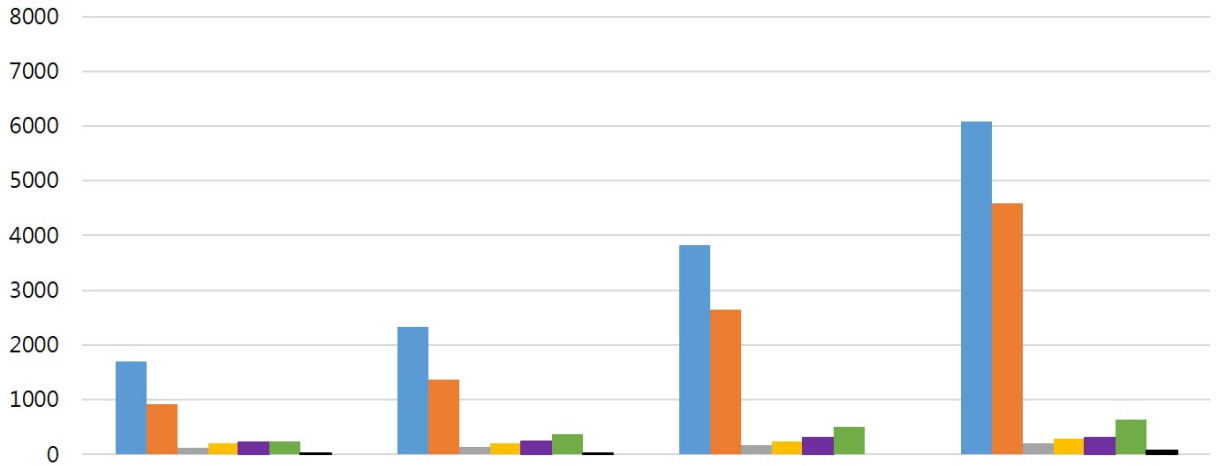

## Integrated Environmental Radiation Monitoring Net.

- Nation-wide environmental Radiation Monitoring
  - 130s Monitoring stations



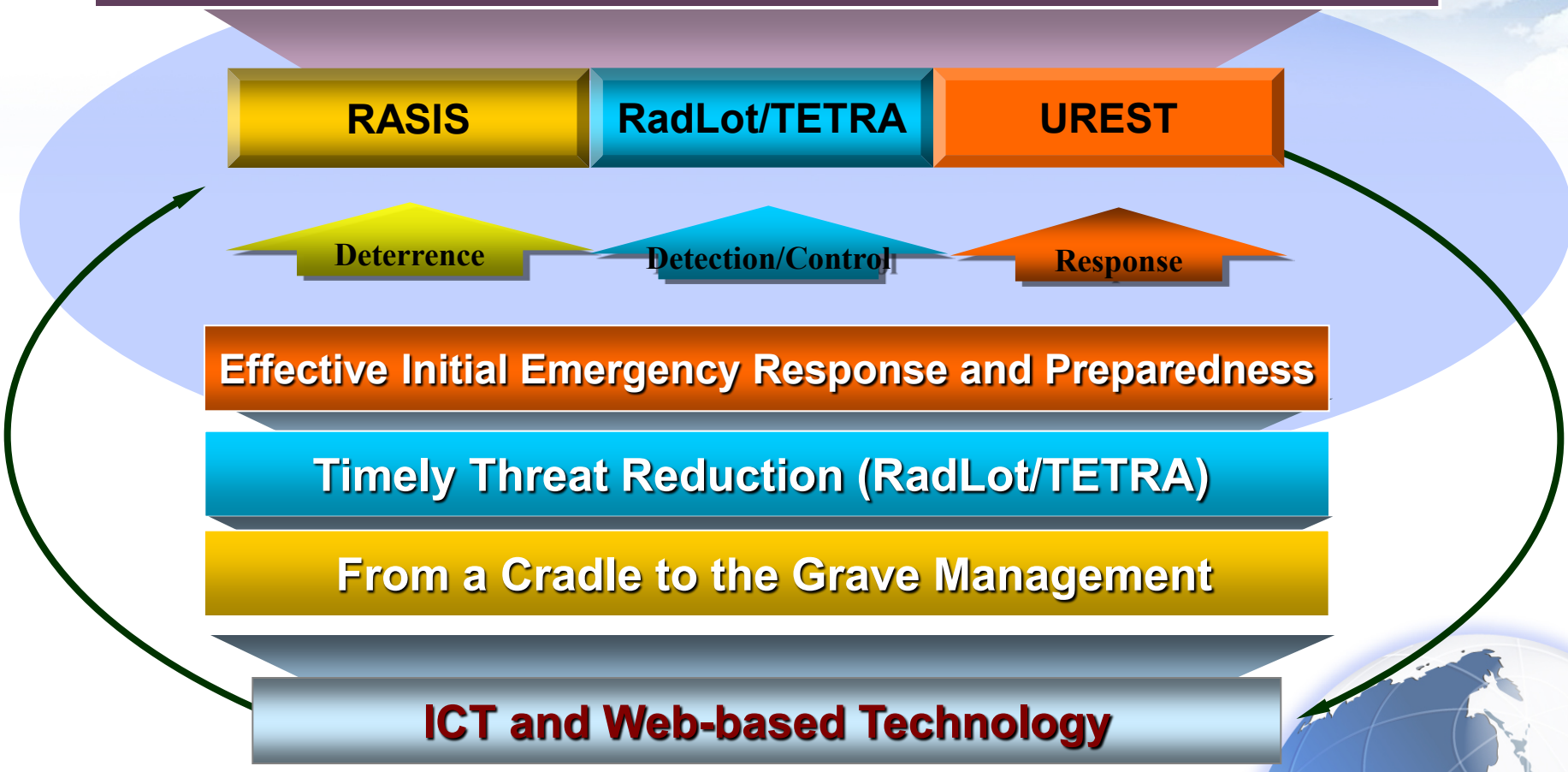
# 2 Integrated Risk management system for Radioactive Material and Radiation Sources

# Statistics of Radiation Utilization in Korea



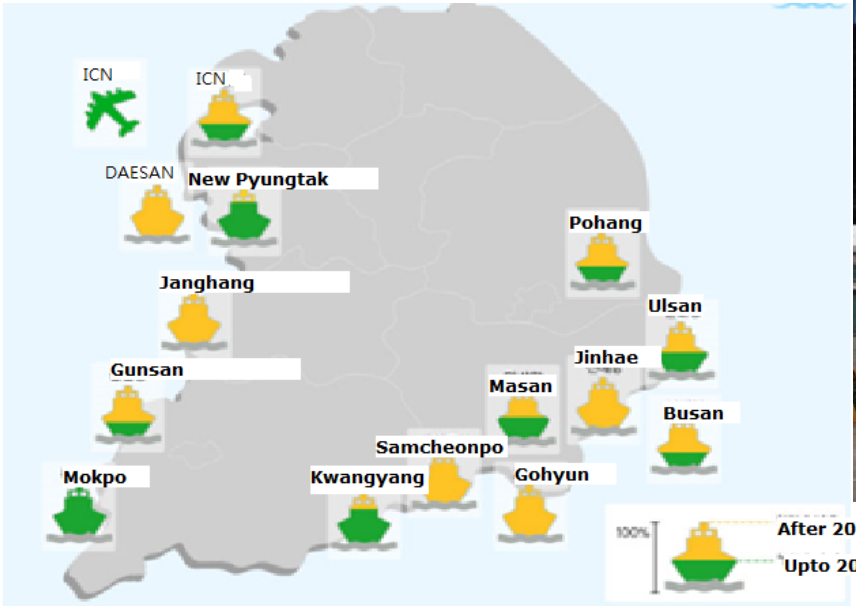

| | 2000 | 2004 | 2008 | 2013 |
|---|---|---|---|---|
| Total | 1,692 | 2,336 | 3,824 | 6,085 |
| Industry | 913 | 1,370 | 2,643 | 4,594 |
| Medical | 125 | 136 | 162 | 206 |
| Research | 199 | 203 | 227 | 282 |
| Education | 211 | 243 | 299 | 294 |
| Public Service | 235 | 373 | 493 | 642 |
| ETC | 9 | 11 | - | 67 |

# Integrated Risk Management System for Radiation Sources and Radioactive Materials

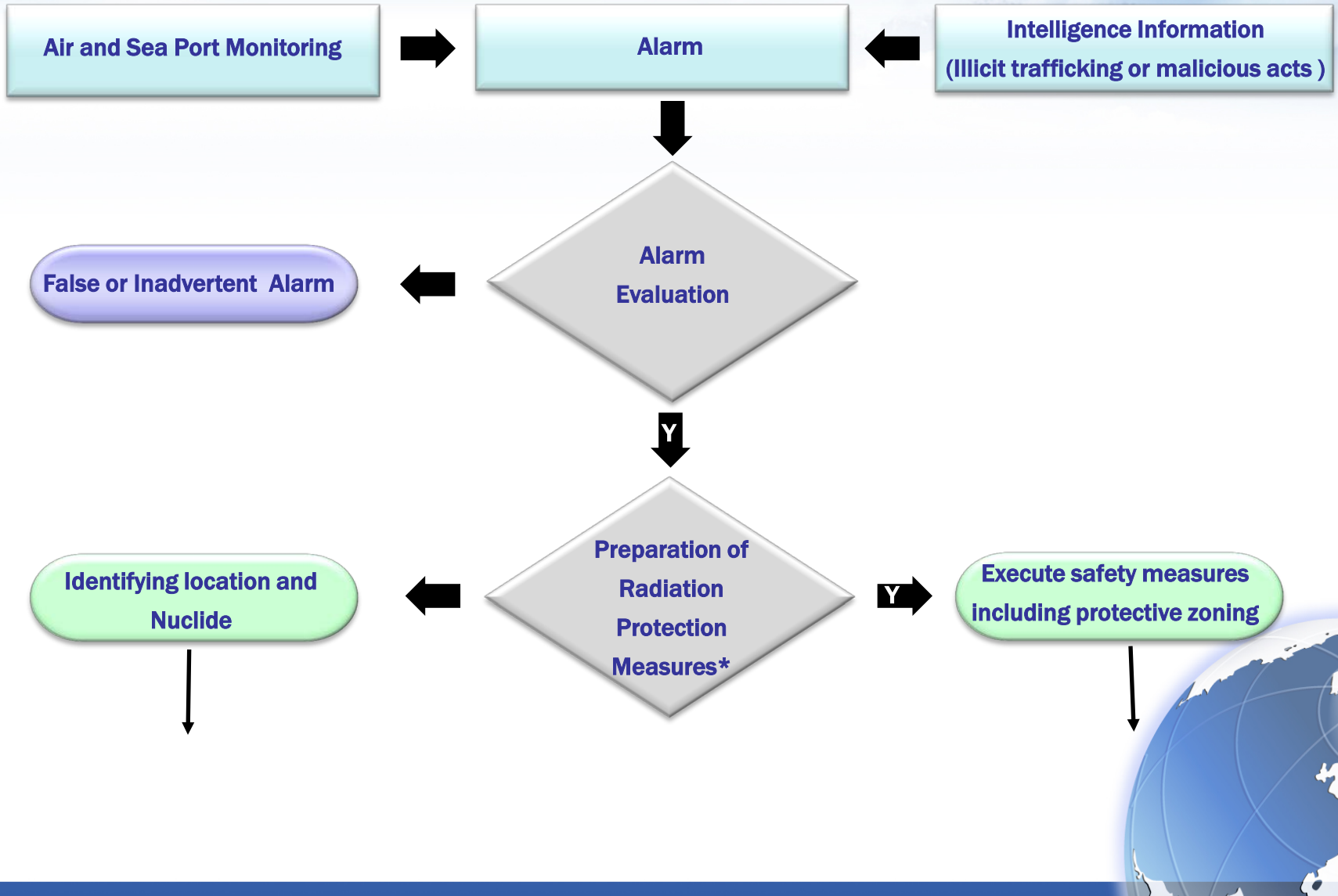


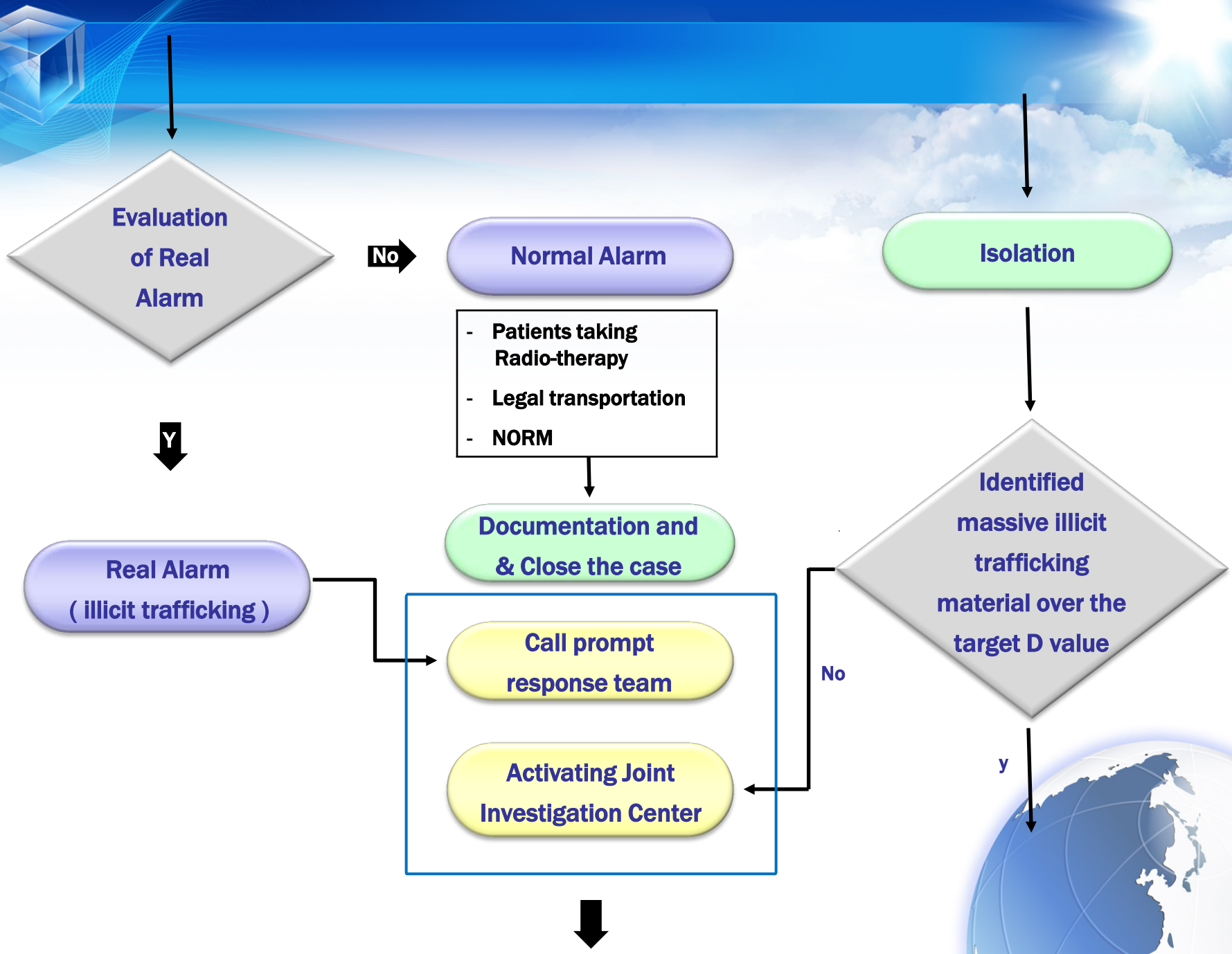
# Boarder Monitoring for countering illicit trafficking of Nuclear and Radioactive material

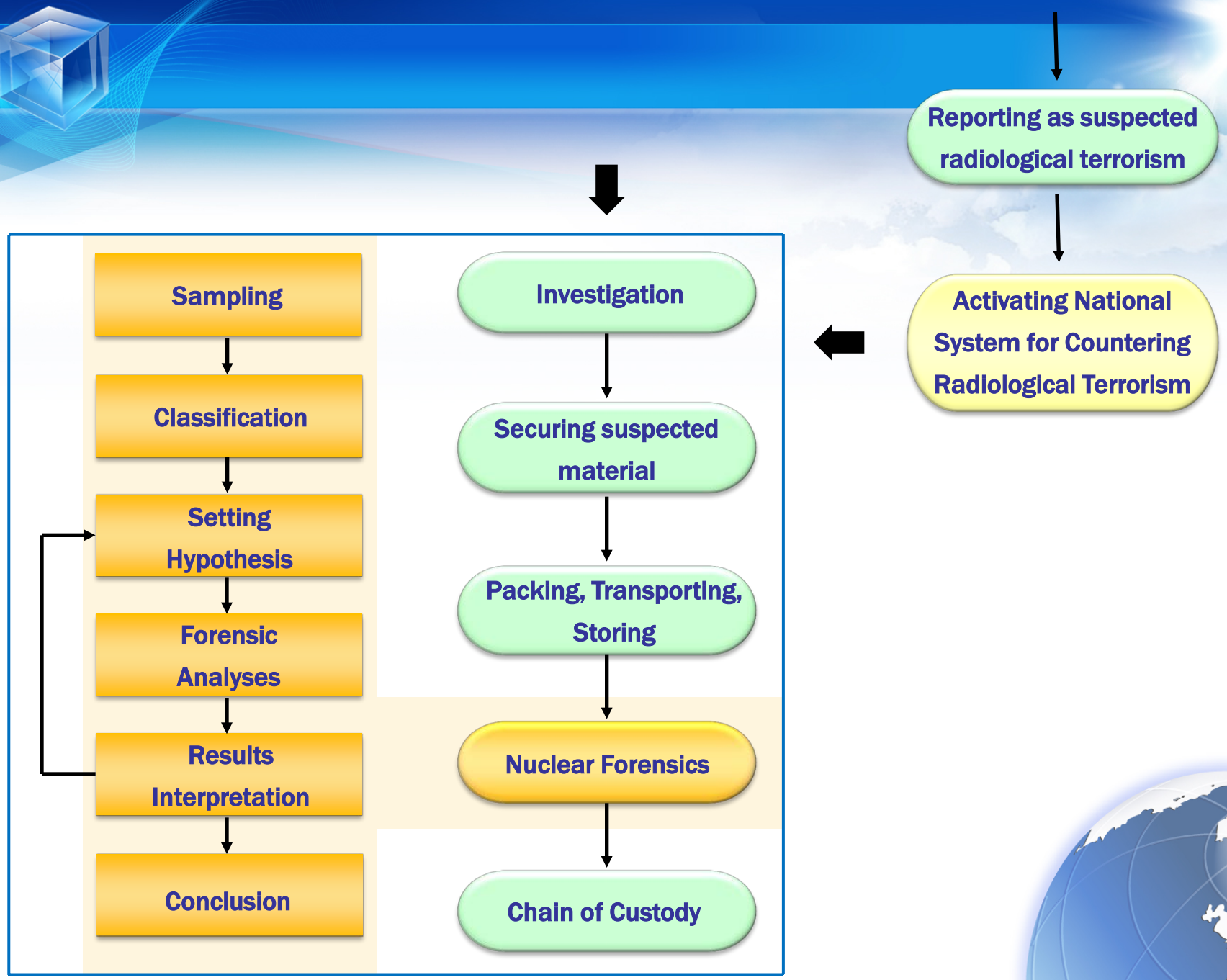
- **Promulgated the Act on Protective Action Guidelines Against Radiation in the Natural Environment in 2011**
- **Deployed 53 RMSs(Radiation Monitoring System) to 10 Air and Seaports and planned 20 more RMSs till end of 2015 for 14 sites**




# Framework of responding with illicit trafficking of Radioactive Material and Radiation Sources




Evaluation of Real Alarm
No
Normal Alarm
- Patients taking Radio-therapy
- Legal transportation
- NORM
Documentation and & Close the case
Y
Real Alarm ( illicit trafficking )
Call prompt response team
Activating Joint Investigation Center
Isolation
Identified massive illicit trafficking material over the target D value
No
y


Reporting as suspected radiological terrorism
Activating National System for Countering Radiological Terrorism
Investigation
Securing suspected material
Packing, Transporting, Storing
Nuclear Forensics
Chain of Custody
Sampling
Classification
Setting Hypothesis
Forensic Analyses
Results Interpretation
Conclusion

# Panopticon Systems for illicit trafficking of RM

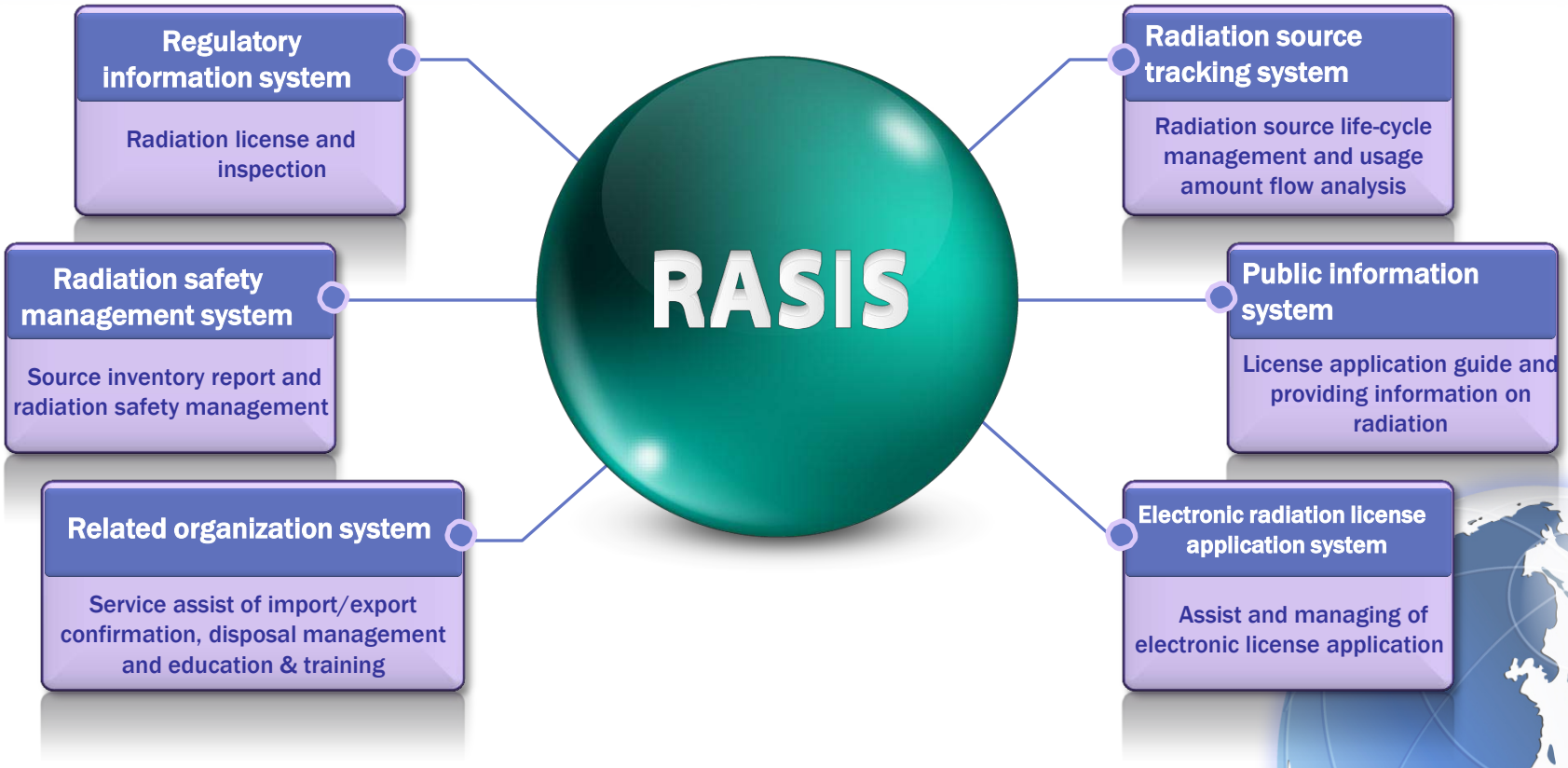
- **Target : Radiation Sources, Radioactive and Nuclear Materials**
- **RASIS**
  - Cradle-to-Grave Control System for radiation sources, radioactive and nuclear Material
- **RADLOT**
  - GPS/CDMA based real-time based
- **UREST**
  - Regional volunteer emergency support team

# RASIS (Radiation Safety Information System


**Cradle-to-Grave Control System**

# RASIS (Radiation Safety Information System

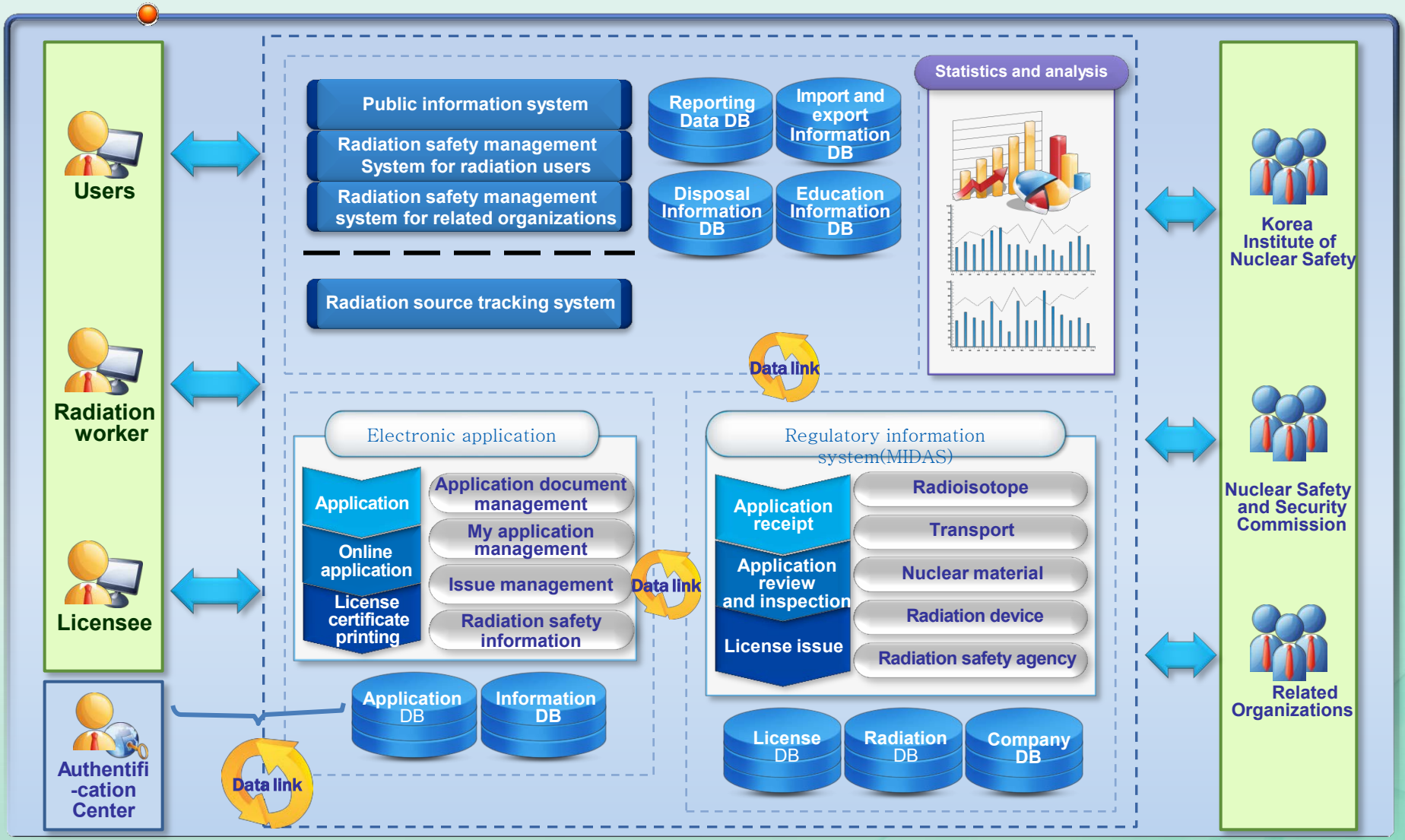
**Radiation Safety Information System** is total management system of radiation safety which is used by Nuclear Safety and Security Commission, Korea Institute of Nuclear Safety, Korea Radioisotope Association and more than 6,100 radiation users.



# RASIS : System Configuration and work flow



## System configuration



# RASIS : System Configuration and work flow

## Work flow

### Applicant/regulatory authority

**Electronic radiation license application system**

- Online application
- Application confirmation License printing

**Radiation safety management system for radiation users**

- Regular report Source management
- Radiation worker management

### KINS / NSSC

**Regulatory information system**

- Safety review and inspection Statistics/status

**Radiation source tracking system**

- Report status management
- Usage amount flow management Source life-cycle tracking

### Related organizations

**Radiation safety management system for related organizations**

- Radiation worker education
- Export and import management Consigned source disposal

### General public

**Public information system**

- Application form and guidance information
- General information on radiation

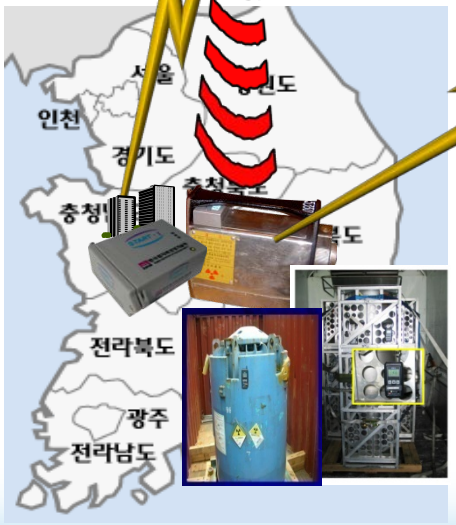
1. Application submit
2. License certificate
3. Education/consigned source disposal
3. Quarterly report

# Real time Source Tracking & Remote Tech. Supporting

## GPS Satellites

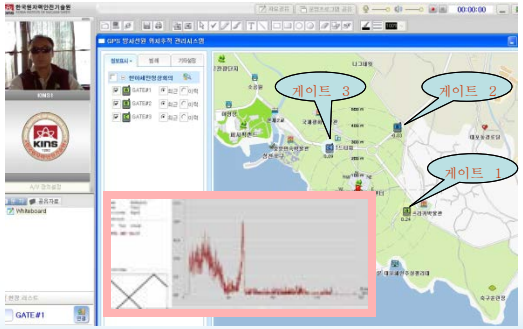
## CDMA Mobile Net.

## Location Tracking

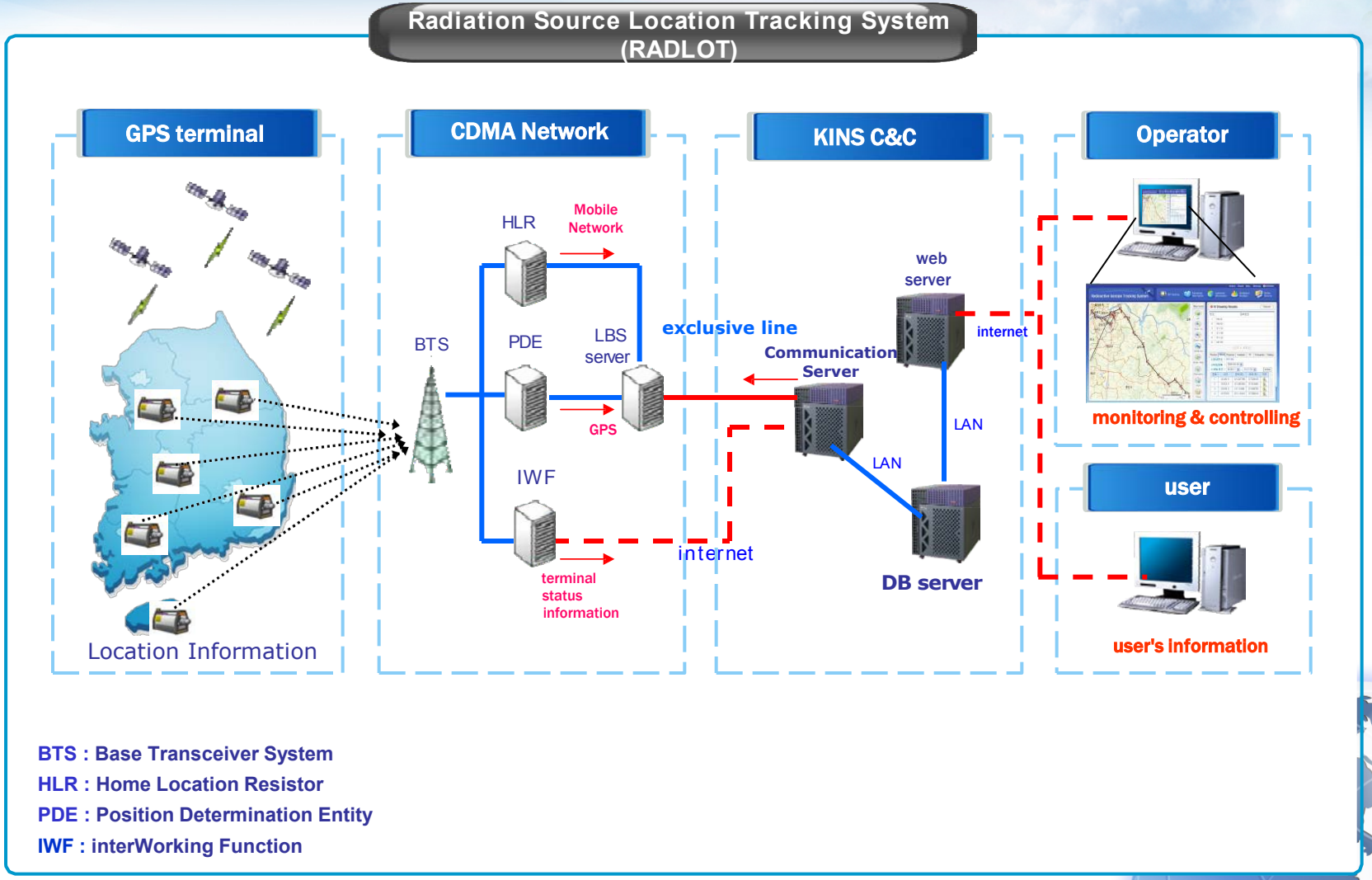




## KINS C&C

## Remote Response Support

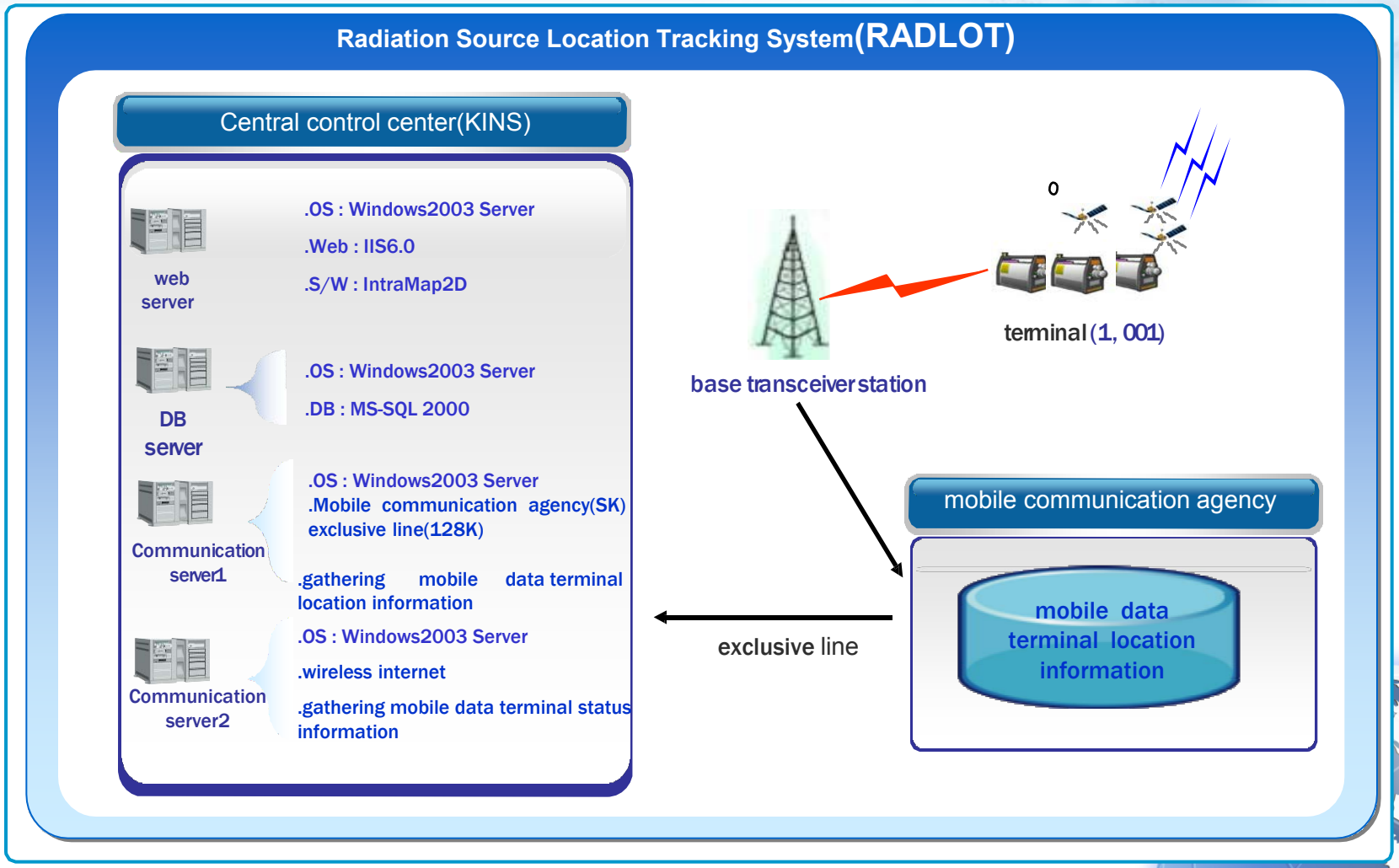


# RadLot: System configuration




BTS : Base Transceiver System
HLR : Home Location Resistor
PDE : Position Determination Entity
IWF : interWorking Function

# RadLot: Operational Environment



# RadLot: Mobile Data Termainal

| Terminal | Type | Note |
|---|---|---|
| START - Ⅰ |  | Mobile Data Terminal was mounted on the top of the NDT equipment with adhesive tape. The Data Termnial comprised of CDMA RF Module and I/O controller to communicate with KINS C&C center .<br><br>CPU : ATMEL MEGA128M (9 x 9(mm))<br>case : 71 x 83 x 30(mm)<br>battery : lithium polymer 5600mA(size:50 x 35 x 17(mm)) |
| START- Ⅰ - SS<br>(Minimized terminal type) |  | Improved Version of START-1 with reducing the size and enhance robustness.<br><br>CPU : ultra low power MPU (5.1 x 6.6(mm))<br>case : 65 x 44 x 30(mm)<br>battery : lithium polymer 5100mA(size:50 x 35 x 17(mm)) |
| START- Ⅰ - IH<br>(built-in handgrip type) |  | same type of START-I-SS(Minimized terminal type), improved bulit- in handle type reducing the performance degradation caused by impact<br><br>CPU : ultra low power MPU (5.1 x 6.6(mm))<br>case : built-in handgrip<br>battery : lithium polymer 5100mA(size:50 x 35 x 17(mm)) |

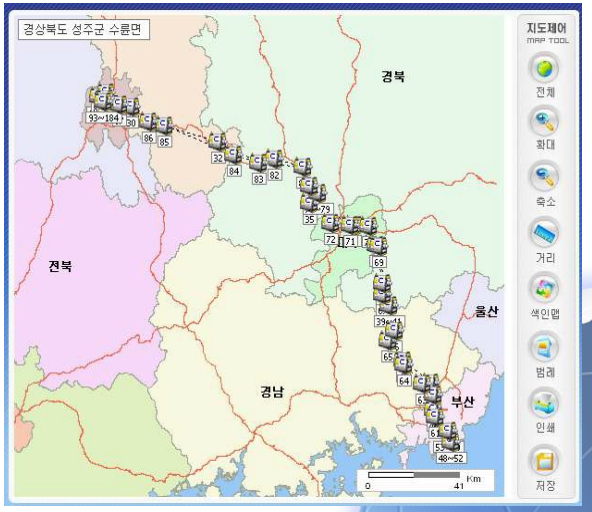
# RadLot: START-II with GM Dosimeter

| Terminal | Type | Note |
|---|---|---|
| START- Ⅱ |   | STARTER II provides the radiation dose level in addition to locational information. It make possible to monitor radiation dose level and to detect that Data terminal is separated from the source inadvertently or intentionally.<br><br>CPU + RF module : 24 x 386(mm)<br>case : 20 x 72 x 100(mm) LCD : 40.5 x 30(mm)<br>battery : rechargeable battery compatible with commercial dry cell(Two AA size) |
| START-88e |  | Upgrade type of START-I for 880 typed irradiator with G-M dosimeter(radiation measurement) and GPS function in addition to CDMA and detachable battery box.<br><br>CPU : ultra low power MPU (5.1 x 6.6(mm))<br>case : 16 x 70 x 160(mm)<br>Battery : lithium-ion polymer 5200mA (size:59 x 74 x 10(mm)) |

# RadLot: Web-based Location Tracking

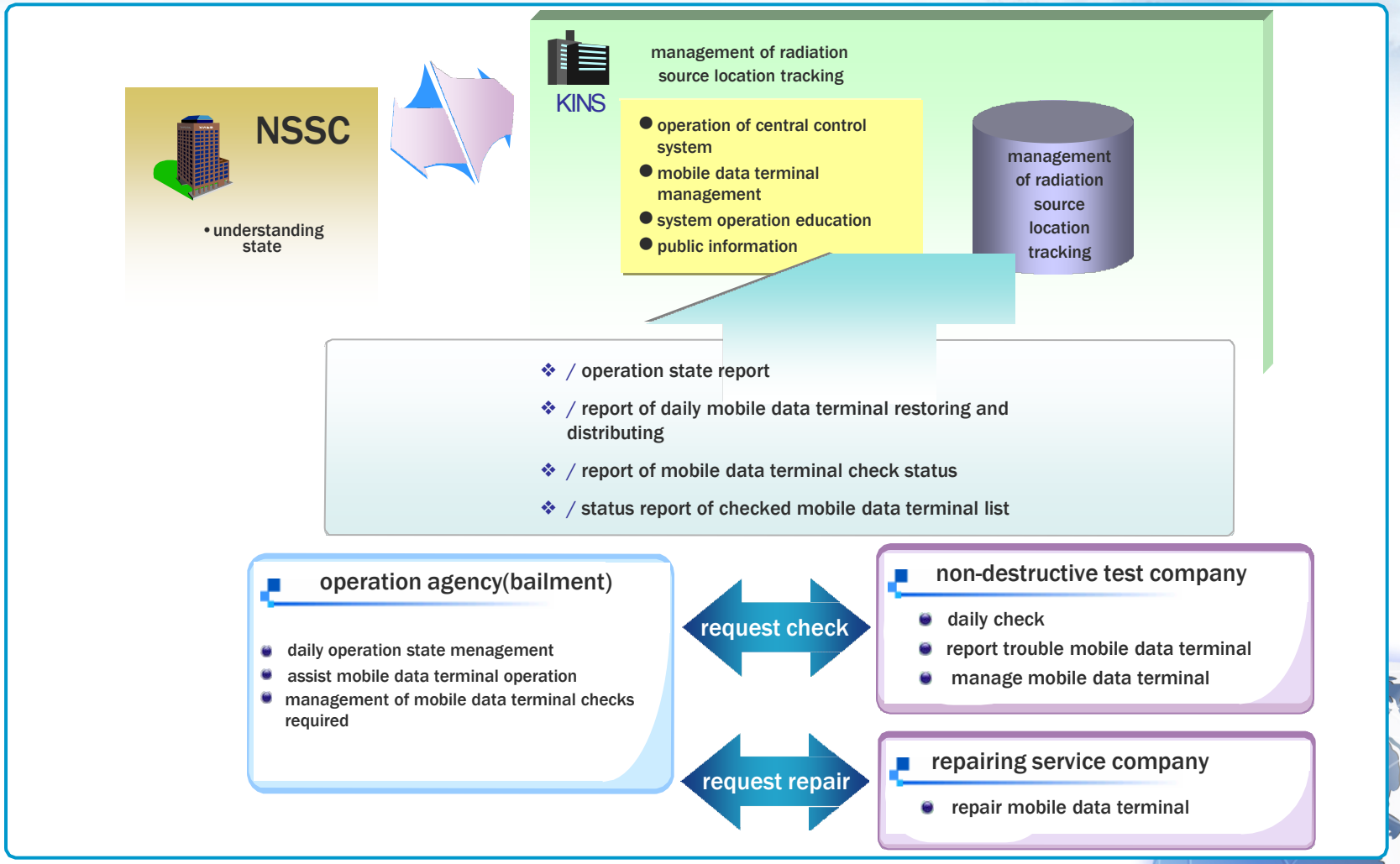


[mobile data terminal location information using GIS]




- super speed GIS engine based web
- 1:5000 scale geographical information(downtown 1:1000)
- demand to send mobile date terminal status,
  GPS information and RF signal

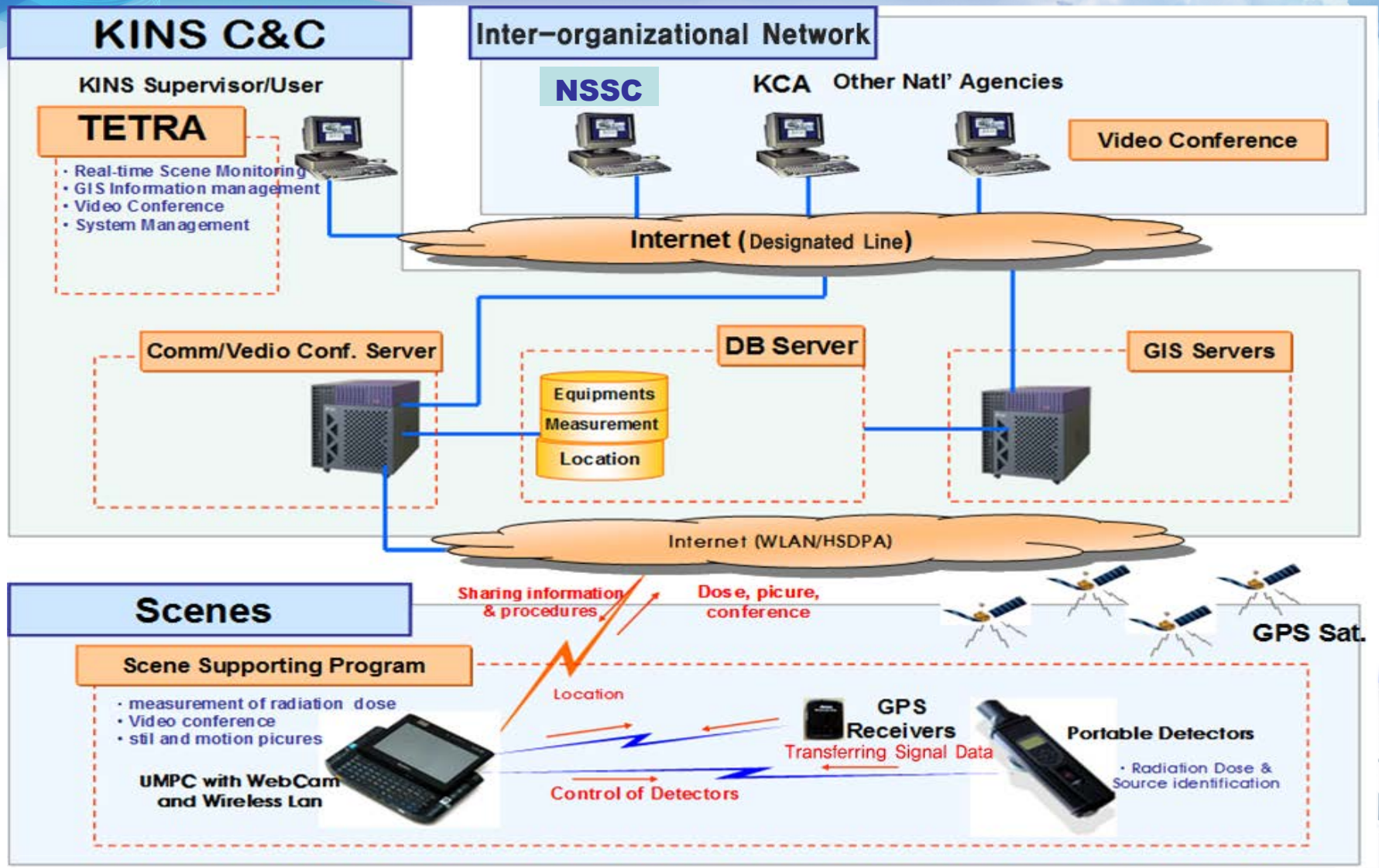
# RadLot: Work Flow



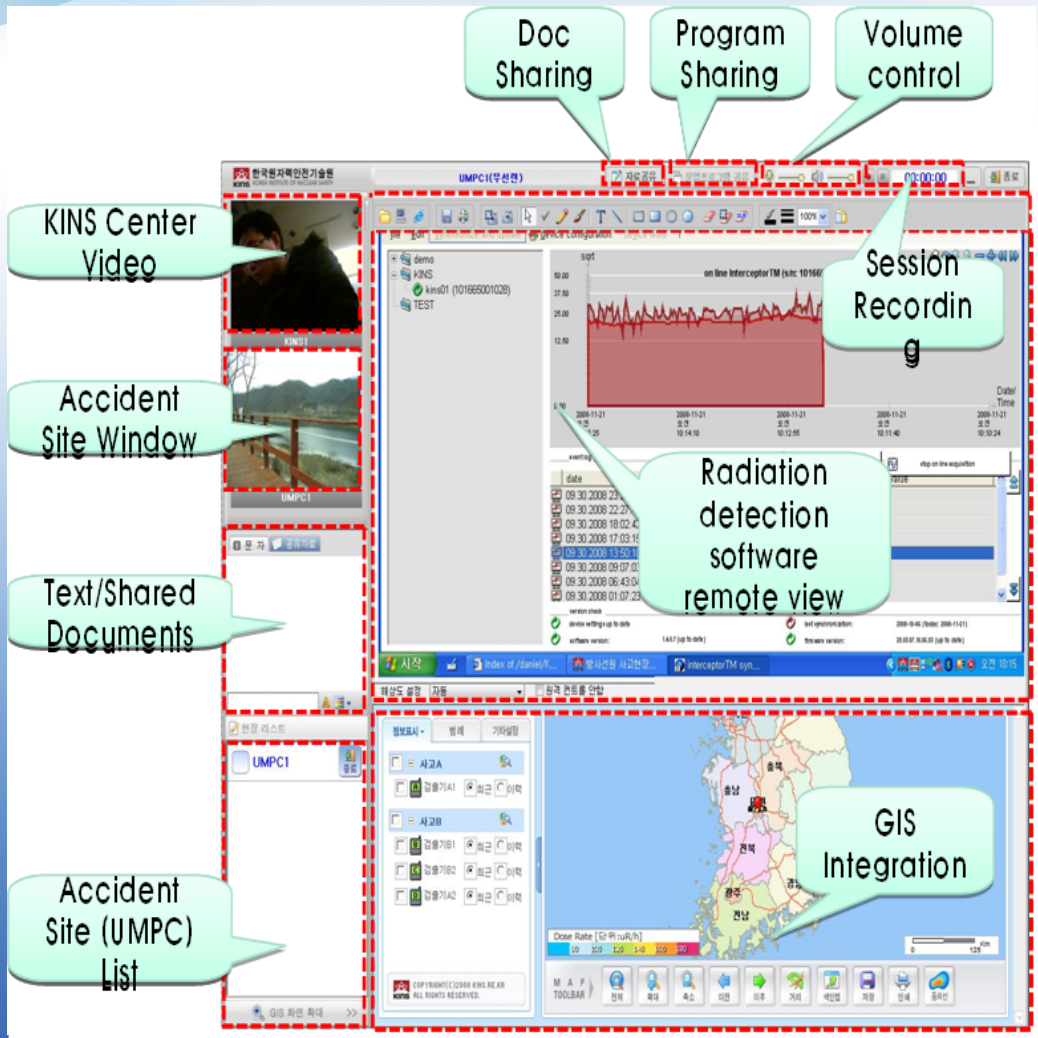
# 2 TESTRA: In-Situ Mobile Response Supporting System

- Developed in 2009 for effective detection and response nuclear and radioactive material for radiation accident and radiological terrorism
- Web-based remote monitoring and characterization of nuclear or radioactive material.
- Deployed various national or international event to detect unauthorized nuclear and radioactive material and to response nuclear and radiological terrorism.
  - ASEAN Commemorative Summit in 2006
  - G-20 Summit ( to be deployed)
  - National inter-ministrial exercises and drills for nuclear and radiological terrorism
  - SFI Supporting

# TETRA: System Configuration



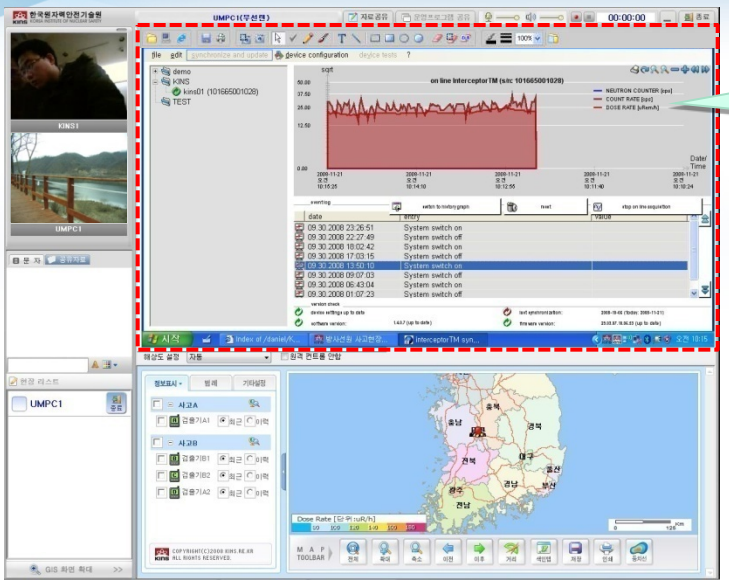
# KINS C&C Module




- Real time audio-video communication, collaboration)
- Authentication (Password, user profile etc)
- File and instant message transfer
- Accident scene list and call in function
- Various types of document sharing

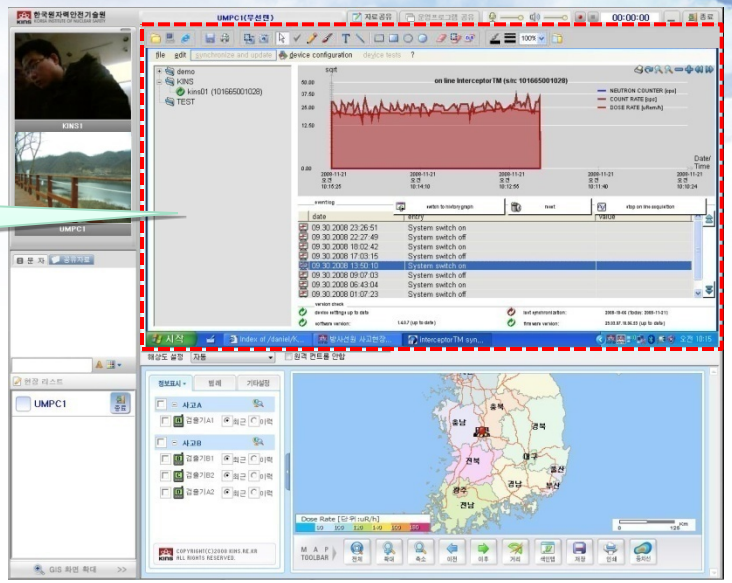
  (MS-Office, hwp, pdf, image , etc)
- Application Sharing(Radiation detection application)
- Real times session recording(avi Format)
- Real-time transmission of GIS measurement information
- Interactive whiteboard
- Drawing feature (lines, shapes, text, zoom etc)

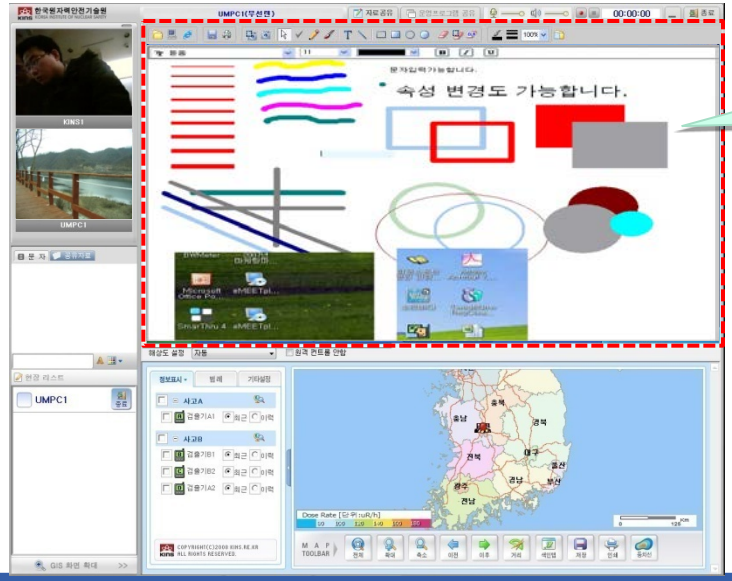
# KINS C&C Module



Doc. Sharing Window (Preview )

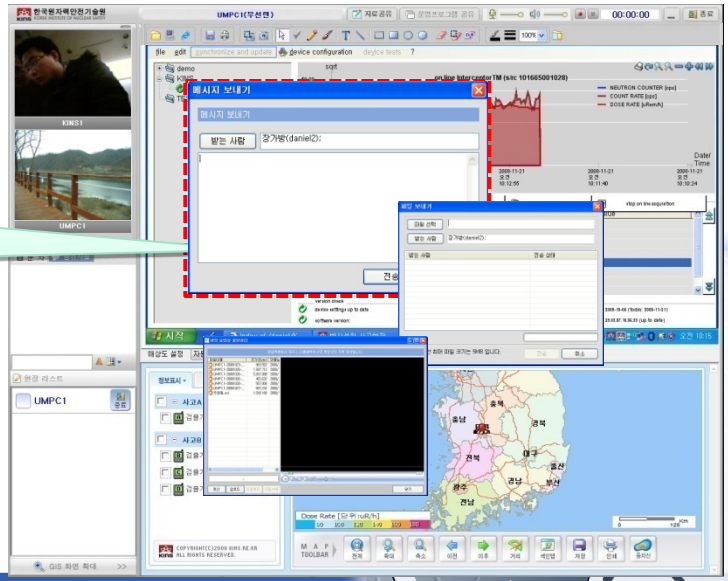
Web Sharing Window



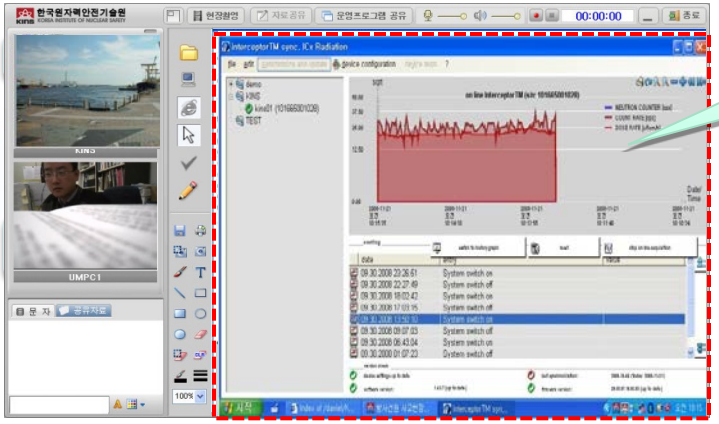


Whiteboard (Digital Board)

File and Message Transfer window

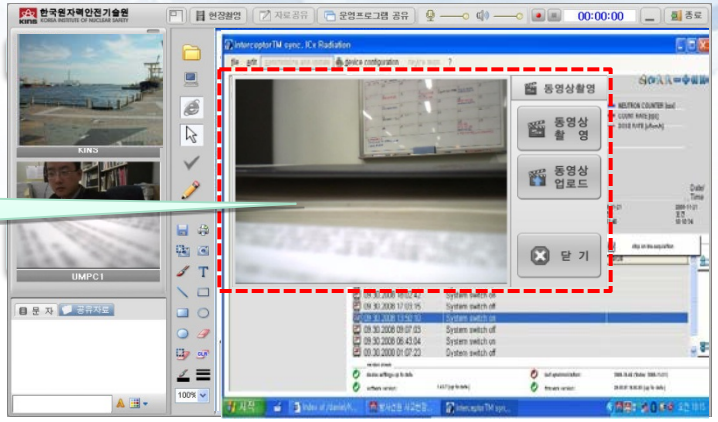


# In-situ Module (UMPC Window)



Shared Monitoring Software

Recorded file Management



✠ Optimized for 1024 X 600 Resolution

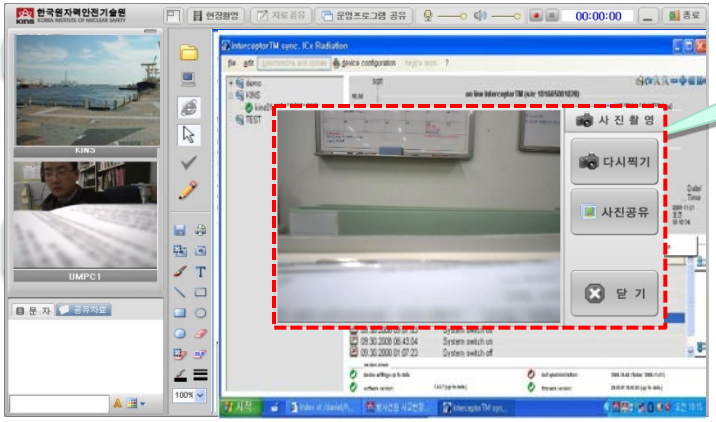
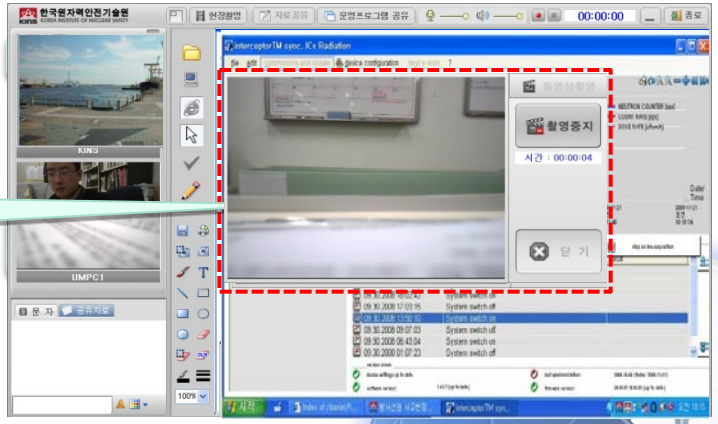


Image Capture

Video recording Window

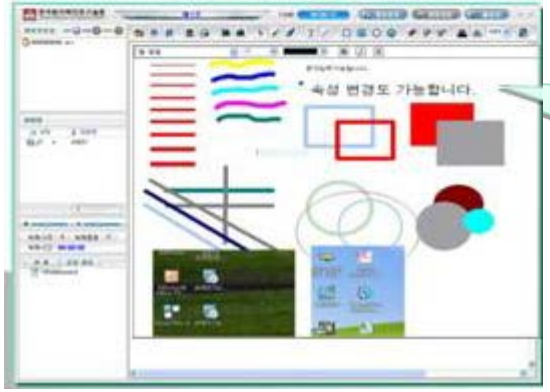


# Video Conference Module

# Video Conference Module


Document Sharing Window


Web Sharing Window

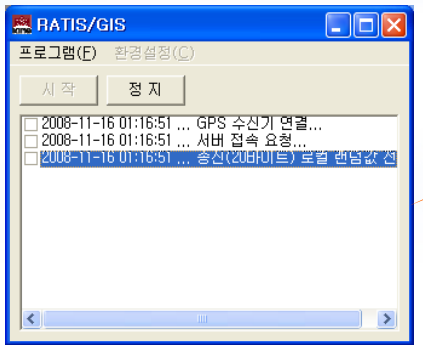


Whiteboard Window

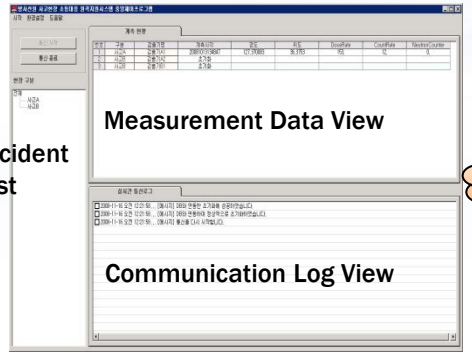
- Real time audio-video communication, collaboration)
- Authentication (Password, user profile etc)
- File and instant message transfer
- Accident scene list and call in function
- Various types of document sharing

  (MS-Office, hwp, pdf, image , etc)
- Application Sharing(Radiation detection application)
- Real times session recording(avi Format)
- Real-time transmission of GIS measurement information
- Interactive whiteboard
- Drawing feature (lines, shapes, text, zoom etc)

# GIS based Remonte Measurement System

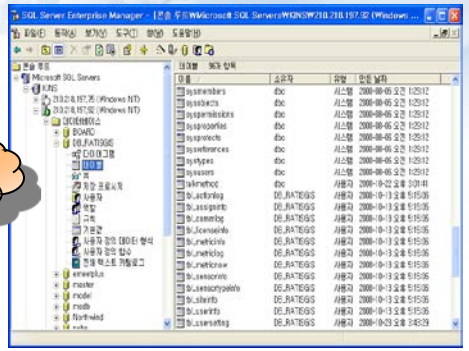



- Accident scene information



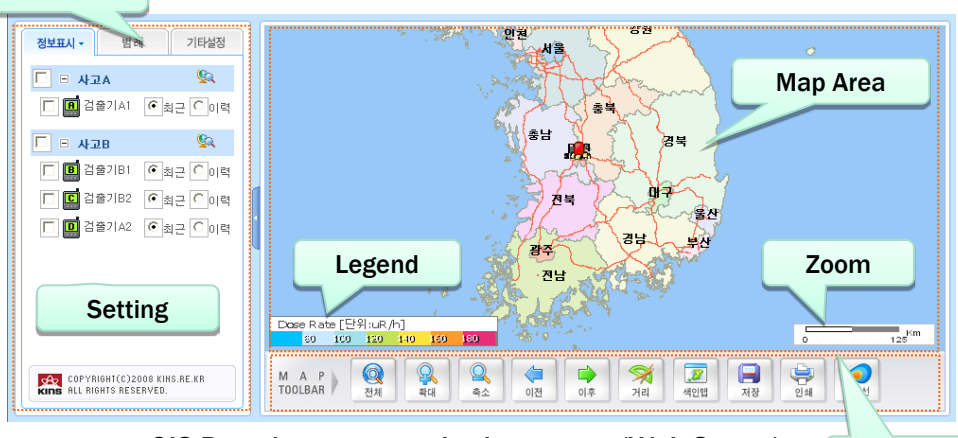

- Communication Server SW

LAN



- Database (DB Server)

Internet

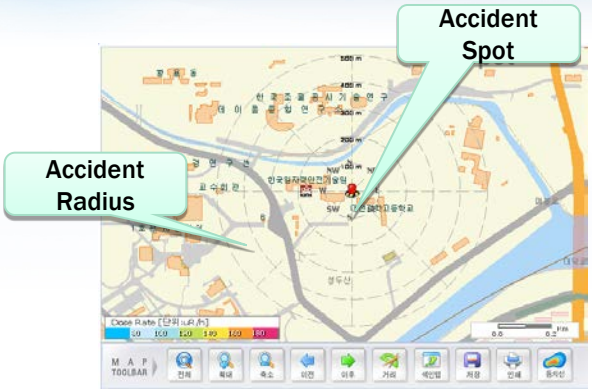



- GIS Based remote monitoring system(Web Server)

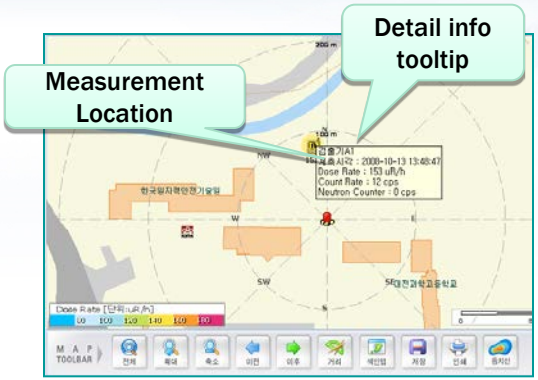
Map Control

System Management(Web Server)

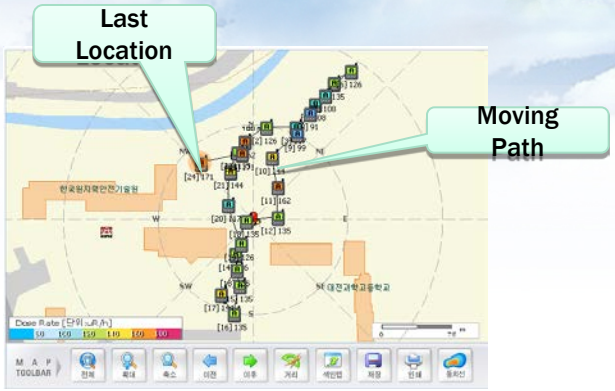
# GIS based Remote Measurement System



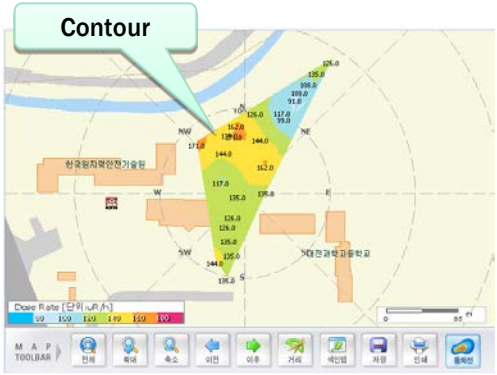

➲ Accident Location



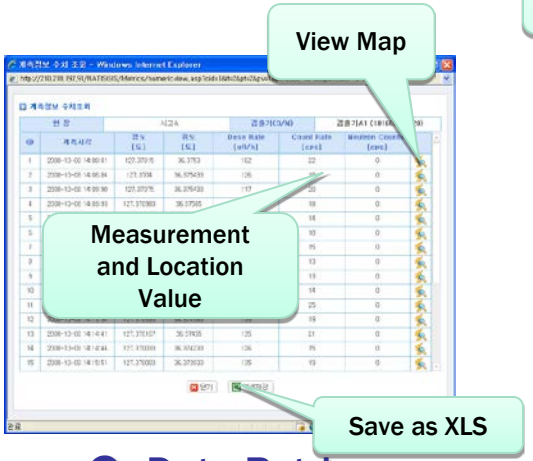

➲ Measurement Monitoring



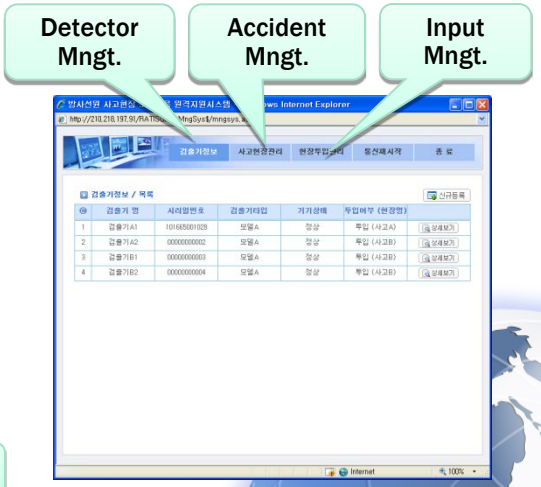

➲ Real-time Location Tracking




➲ Contouring Info




➲ Data Retrieve




➲ System Management

# UREST : Ubiquetous Radiation Emergency Supporting Team

- **12 Regions, 300s voluntary experts**
- **Effective initial response and preparedness**
  - **Radiation control zoning**
  - **Contamination check**
  - **environmental monitoring**


# 3 Forensic Laboratory capability in KINS

# Laboratory for Radioactivity Analysis

| | Facilities | Size ($m^2$) | # of Systems |
|---|---|---|---|
| ANALYSYS | Alpha /Beta Measurement Room | 159 | 6 |
| | Gamma Measurement Room | 161 | 11 |
| | Radioact. Waste Measure. Room | 33 | 2 |
| | ICP-MS Operating Room | 70 | 1 |
| PRETREATMENT | Seawater Pretreatment Room | 114 | Chemical Facilities |
| | Strontium Pretreatment Room | 219 | Chemical Facilities |
| | Alpha Nuclides Pretreatment Room | 155 | Chemical Facilities |
| | Tritium Pretreatment Room | 259 | Chemical Facilities |
| | Electric Furnace Ash Room | 111 | 3 |

# Laboratory for Radioactivity Analysis

| | Equipments | # of Systems | Target Nuclides |
|---|---|---|---|
| ANALYSIS | Alpha Spectrometer | 2 | U, Pu, Th, Ra etc |
| | ICP-Mass Spectrometer | 1 | Pu, U etc |
| | Low Background α/β Counter | 3 | Sr-90 |
| | Liquid Scintillation Counter | 3 | H-3, C-14 |
| | HPGe Gamma Spectrometry | 16 | Gamma Nuclides |

# HPGe γ spectrometer

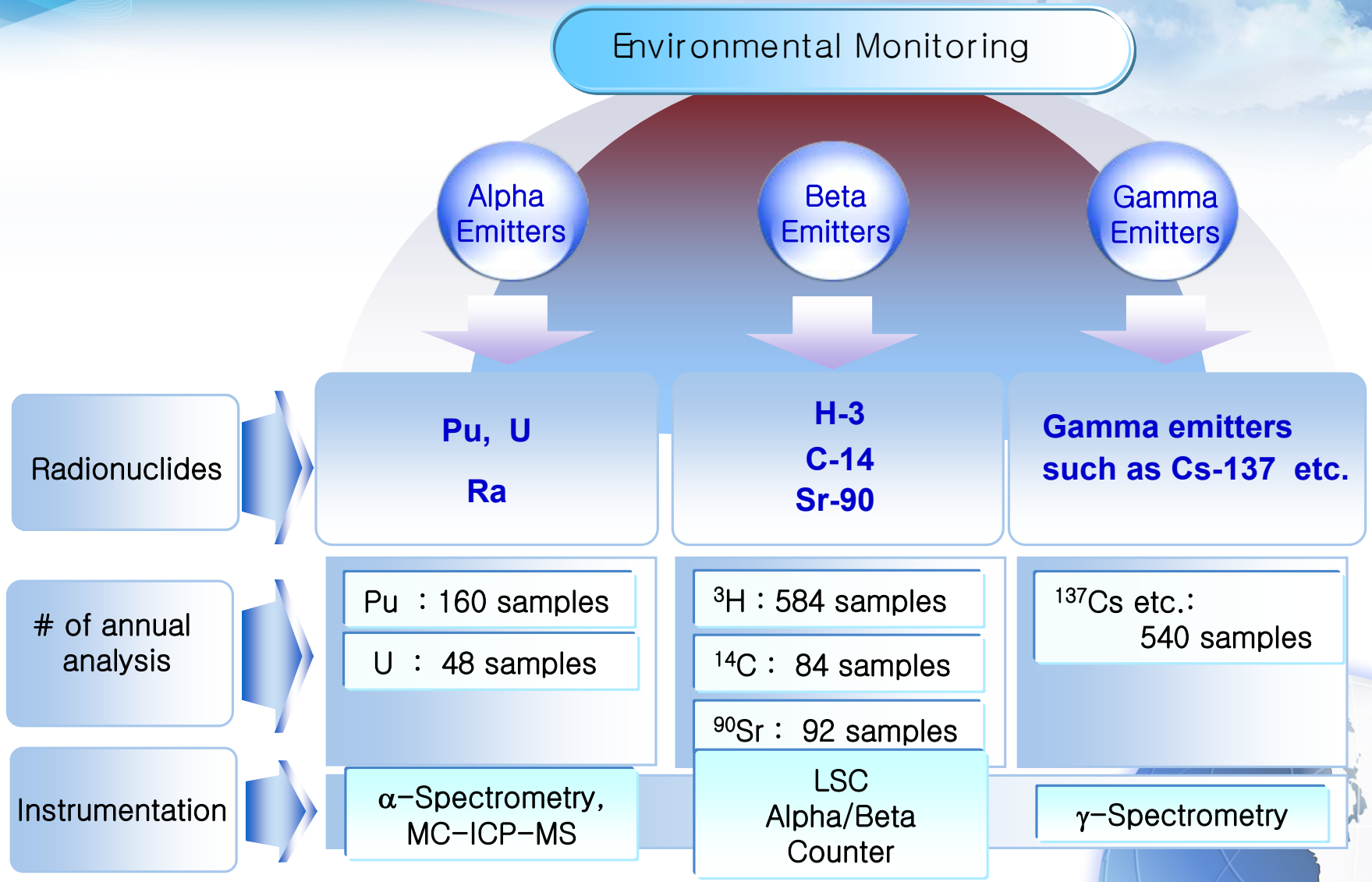
# Liquid Scintillation Counter

# Chemical separation room

# Clean room

# ICP-MS

# Laboratory for Radioactivity Analysis



# Conclusion

- **Full spectrum of integrated risk management system for the radioactive material and radiation sources has been in place in Korea**
  - **AtomCARE system for Nuclear Installations**
  - **Web based Cradle-to-Grave Control**
  - **CDMA-GPS real-time tracking system**
  - **TETRA: in-situ mobile response supporting system**
  - **Volunteer based regional emergency supporting team (UREST)**

- **Operational experience of in-situ mobile response supporting system demonstrate the viability of preventing and responding illicit trafficking of radioactive material**

원자력 안전
KINS가 만들어 갑니다!

감사합니다

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