제7차 GIS 국제 세미나 · 워크숍

The 7th International Seminar & Workshop on GIS

- 일시 : 2002년 11월 8일(금)
- 장소 : 코엑스 인터컨티넨탈 호텔 하모니볼룸(B1)
- 주최 : 정보통신부 / 건설교통부
- 주관 : 국토연구원 / 한국전자통신연구원

초대의 글

GIS는 새천년 지식정보사회의 핵심적인 사회간접자본입니다.

GIS의 발전은 지식정보사회의 국가경쟁력확보에 필수적인 요소입니다.

공공 및 민간분야에서의GIS 기반확충과 활용확산에 기여하기위해 국토연구원과 한국전자통신연구원이 공동으로 '제7차 GIS 국제세미나 • 워크숍'을 개최하고자 합니다.

본 GIS 국제세미나 • 워크숍은 국내외 전문가들을 초빙하여, GIS 구축 및 활용에 관한 선진경험을 공유하고, GIS 기술의 발전동향을 파악하여, 국가 GIS 정책 및 기술개발의 발전방향을 모색함으로써, 지식정보사회의 핵심요소가 될 GIS의 기반확충과 활용확산에 기여하는 것을 목적으로하고 있습니다.

부디 참석하시어 자리를 빛내주시기 바랍니다.

2002년 11월 8일

국토연구원원장 이정식 • 한국전자통신연구원원장 오길록

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행사 프로그램

2002년 11월 8일(금요일)

시 간	내 용	장 소
Opening Session	사회 : 사공호상(국토연구원)	하모니볼룸
09:30~10:00	튜토리얼 : 차세대 GIS 기반 및 응용기술의 이해 (이기원, 한성대)	
10:00~10:10	개회사 (오길록, 한국전자통신연구원장)	
10:10~10:20	환영사 (이정식, 국토연구원장)	
Session I	국가GIS 발전을 위한 기반조성 사회 : 사공호상(국토연구원)	
10:20~10:50	국가GIS 정책방향 - 제2차 국가GIS 사업 추진방향 (권상대, 건설교통부 NGIS 팀장)	
10:50~11:20	국가GIS 연구동향 - 디지털 국토 구현을 위한 GIS 활용 및 연구방향 (정문섭, 국토연구원)	
11:20~12:00	해외 GIS 연구동향 - GIS and Photogrammetry: The impact of new sensors/systems (Ayman Habib, Univ. of Calgary)	
12:00~13:00	점심 및 휴식	다이아몬드홀
Session II	차세대 공간정보기술 개발현황 사회 : 박종현(한국전자통신연구원)	하모니볼룸
13:00~13:30	국가GIS 기술개발 방향 - 국가GIS 기술개발을 위한 로드맵 (박재문, 정보통신부 정보화지원과장)	
13:30~14:00	차세대 GIS 기술개발 - 4S 기술 및 비디오 GIS 기술 등 최신 기술개발 (이종훈, 한국전자통신연구원)	
14:00~14:40	차세대 RS 기술개발 - Analysis and Visualization of Large-Scale Multidimensional Data Sets (Dmity Varlyguin, RESAC)	

14:40~14:50	휴식 및 티타임	
Session III	세계의 GIS 산업기반 정책 및 비즈니스 사회 : 박종현(한국전자통신연구원)	하모니볼룸
14:50~15:30	캐나다의 GIS 산업기반 및 차세대 기술 개발현황 (Stefan Palko, Geomatics)	
15:30~16:10	일본의 GIS 산업기반 및 차세대 기술 개발현황 (Shibasaki, 동경대)	
16:10~16:50	중국의 GIS 산업기반 및 차세대 기술 개발현황 (Chen Jun, CAGIS)	
16:50~17:00	휴 식	
패널토의	좌장 : 배해영 교수(인하대)	
17:00~17:40	국가GIS의 발전 방향 및 전망 - 국가GIS 및 지자체 GIS 정책 - 사회간접자본으로서의 GIS 구축 및 활용 방안	
패널토의자	권상대팀장(건설교통부), 염형민센터장(국토연구원), 박재문과장(정보통신부), 이종훈센터장(한국전자통신연구원), 한상득과장(국립지리원), 김은형교수(경원대), 이도훈(한국지리정보소프트웨어협회장)	
17:40~	폐 회	하모니로비

SEMINAR SCHEDULE

November 8, 2002 (Friday)

09:00 - 09:20 Registration

09:20 - 09:30 Exhibition Hall Open

• Opening Session

Moderator : Ho-Sang Sagong (KRIHS)

09:30 - 10:00 Tutorial: Toward GIS in Next Generation

- LBS and Wearable GIS (Gi Won Lee, Hansung Univ)

10:00 - 10:10 Opening Address (Gil Rok Oh, ETRI)

10:10 - 10:20 Welcome Remarks (Jeong-Sik Lee, KRIHS)

• Session 1 Foundations for National GIS Development

Moderator : Ho-Sang Sagong (KRIHS)

10:20 - 10:50NGIS Policy

The 2nd Master Plan of NGIS (Sang Dae Kwon, MOTC NGIS Team)

10:50 - 11:20 Research Activities for NGIS

GIS Research toward Digital Territory (Mun Seop Jeong, KRIHS)

11:20 - 12:00Oversea Research Trends

GIS and Photogrammetry: The Impact of New Sensors/systems (Ayman Habib, Univ. of Calgary)

12:00 - 13:00 Standing Buffet

• Session 2 The Latest Trends in GIS Technology

Moderator : Jong -Hyun Park (ETRI)

13:00 - 13:30 Technologies for NGIS

Directions of Technology Development for NGIS (Jae Mun Park ,MIC)

13:30 - 14:00GIS Technology in the Next Generation

Present and Future of GIS Technology (Jong Hun Lee, ETRI)

14:00 - 14:40 RS Technology in the Next Generation

Analysis and Visualization of Large-Scale Multidimensional Data Sets (Dmitry Varlyguin, RESAC)

14:40 – 14:50 Coffee Break

- **Session 3 International Experiences in GIS Business and Policy**

Moderator : Jong -Hyun Park (ETRI)

14:50 - 15:30Case Study - Canada (Stefan Palko, Geomatics)

15:30 - 16:10 Case Study - Japan (Shibasaki, Tokyo Univ.)

16:10 - 16:50 Case Study - China (Jun Chen, CAGIS)

16:50 – 17:00 Coffee Break

- **Panel Discussion**

Moderator : Hae Yeong Bae (Inha Univ.)

17:00 – 17:40 Outlook and Challenges in NGIS

Panelists: Sang Dae Gwon(MOTC), Hyeong Min Yeom (KRIHS),
Jae Mun Park(MIC), Jong Hun Lee(ETRI),
Sang Deuk Han(NGI), Eun-Hyung Kim(Kyungwon Univ.),
Do Hun Lee (KOGIS)

17:40 - Concluding Remarks and Questions

1. 차세대 GIS 기반 응용기술의 이해

(이기원, 한성대)

New Geo-spatial Technologies: Overview

2002. 11. 08.

Kiwon Lee

Dept. of Information Systems
Hansung University, Seoul
Tel: 02-760-4254
E-mail: kilee@hansung.ac.kr

Contents

- *Market Signals*
- *Chronicle*
- *OGC and "Open" Concept revisited*
- *GML*
- *Geo-VRML*
- *LBS*
- *New Grid Coverage Sources*
- *Summary: New(or Current) Applications*

Addressing Market Signals

- ***Diminishing use of the term "GIS"***
- ***The increasing use of "spatially enabled enterprise services", "location services" and "location-based services".***
  - *where geographic information and processing is no longer primarily an end in itself*
  - *but is justified in terms of the services brought to businesses and consumers in the much larger marketplace - route planning, route guidance, geo-coding, gazetteer services, geo-parsing, proximity-based advertising, locating points of service…...*
- ***For OGC to institute successful business approaches to better integrate spatial into the wider set of business requirements.***
  - *Extend relationship with business components in enterprise marketplace including businesses dedicated to telephony, wireless services, broadband, voice technologies, devices, content providers, in-car systems, locating services, billing, privacy, and security, among others*

Market Change using Spatial Technology

Stove-piped, central:

- ***GIS***
- ***Earth Imaging***
- ***CAD***
- ***AM/FM***
- ***Navigation Sys.***

Few users, few sources

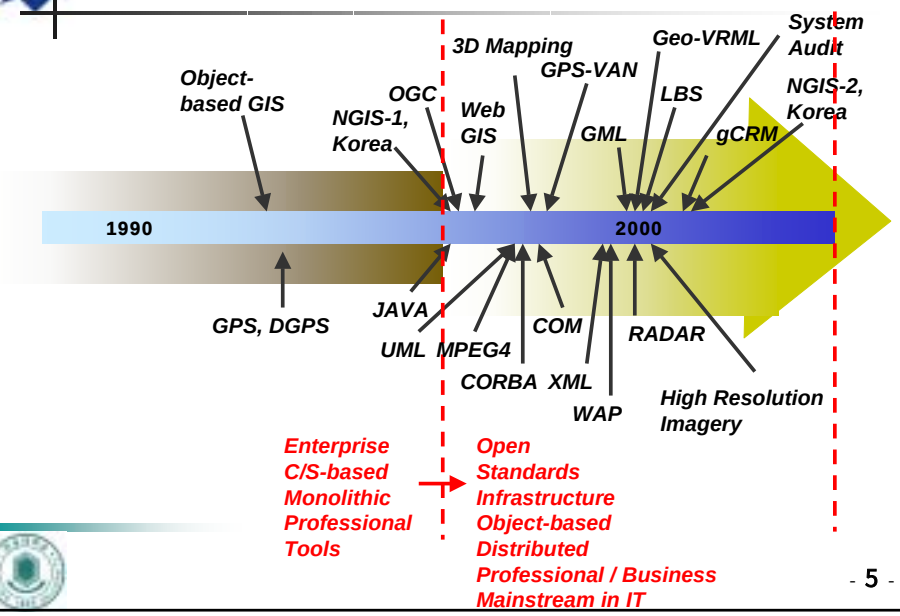
Open, distributed:

- ***Web access to "views"***
- ***Live map links, live data links***
- ***Geo-Application Service Providers***
- ***Location Services for position-aware devices***
- ***Non-visual geospatial services***

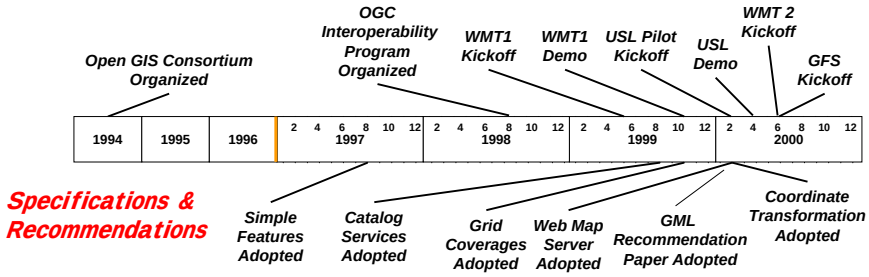
Many users, many sources, Geospatially en abled markets driven by <u>communications</u>!

" *Ubiquitous Geospatial Information' will empower individuals and nations to become better informed and act more intelligently for the good of all. It is a vision of the not too distant future that will improve the health, wealth, and security of individuals, communities, and nations around the globe."*

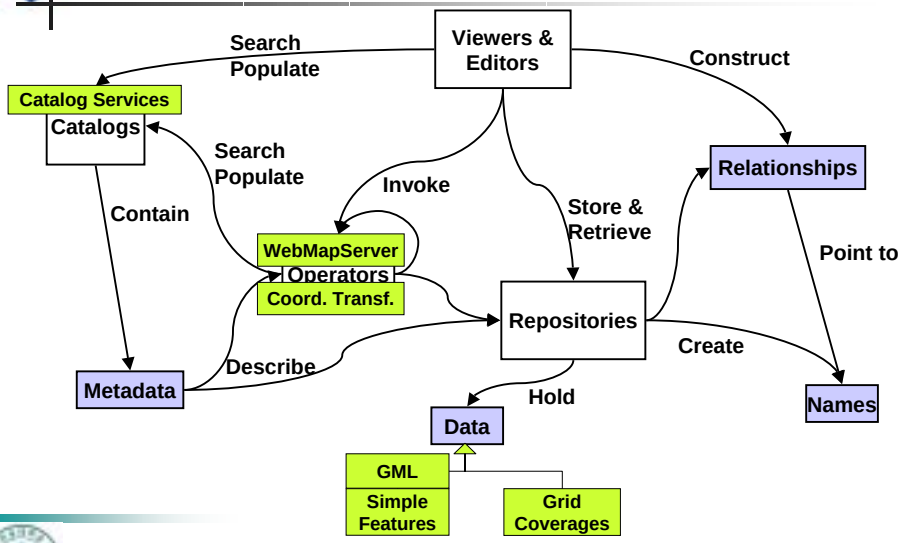
Chronicle



OGC Activities



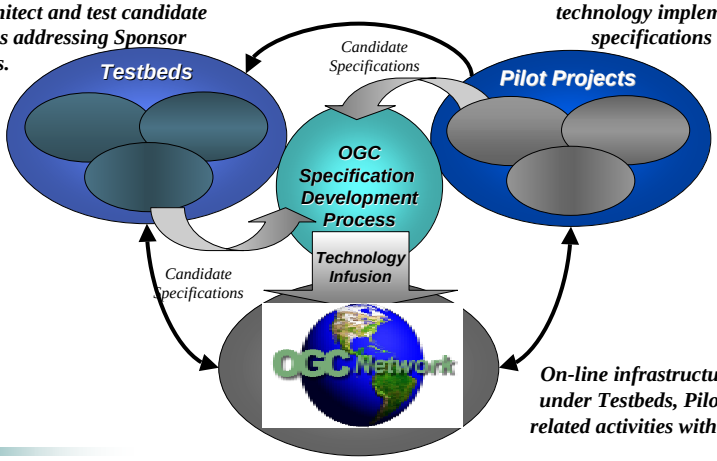
OGC Specifications: Block



OGC Interoperability Program

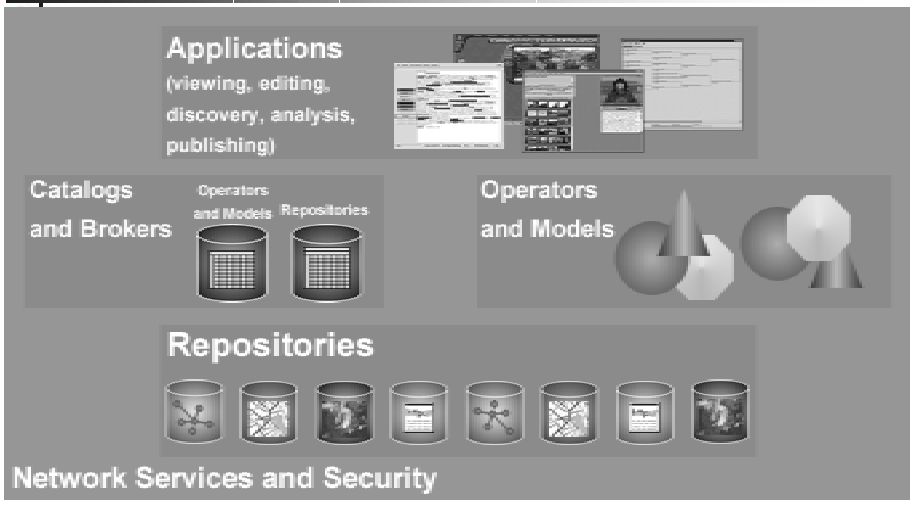
Collaborative, applied R&D efforts develop, architect and test candidate specifications addressing Sponsor requirements.

Collaborative efforts apply technology implementing OGC specifications to real world situations.

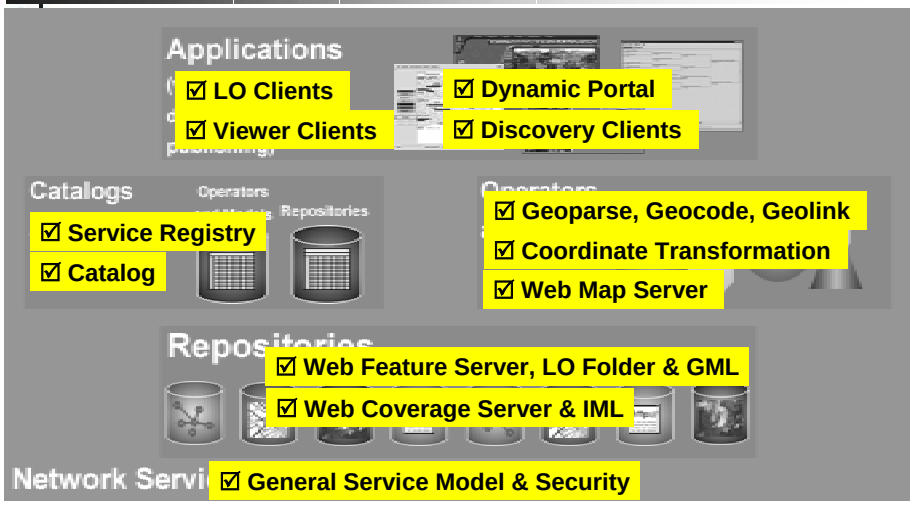


On-line infrastructure developed under Testbeds, Pilots, and other related activities within geospatial community.

How "Open" is Defined : Services(1)



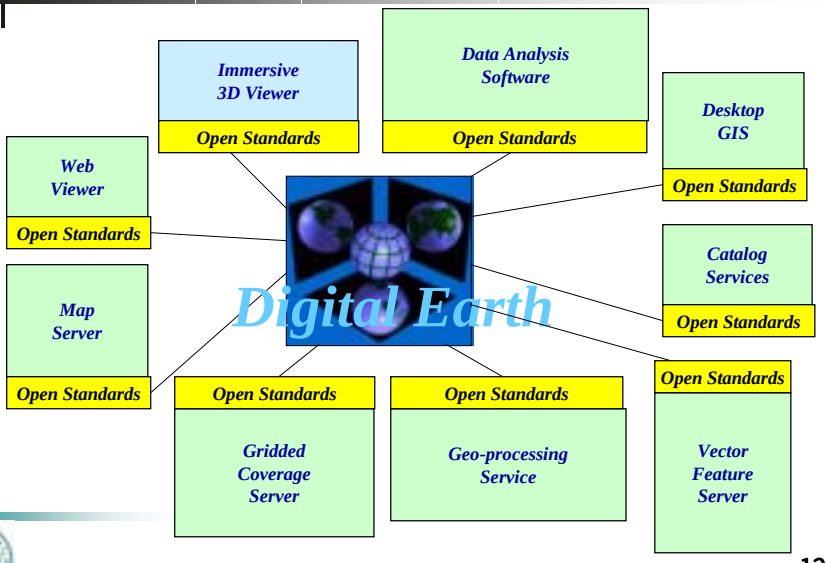
How "Open" is Defined : Services(2)



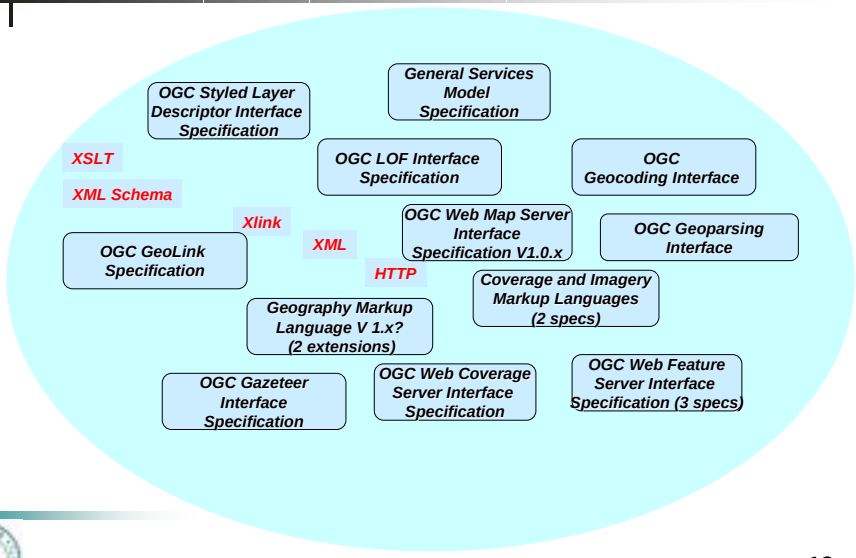
OGC Functional Process

Specification Development Program	Interoperability Program	OGC Global Initiatives
Open GIS Consortium Technical Committee SIGs & WGs Abstract Specification Implementation Specifications Planning Committee	Feasibility Studies Test Beds Pilots Insertions Studies	Location Services Geospatial Fusion Web Mapping

Conceptual Digital Earth Architecture : Global Initiatives



New Technology Orbiting Around XML in OGC

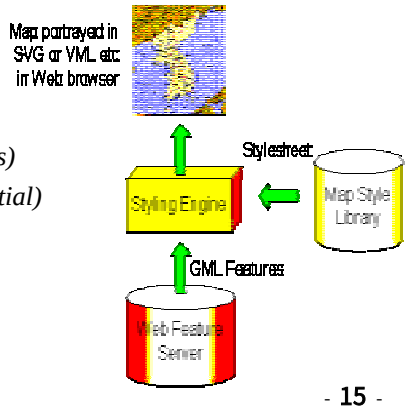


GML (Geography Markup Language)

- *XML-based encoding standard for geographic information developed by the Open GIS Consortium (OGC), Inc.*
- *Supported by a variety of vendors; Oracle corp., Galdos, MapInfo, CubeWerx ...*
- *A simple text-based encoding of spatial features that can be understood anywhere*
- *Implemented and tested as a part of OGC's WMT (Web Mapping Test Bed), involving GML mapping client and interacting with GML data servers and services providers*
- *GML encodes 'Feature Geometry and Properties' and 'Spatial Reference System'*
- ***GML is … based on XML of W3C***
  - *Feature Collection*
  - *An effective means for transporting geo-information from one place to another, as well as storage format, by Xlink and Xpointer*
  - *Transformation the WWW, by using XSL and XSLT*
  - *Transformed into one of graphical vector formats such as SVG(Scalable Vector Graphics), VML (Vector Markup Language), or X3D*
  - *Easy to generate and validate complex hierarchical data structures for spatial information applications*

Why GML …

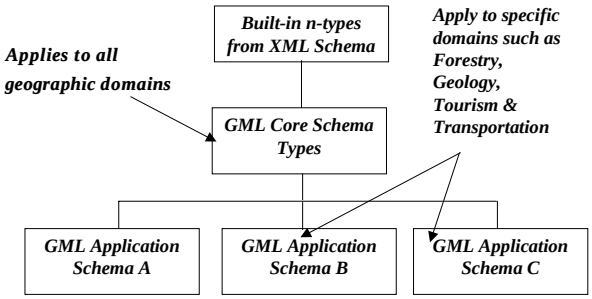
- *Automated verification of data integrity*
- *Can be read by public tools and easily edited*
- *Can readily integrate with non-spatial data, and transformable*
- *Can transport behaviors*
- *Allows us to leverage the world of XML*
  - *Graphical Drawing (2D and 3D)*
  - *Querying and Element Selection*
  - *Meta-data & Relationships (Semantics)*
  - *Transformations (spatial and non-spatial)*



GML Technical Objectives

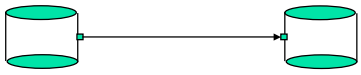
- *Provide a schema language for geo-spatial features.*
- *Encode geometry of geo-spatial features.*
- *Encode non-geometric properties of spatial features.*
- *Encode feature relationships supportable in a wide area network context.*
- *Enable simple and sophisticated spatial queries & analysis over the Internet.*
- *Enable styling of complex data sets using public and standard mechanisms.*
- *Provide the foundations for Geo-Spatial World Wide Web.*

GML & Typing Framework



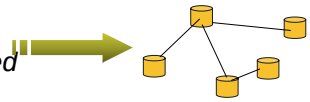
- *GML does not describe presentation – there are no colours or line styles in GML.*
- *Presentation must be added by a style mechanism.*
- *Style mechanisms using XSLT are available.*
- *OGC is developing standard style descriptions in XML.*

GML Scope



Spatial Data Interchange

Building/querying complex distributed spatial datasets

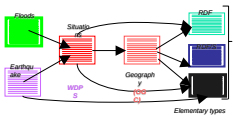


Facilitating open standards for Map Styling & Symbology

Foundation for a comprehensive distributed spatial infrastructure based on XML and related Web technologies.

GML Scope

Facilitating open standards for spatial querying and analysis



Laying the foundations for a spatial semantic-web

Providing a framework for open spatial reference system dictionaries & coordinate transformation services

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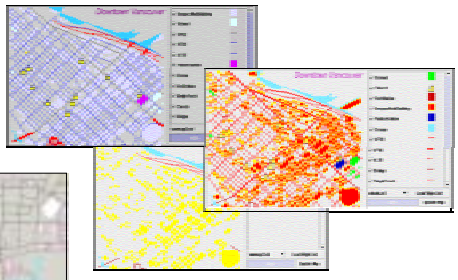
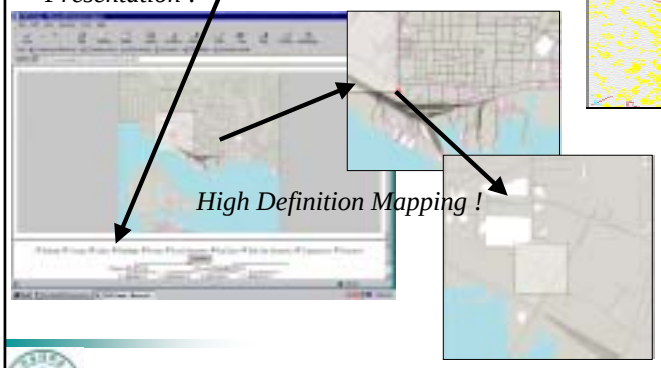
GML Mapping Examples

Maps display in a standard browser web page!

GML Separates Content & Presentation !



Same spatial data – many different styles !



High Definition Mapping !

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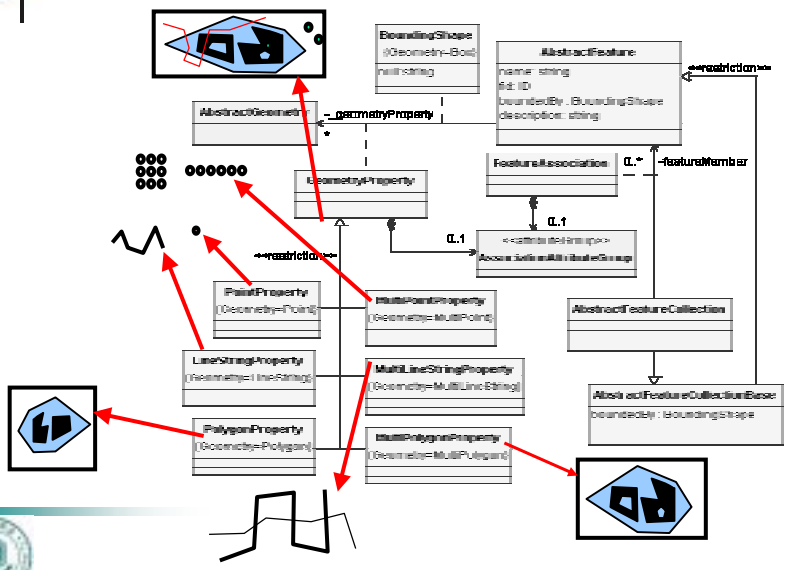
GML Feature Model in UML



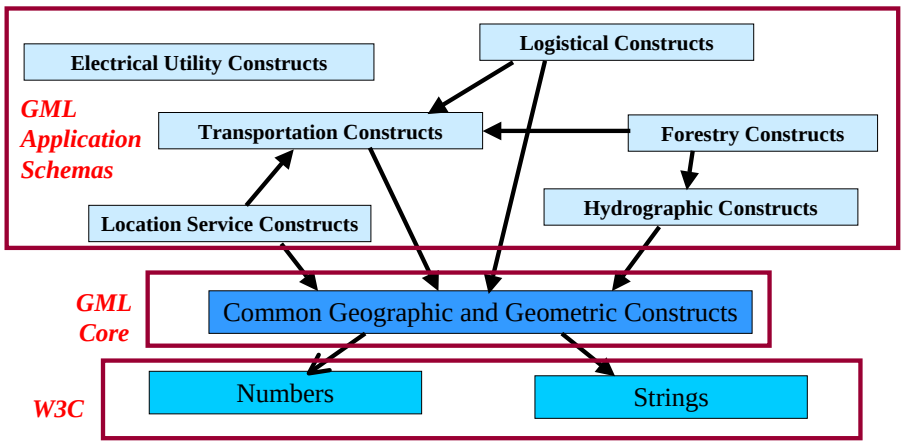
GML 3.0 …

- *GML 3.0 – Anticipated for October 2001*
- *Converge with G-XML (Japan)*
- *Many new features including:*
  - *Topology*
  - *3D and non-linear geometries*
  - *Coverages*
  - *Temporal support*
  - *Metadata support*
  - *Units of Measure*
  - *Default Styling*
  - *Points of Interest/LBS Support*

GML Software Components

- *Web Feature/Map Server(s)/ GML Connectors*
- *Web Coverage Servers*
- *Data Management Tools*
- *Map Styling Engines/Symbol Libraries/Map Style Libraries/Map Style Editors*
- *Transformation Engines*
- *Coordinate Transformation Engines*
- *Geo-coders, Gazetteers, Geo-parsers*
- *Annotation Editors*
- *Conversion Tools*
- *Relationship Editors*

Information Community



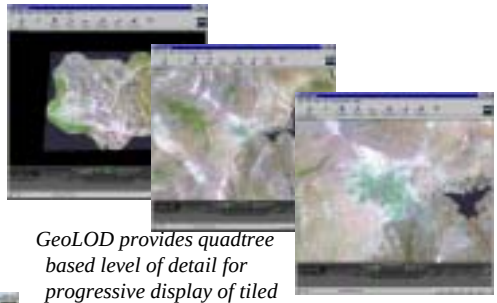
GML Applications

- *Internet Mapping (e.g. MapQuest)*
- *Internet Based Situation Management*
  - *Disaster Management*
  - *Accident & Police Investigation*
  - *Emergency Services*
- *Public/Private systems for Land Titles/Leases/Permits.*
- *Location based services for wire & wireless users.*
- *Internet GIS and GIS Portals*
- *Private, Municipal and other Government Services ASP's*

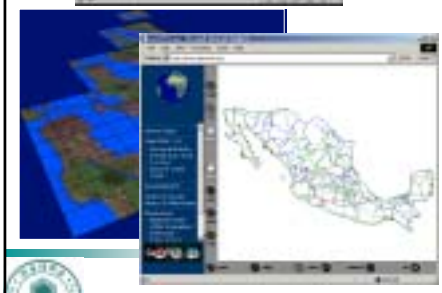
What is GeoVRML?

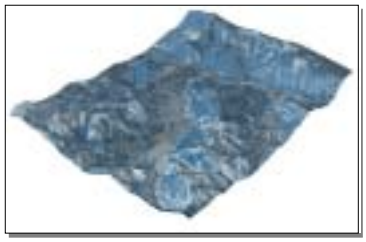
- *GeoVRML <- Web3D Working Group*
- *GeoVRML is also a file format*
  - *Based on the ISO Virtual Reality Modeling Language (VRML97)*
  - *Extra features for supporting geographic applications*
  - *Browsable in most standard VRML Browsers within Internet Explorer and Netscape Communicator*

GeoVRML Screenshots



GeoLOD provides quadtree based level of detail for progressive display of tiled multi-resolution terrain





ISO Standardization

- *GeoVRML nodes added to Amendment 1 of the VRML97 ISO specification (in final review cycle)*
- *GeoVRML nodes added to the X3D specification as the Geospatial Profile*
- *GeoVRML DTD produced for X3D*

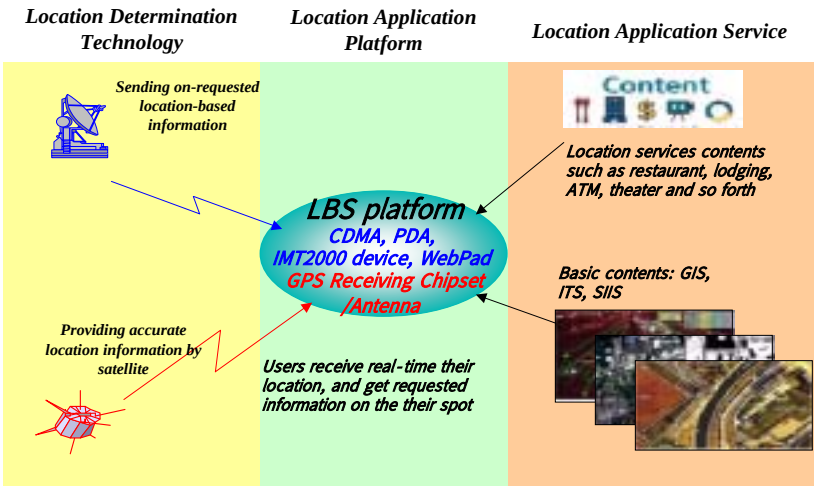
- *OGC creates de facto standards for interoperability of GIS data*
- *Geographic Markup Language (GML)*
  - *Representation of geographic features*
  - *GeoVRML could be a presentation layer*
- *Web Map Server (WMS)*
  - *Standard interface for serving map data*
  - *SRI WMS supports the GeoVRML format*

LBS

- ***LBS***
  - ***Location Based Service(s)***

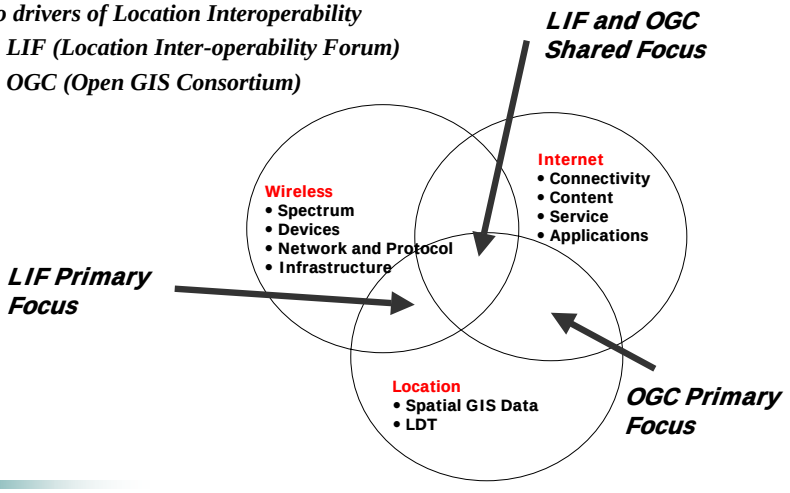
- *The ability to find the geographic location of the mobile device and provide based on the location information*
- *Real-time(Anytime) access of location(Where) information, and multi-platform S/W Services for these functionalities*

Technology Components for LBS

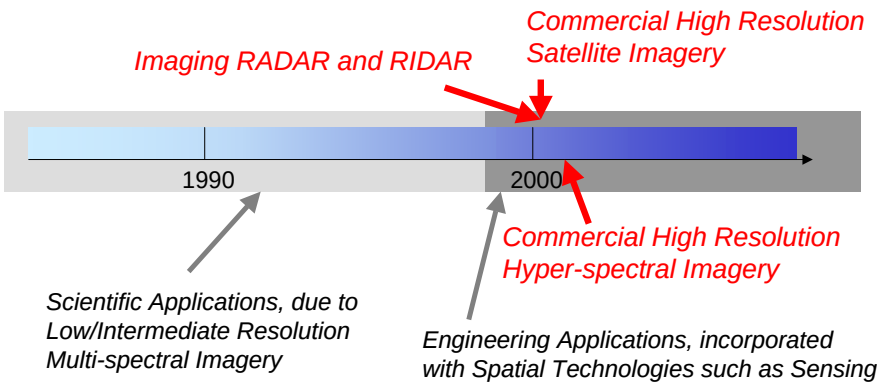


Location-specific Standards for LBS

- *Two drivers of Location Interoperability*
  - *LIF (Location Inter-operability Forum)*
  - *OGC (Open GIS Consortium)*



New Grid Coverage Data Sources



Commercial High Resolution Satellite Imagery

Satellite	Launch (Planned)	Operator	Capability	Swath Width
IKONOS 2	1999	Space Imaging	0.82-1PAN/4MS	13/13
QuickBird 2	2000	EarthWatch	1PAN/4MS	22/22
OrbView 4	2000	Obimage	1PAN/4MS/8HS	8/8/5
RADARSAT-2	2002	MDA, Canada	3SAR	50-500
SPIN-2	Periodic	Russia	2PAN/10PAN	180-200
SPOT-5	2002	SPOT Image	2.5PAN/10MS	60/60
ALOS-1	2003	Japan	2.5PAN/10MS/SAR	70/70/70
KOMPSAT-2	2003	KOREA	1PAN/4MS	
ROESAT-2	2002	Taiwan	2PAN	
CEMD	2003	China	4SAR	700
Aries	2003	Australia	10PAN/30HS	15/15
CartoSAT-2	2003	India	1PAN	
SING-1	2003	Singapore	1PAN	
TURKSAT	2003	Turkey	1PAN	

• • • • • •

Data Fusion in Spatial Applications Examples: NCRST Program, US

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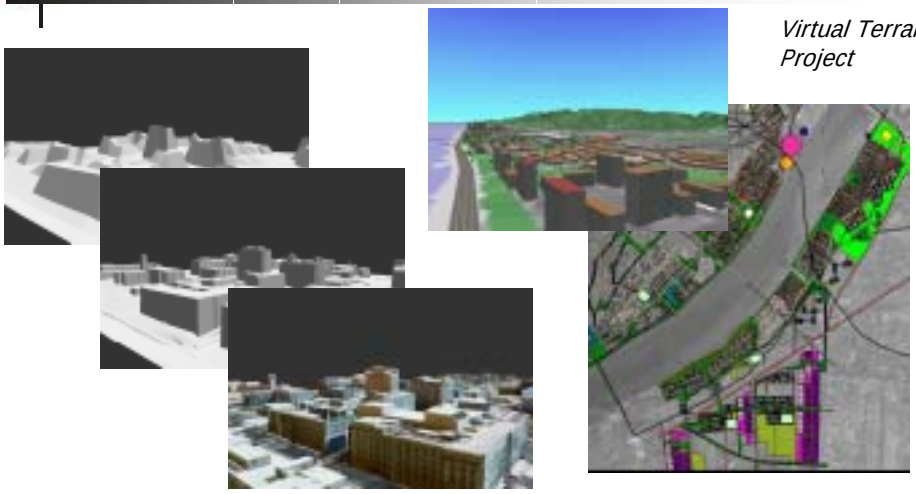
Data Fusion with Multiple Sources

Virtual Terrain Project



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Summary: New (or Current) Applications

- *Data Acquisition System for Mobile Mapping*
  - *4S VAN or GPS-VAN …*
- *Mobile Applications Systems*
- *LBS*
- *ERP with Spatial Information*
  - *gCRM …*
- *Open Data Mining with Distributed Resources*
- *3D/4D Applications*
- *High-end Applications by Multi-sources Data Fusion*

2. 제2차 국가GIS 사업 추진방향

(권상대, 건설교통부 NGIS 팀장)

NGIS 추진현황 및 계획

2002. 11

건설교통부 / 권상대

순 서

- NGIS 기본계획의 의의와 특성
- 제2차 국가지리정보체계(NGIS) 기본계획
- 계획의 집행 및 관리
- 결 론

NGIS기본계획의 의의와 특성

NGIS 기본계획의 의의와 특성

■ 기본계획 수립당시('95) 한국의 GIS 수준 및 상황

- 각 지자체 및 국가기관에서 개별적으로 GIS 진행
  - → 기본도 데이터베이스의 중복구축
  - → 활용체계의 개발도 초보수준
  - → GIS의 본격적 도입이 아닌 단순사안 해결을 위한 방편으로 인식
- GIS관련 소프트웨어 및 DB Tool 등 핵심기술을 외국에 의존

⇩

- ❑ 중복투자로 인한 예산낭비 발생
- ❑ 공간정보이용의 범용성과 호환성 결여
- ❑ 외국에 대한 기술종속 심화

NGIS 기본계획의 의의와 특성

■ NGIS 기본계획의 의의

NGIS 기본계획 수립('95)

개별 기관들이 산발적으로 진행하던 사업을
체계적이고 일관된 계획 내에서 진행하도록 유도

예산의
중복투자 방지

공간정보의
호환성·범용성 확보

체계적인
기술개발, 산업육성

NGIS 기본계획의 의의와 특성 - 단계별 추진전략

제1단계 (1995년~2000년) : GIS기반조성단계

- 민간에 의한 GIS기반조성이 어려운 점을 감안하여 정부주도로 투자 및 지원시책을 적극 추진
- 먼저 지형도, 주제도, 지하시설물도, 지적도 등을 전산화하여 GIS초기수요를 창출하는데 주력
- 공간정보의 표준정립, 관련제도의 정비, GIS기술개발, 전문인력양성, 지원연구 등 GIS기반조성사업 수행

NGIS 기본계획의 의의와 특성 – 단계별 추진전략

제2단계 (2001년~2005년) : GIS활용확산단계

- 지방자치단체와 민간의 참여를 적극 유도
- 공간정보를 활용한 대국민 응용서비스를 개발하여 국민의 삶의 질을 향상시킬수 있는 방안 모색
- 수요자가 공간정보를 손쉽게 취득하여 활용할 수 있도록 하기 위하여 공간정보유통체계 구축

NGIS 기본계획의 의의와 특성 – 단계별 추진전략

제3단계 (2006년 이후) : GIS정착단계

- 공간정보를 편리하게 생산·유통·이용할 수 있는 고도의 GIS활용단계에 진입
- GIS서비스를 극대화하고 GIS활용의 보편화를 실현
- 축적된 공간정보를 활용한 새로운 부가가치산업 창출

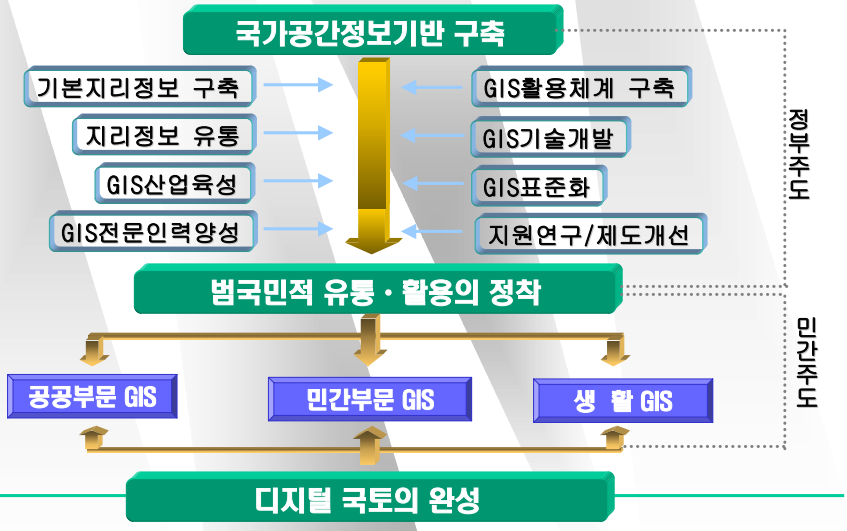
제2차 NGIS 기본계획

목 표

- 국가공간정보기반 확충으로 국토정보화의 기틀 마련
- 지리정보의 전국민 인터넷 유통·활용
- GIS 관련 핵심기술개발과 산업의 육성
- 표준화, 인력양성, 지원연구 등 기반환경 지속개선

범국가차원의 강력한 지원으로
디지털 국토 완성

추진전략



부문별 추진계획 1. 기본지리정보구축

■ 기본지리정보의 개념(NGIS법)

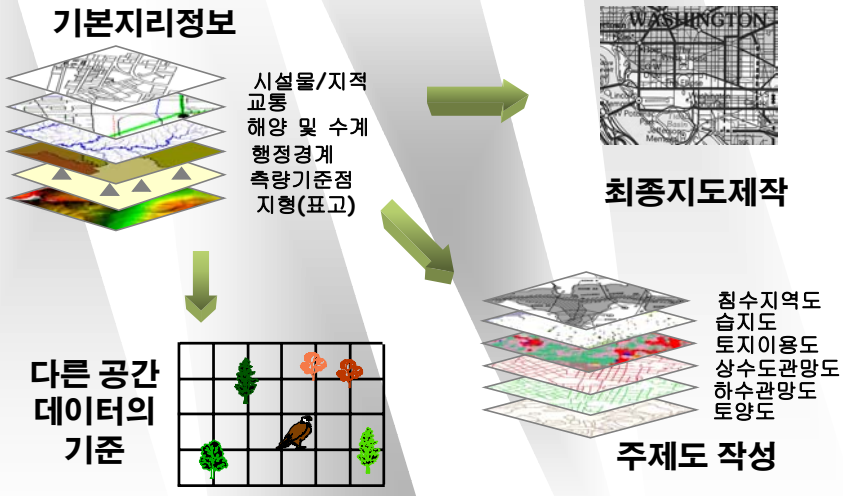
관계중앙행정기관의 장이 국가지리정보체계 효과적인 구축, 관리 및 활용을 위하여 행정구역, 교통, 수자원, 지적 등 대통령령이 정하는 기초적인 주요 지리정보를 기본지리정보로 선정하여 이를 고시

- 대통령령이 정하는 기본지리정보(NGIS법시행령 제15조) -
  행정구역, 교통, 해양 및 수자원(수계포함), 지적, 측량기준점, 지형, 시설물(문화재 포함), 위성영상 및 항공사진

■ 기본지리정보의 특징

다른 지리정보에 공통적으로 포함되어 있거나, 여러 지리정보를 통합하기 위해 위치적 혹은 내용적 참조체계를 제공

부문별 추진계획 1. 기본지리정보구축



부문별 추진계획 1. 기본지리정보구축

■ 목 표

국가지리정보 수요자가 광범위하고 다양하게 GIS를 활용할 수 있도록 가장 기본이 되고 공통적으로 사용되는 지리정보 구축·제공

■ 추진전략

- 국가기준점을 GPS등 신기술을 도입하여 우선 정비
- 지침, 표준, 기준 등의 마련을 위한 시범사업 실시
- 시범사업 결과를 통한 정책, 기술, 제도 예산 등을 포함한 종합적인 추진전략 수립
- 기본지리정보의 신규 제작 및 기 구축된 수치지형도, 관련 지리정보 등을 활용

부문별 추진계획 1. 기본지리정보구축

■ 단계별 추진계획

ㅇ 1 단계 : 기본지리정보 구축 전략수립을 위한 시범사업 수행

- 시범지역을 선정하고 시범연구 및 시범사업을 실시
- 종합적인 추진전략(정책·기술·제도·예산 등 포함) 수립
- 관련 지침, 표준, 품셈 등을 마련

ㅇ 2 단계 : 분야별 본 사업의 추진

- 종합추진전략의 방향에 따라 분야별 지리정보를 구축
- 수치지형도는 주기적으로 유지관리: 1/1,000축척은 매칭펀드, 나머지는 국가부담

부문별 추진계획 2. 활용체계 구축

■ 목 표

중앙부처와 지자체, 투자기관 등 공공기관에서 활용도가 높은 지하시설물, 지하자원, 환경, 농림, 산림, 해양,통계 등 GIS활용체계 구축

■ 추진전략

ㅇ 제1차 NGIS사업으로 추진중인 활용체계개발사업의 지속적 추진

ㅇ 지하시설물 관리시스템 개발확대

- 상하수도는 19개 거점도시를 2002년까지 완료하고 전국도시지역으로 확대

ㅇ 환경, 농림, 산림, 해양, 통계 등 분야별 지리정보를 단계적으로 구축

ㅇ 각종 GIS활용체계의 호환성을 고려한 작업지침, 데이터 형식, 표준품셈 등 제반여건 마련

ㅇ 공공・민간의 활용체계 구축지원

부문별 추진계획 2. 활용체계 구축

■ 중앙행정기관에서 추진중인 GIS활용체계

활용분야	사업명	시행기관
토지이용 지리정보	토지관리정보체계	건설교통부
	농촌지형정보체계	건설교통부
	통계지리정보체계	해양수산부
	산업지리정보체계	산업자원부
수자원 지리정보	하천지도전산화	건설교통부
	물환경정보화	환경부
	지하수정보관리체계	건설교통부
	농촌용수물관리정보화	농림부

부문별 추진계획 2. 활용체계 구축

■ 중앙행정기관에서 추진중인 GIS활용체계 (계속)

활용분야	사업명	시행기관
지하시설물 지리정보	도로와지하시설물통합 DB구축	건설교통부
	광역상수도종합관리체계	건설교통부
	항만지하시설물DB구축	해양수산부
	산업단지GIS 구축	산업자원부
지하 지리정보	국도건설종합지반DB구축	건설교통부
	문화재 지리정보체계 구축	문화재청
	폐탄광지리정보체계	산업자원부

부문별 추진계획 2. 활용체계 구축

■ 중앙행정기관에서 추진중인 GIS활용체계 (계속)

활용분야	사업명	시행기관
환경농림 지리정보	토지피복지도구축	환경부
	자연환경종합GIS구축	환경부
	산림지리정보체계	산림청
	화학물질사고대응정보체계	환경부
	대기환경예측평가시스템	환경부
	농업토양환경정보DB구축	농촌진흥청
해양수산 지리정보	연안관리정보체계	해양수산부
	환경관리해역 의사결정지원체계	해양수산부
	해양관광정보 관리체계	해양수산부

부문별 추진계획 3. 지리정보유통

■ 목 표

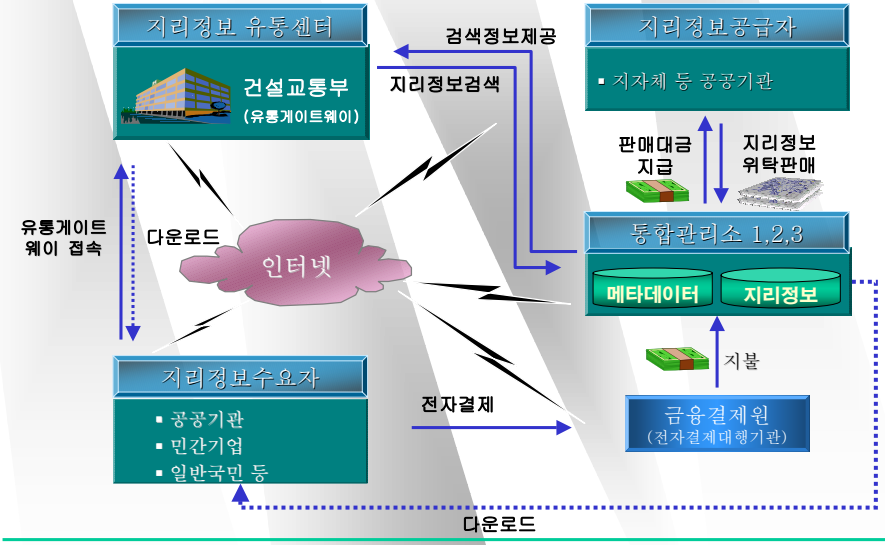
○ 구축된 지리정보를 인터넷 등 전자적 환경으로 수요자에게 신속·정확·편리하게 유통하는 선진 유통체계의 구축

■ 추진전략

○ 21세기 초고속 정보유통 시대의 도래에 따른 선진형 지리정보 유통체계의 구축을 위한 한국실정에 맞는 유통망 추진

- 수치지형도 등 기구축된 지리정보를 우선 유통하고 기본지리정보 등으로 유통정보의 범위를 확대
- 최종수요자인 국민 위주의 지리정보 서비스를 위한 가격정책·구입방식·표준·유통모델·품질보증 등의 결정 및 시행

부문별 추진계획 3. 지리정보유통-개념도



부문별 추진계획 3. 지리정보유통

■ 중점 추진과제

○ 지리정보유통 기반구축

- 지리정보 유통을 위한 정보보호·인증·보안정책 연구
- 전국적인 유통망 및 관리기구 설치방안 수립
- 유통되는 지리정보의 정확도·활용도 등에 대한 평가분석

○ 전국적인 유통망의 구축 및 관리기구의 설립·운영

- 지리정보 생산자 및 관련기관 합동의 실무협의체를 구성하여 기본방향 협의 (유통정보의 범위·메타데이타 표준·가격정책·상거래방식·유통망형태·유통관리기구의 기능·조직운영 등을 협의,추진)

부문별 추진계획 3. *지리정보유통*

■ 중점 추진과제(계속)

○ 전국적인 유통망의 구축 및 관리기구의 설립・운영(계속)

- 정보유통에 필요한 제도・기술 측면의 환경을 정비

1. 접근제한(항공사진, 수치지도 등), 소유권 및 사용권, 국내외 정보유통체계와 연계 등 제도적 보완사항을 발굴 정비
2. 초고속 국가망과 공중망의 사용, 메타데이타 및 정보제공 표준, 이기종호환 등 기술적 문제점에 대한 연구와 대안의 제시

○ GIS사업 및 연구개발 성과물의 유통을 위한 GIS전자도서관 구축・운영

- 지식정보 인터넷 서비스 공급방안, 운용방안 등의 표준모델 연구
- GIS전자도서관 확대 구축 및 국내외 공간정보유통관리기구와의 연계, 고도화

부문별 추진계획 3. *지리정보유통*

■ 단계별 추진계획

○ 1단계 : 본사업 수행에 앞선 시범사업 실시 및 실무협의체 구성

- 유통시스템(게이트웨이, 시범노드, 전자상거래, 보안 등)구축
- 지리정보 유통시범실시 : 수치지형도, 항공사진, 토지이용현황도, 토지특성도 등 유통이 시급한 지리정보에 대하여 우선 유통

○ 2단계 : 전국적인 유통망구축 운영

- 기본지리정보 및 GIS활용체계 지리정보의 본격적인 유통

○ 3단계 : 다양한 지리정보 유통서비스 제공 및 유통체계의 고도화 추진

- 유통되는 지리정보의 내용 및 방식의 다양화
- 효율적인 유통노드 체계를 구축・확산하는 등 유통체계 고도화

부문별 추진계획 4. 기술개발

■ 목 표

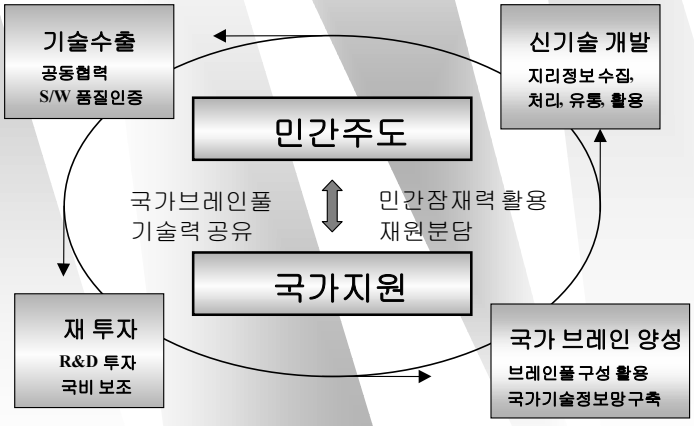
- 국가차원의 GIS 기술개발에 대한 지속적인 투자로 국가GIS 사업의 성공과 해외 기술수출 원천을 제공
- 지리정보의 수집·처리·유통·활용 등과 관련된 다양한 분야의 핵심 기반기술을 단계적으로 개발

■ 중점개발기술

- S/W 및 IT 기술 : 지리정보 인터넷 연계 기술 개발
  공간지리정보 가공·처리 및 통합 기술 개발
- 장비 및 부품 : 공간지리정보 수집·활용을 위한 장비 및 부품개발
- 측량 및 기타 : 지리정보의 수집 추출(Sensing) 기술 개발
  분야별 지리정보 활용 지원을 위한 응용 기술개발

부문별 추진계획 4. 기술개발

■ GIS 기술개발 순환과정



부문별 추진계획 5. GIS산업육성

■ 목표

- 국토 정보의 디지털화라는 국가GIS기본계획의 비젼과 목표에 상응하는 GIS 산업의 육성

■ 중점 추진과제

- GIS 산업육성 및 지원방안에 관한 연구를 수행하여 법제도 정비
- GIS산업을 지식기반 산업에 포함하고 전문 중소기업 발굴·육성
- 국내 GIS 기반기술의 수출지원 시책 적극 추진
- 공간정보를 효과적으로 이용하기 위한 활용분야 및 서비스 개발

부문별 추진계획 6. GIS 표준화

■ 목 표

- 자료·기술의 표준과 함께 지리정보생산·업무절차 및 GIS 활용 공통모델개발 표준화 추진
- ISO, OGC 등 국제표준 활용의 지속적 참여로 국제 표준화 동향을 모니터링하고 국제표준을 국내표준에 반영

■ 추진전략

- 수요에 입각한 국가GIS 표준 통합체계 마련
- 연차별 표준화 추진계획의 수립과 표준화 업무분장
- 표준의 영역을 자료·절차·기술표준으로 정립
- 연구사업의 지속추진과 국제협력의 강화

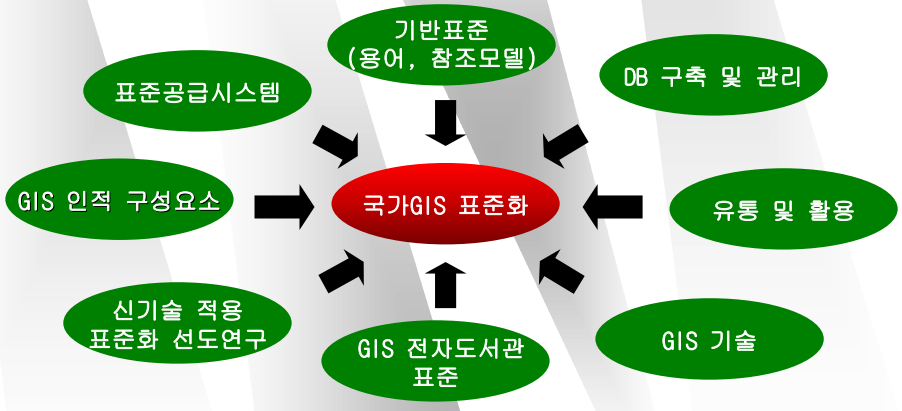
부문별 추진계획 6. GIS 표준화

■ 국가GIS표준의 제정절차

표준안 연구개발 및 제안	(관련기관 및 이해관계인)
↓	
표준안 검토·보완 및 개발	표준화분과위원회 분야별 소위원회
↓	
표준안 심의	표준화분과위원회
↓	
국가GIS 표준	표준제정(정보통신 단체표준)

부문별 추진계획 6. GIS 표준화

■ 국가GIS표준 사업내용



부문별 추진계획 7. 전문인력양성 및 홍보

■ 목 표

- GIS 교육 전문인력 양성기관의 다원화 및 GIS 교육 대상자 특성에 맞는 교육 실시
- 산·학·연 협동의 GIS 교육 네트워크를 통한 원격교육체계 구축
- 대국민 홍보강화로 일상생활에서 GIS의 이해와 활용촉진

■ 추진전략

- GIS 교육기관의 다원화·차별화 → 다양한 교육기회
- 학교중심의 교육을 강화
- GIS 교육홍보센터 설치·운영
- 다양한 대국민 홍보전략의 수립 및 시행

부문별 추진계획 7. 전문인력양성 및 홍보

■ 추진계획

- GIS 인력기관의 다원화
  - 수요자 중심의 권역별 인력양성기관 육성 및 다원화
  - GIS 관련학과가 있는 대학을 지정, 권역별 GIS교육센터로 활용
  - 피교육자 수준 및 특성에 맞는 다양한 교육기회 제공
  - 선진국과의 기술교류를 통한 첨단기술 습득기회 확대
- GIS 교육방법의 다원화
  - 단기적으로 Off-Line 교육을 시행
  - 점진적으로 인터넷을 이용한 On-Line 교육환경 구축

부문별 추진계획 7. 전문인력양성 및 홍보

■ 추진계획(계속)

- GIS 교육지원 및 교재개발
  - 학교교육 지원 및 프로그램 개발
  - GIS 교육과정별 교재의 기본모형 개발 및 보급
- GIS 홍보
  - GIS 홍보센터 설치·운영
  - 다양한 홍보전략의 수립 및 시행
  - 매년마다 GIS 대회 개최

부문별 추진계획 8. 지원연구 및 제도개선

■ 목 표

- 국가 GIS 사업의 효율적 추진에 필요한 지원연구 추진
- 불합리한 제도의 개선 및 보완
  - 지리정보의 생산·가공·유통·활용 등 전단계에서 활성화 될 수 있도록 「국가지리정보체계의구축및활용등에관한법률」을 중심으로 정비

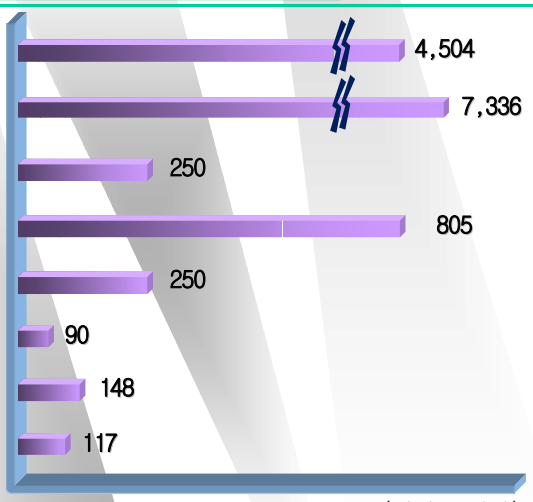
■ 중점 추진과제

- 국가 GIS지원연구의 체계적인 수행
  - 정책·기술·지자체·평가로 나누어 분야별로 수행
  - 체계적인 연구를 위한 추진체계 마련
- 국가GIS 사업추진을 이한 제도의 지속적인 개선
  - GIS 감리제도 도입, 측량제도 개선, 위성영상의 활성화를 위한 제도정비

투자규모

부문별 투자소요(추정)

- 기본지리정보의 구축 및 유지관리
- GIS활용체계 구축 및 유지관리
- 지리정보유통체계 구축
- 국가GIS 기술개발
- GIS 산업육성
- 국가GIS 표준화
- GIS전문인력 양성 및 홍보
- 지원연구 및 제도개선



(단위 : 억원)

※ 전체 사업기간중(2001~2005년) 총 13,500억원의 투자 비용 소요 전망

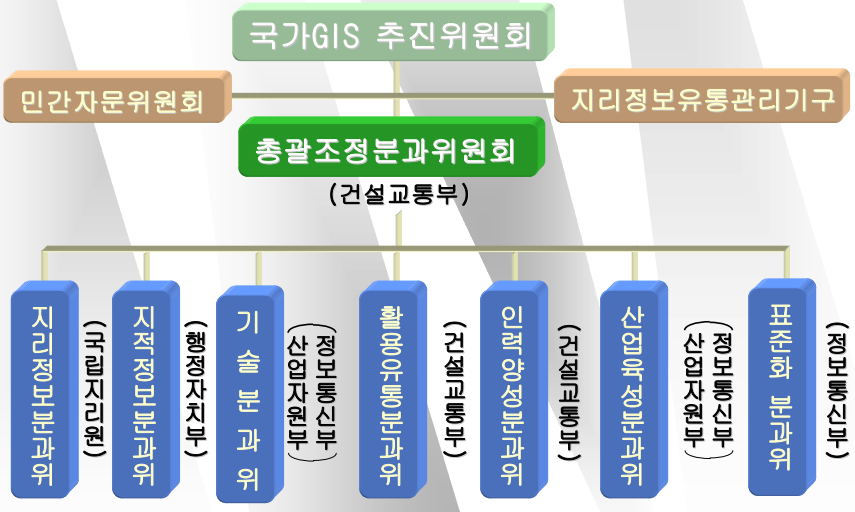
계획의 집행 및 관리

계획의 집행 및 관리 - 계획수립 및 시행

「국가지리정보체계의구축및활용등에관한법률」에 의거하여 기본계획과 연도별 시행계획을 수립·시행·평가

- 정부(건설교통부)는 5년 단위의 국가GIS 기본계획을 수립
- 관계중앙행정기관의 장은 매년 시행계획 수립 후 실적을 평가
- 지방자치단체의 장은 기본계획 및 시행계획의 내용에 따라 매년 지역별 시행계획을 수립·시행

계획의 집행 및 관리 - 추진체계



계획의 집행 및 관리 – 예산중복방지

■ 예산중복방지를 위한 사전예산협의

국가GIS 사업의 추진에 필요한 분과별·부처별 예산을 협의하여 사업의 중복을 방지하고 투자효율을 제고

- 근거 : 국가지리정보체계의구축및활용등에관한법률 제6조
- 단계별 예산 사전협의방안
  - 1 단계 : 실무협의회를 통한 협의(안) 작성
  - 2 단계 : 국가GIS 추진위원회 상정 및 심의

계획의 집행 및 관리 – 평가

■ 국가GIS 투자에 대한 효과평가

국가GIS사업의 추진에 따른 사업별 투자효과를 매년 체계적으로 평가하고, 이를 통해 문제점과 개선방안을 마련함으로써 투자효율을 극대화

- 근거 : 국가지리정보체계의구축및활용등에관한법률 제6조
- 평가결과를 활용하여 매년 계획상의 문제점 및 사업추진상의 문제점을 도출
- 기본계획 및 시행계획에 이를 반영·조정하는 연동계획 (rolling plan)의 수립·시행

결 론

결 론 GIS의 발전전망

- GIS의 중심이동

공공부문 GIS 중심 → 민간부문의 비중 확대

- GIS와 타 정보통신 기술의 결합

Web - GIS
LBS
GIS
Telematics
ITS

결 론

GIS를 활용한 민간부분 서비스

분 야	기존 서비스	향후 서비스
Web-GIS	- 기본지도서비스 - 관광/여행정보 - 고객관리/매물정보	- 위성영상을 이용한 지도서비스
Telematics	- 차량의 현재위치 - 경로탐색 - 원격차량진단	- 실시간 교통정보 - 자동차량항법
ITS	- 대중교통 생활정보 - 실시간 교통정보	- 실시간 교통제어 서비스 - 돌발상황감지서비스 - 안전운전지원서비스 - 위험물차량관리서비스
LBS	- 현재 위치 서비스 - 친구찾기	- 응급환자 확인서비스 - 위치기반 광고서비스

결 론

■ 향후 정책방향

GIS 발전방향에 맞는 정책의 계속적 발굴

GIS 연계방안 마련 등 기본계획 추진상의 문제점 개선

GIS를 활용한 서비스 확대를 위해 국가와 민간의 역할정립

3. 디지털 국토 구현을 위한 GIS 활용 및 연구방향

(정문섭, 국토연구원)

제7차 GIS국제세미나

사이버국토 건설을 위한 국가GIS사업 활성화방안

2002. 11

국 토 연 구 원
GIS연구센터
정 문 섭

KRIHS Korea Research Institute for Human Settlements

목 차

I. 국가GIS사업 추진경과

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국가GIS사업 추진경과

국가GIS Vision

- 제1차 국가GIS사업 : GIS 기반조성
- 제2차 국가GIS사업 : 공간정보의 범 국민적 유통 · 활용

국가공간정보기반(National Spatial Data Infrastructure) 구축 및 사이버국토 건설 기반조성

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국가GIS 추진목표

- 제1차(1995~2000) : GIS기반조성
- 제2차(2001~2005) : GIS활용확산
- 제3차(2006~2010) : GIS정착/사이버국토건설

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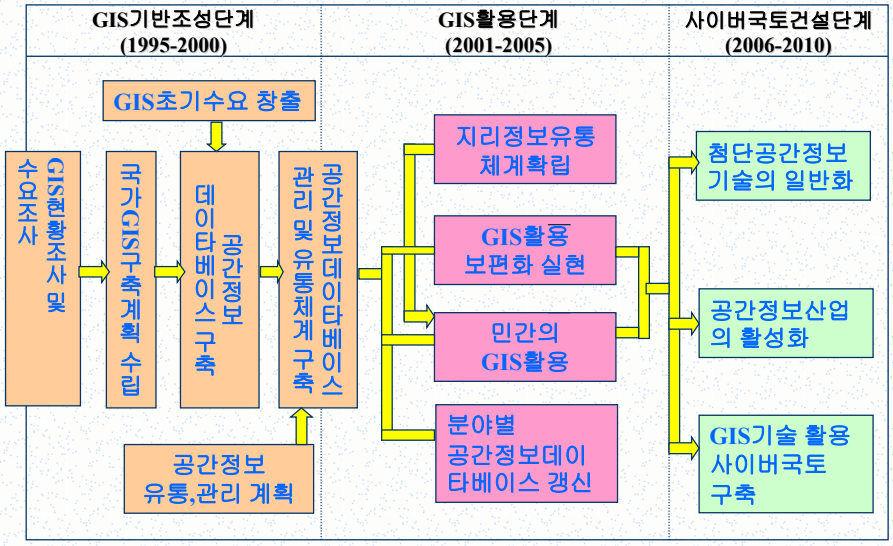
국가GIS 추진단계



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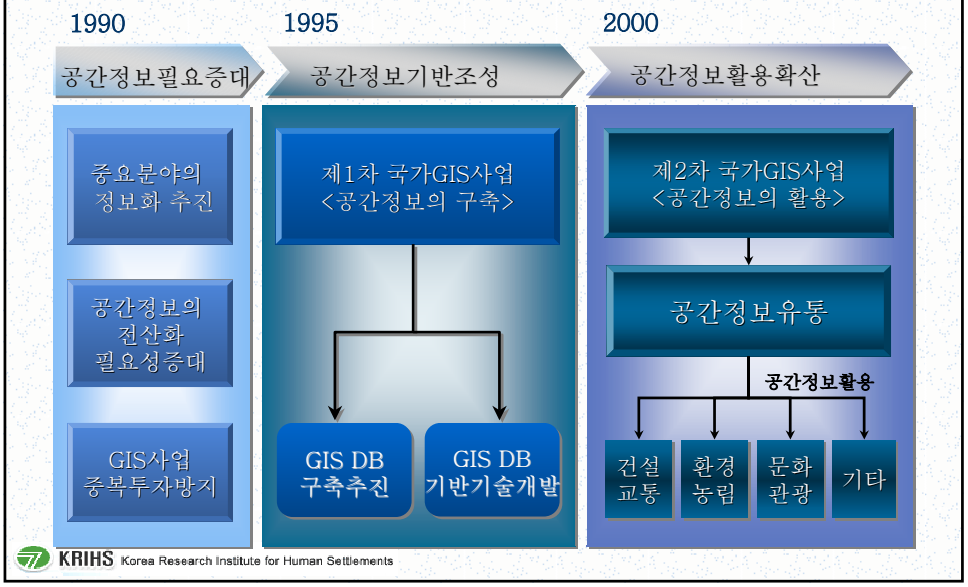
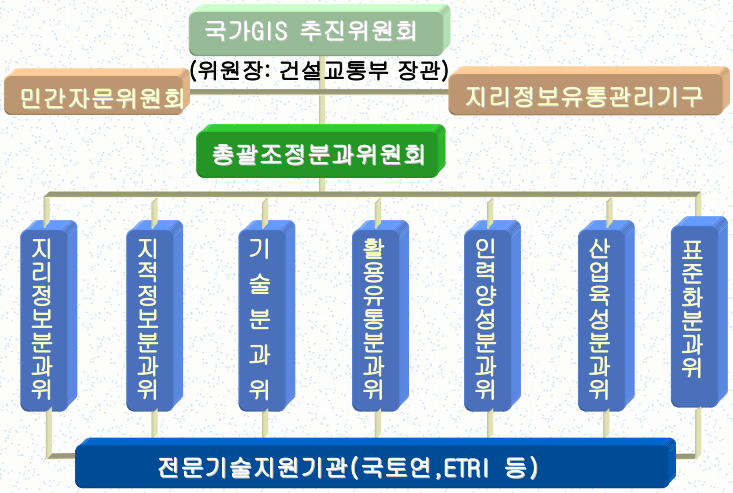
국가GIS사업 추진경과



국가GIS사업과 국토연구원의 역할

제2차 국가GIS사업 추진체계



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국토연구원의 역할 (1)

- 국토연구원은 지난 '89년 국내 최초로 GIS기술을 도입하고 국가GIS 정책수립 및 GIS의 전국확산을 위한 중심기관으로서의 역할을 수행
- 제1차(1995), 제2차(2000) 국가GIS구축기본계획 수립을 지원
- 제1차 국가GIS계획에서는 국가GIS추진위원회 총괄간사기관으로서 2001년까지 총46건의 국가GIS지원연구와 20여건의 학술위탁연구를 수행

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국토연구원의 역할 (2)

- 국가GIS사업의 효율적 추진을 위한 다양한 정책연구 및 실험·시험사업을 수행
- 지하시설물도전산화사업, 주제도전산화사업, 인공위성영상정보화사업, 토지관리정보체계 구축사업 등 다양한 국가GIS활용체계 개발사업을 완료했거나 추진중에 있음
- 제2차 국가GIS기본계획 수립이후 국가GIS 지원 연구관리기관으로서의 역할 외에도 산업입지 정보센터와 GIS중앙교육센터를 유치하여 운영

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국토연구원 수행
국가GIS 연구사업

국가GIS 정책 부문

- 국가지리정보체계 구축방안 연구 (1995)
- 국가GIS구축 2단계사업추진을 위한 기본구상 (1997)
- 제2차 국가GIS기본계획수립 연구 (2000)
- 국가공간정보기반 구축을 위한 전략계획 수립 연구 (2002년 수행중)

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기본지리정보 부문

- 국가기본도 수치지도화 방안연구 (1995)
- 공통주제도 수치지도화 실험연구 (1996)
- 공통주제도 제작지침 연구 (1997)
- 기본지리정보 추진전략 수립 연구 (2002)

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GIS활용체계 부문

- 지방자치단체의 지역정보화추진과 GIS활용체계 개발방향 (1995)
- 공공GIS활용체계 구축계획 수립연구 (1996)
- 국토이용계획을 위한 GIS활용방안 연구 (1997)
- 지하시설물관리를 위한 범용시스템개발 연구 (2000)

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지리정보유통 부문

- 공간정보유통관리기구 설치방안 연구 (1996)
- GIS정보유통을 위한 한국형 모델개발 연구 (1999)
- 지리정보유통을 위한 시범망 구축 및 유통관리기구 설립 운영방안 연구 (2001)

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GIS전문인력양성/홍보 부문

- GIS전문인력 양성을 위한 지원연구 (2001)
- GIS교육·홍보 포털사이트 설치 및 운영에 관한 연구 (2001)

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GIS 법제도 및 평가 부문

- 공간정보의 활용 및 유통촉진을 위한 법제도입방안 연구 (1997)
- GIS구축의 효과분석 (1998)
- 지리정보시스템 감리제도 도입방안 연구 (1999)
- GIS평가방안 및 시행지침 연구 (2001)

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GIS 산업육성 및 기술지원 부문 등

- 지하매설물관리체계 설계 및 운영방안 연구 (1996)
- 입지선정을 위한 GIS활용방안 연구 (1997)
- 공간정보기반확충을 위한 인공위성영상자료 활용방안 연구 (1998)
- GIS를 이용한 국가통계정보의 활용도 제고방안 (1999)
- GIS산업육성방안 (2000)
- 국가GIS통합 Data Model의 확립연구 (2001)

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국토연구원 수행 국가GIS사업

국가GIS 구축사업 수행실적 (1)

- 수치지형도 제작사업
  - 발 주 처 : 국립지리원
  - 사업기간 : 1995. 8 ~ 1998. 7
  - 1/5000지형도중 4,877도엽(전국 50%) 제작
- 지하시설물관리체계개발사업 시범사업
  - 발 주 처 : 건설교통부
  - 사업기간 : 1996. 7 ~ 1997. 4
  - 과천시 관내 지하시설물도 전산화 및 관리시스템 개발

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국가GIS 구축사업 수행실적 (2)

- 토지관리정보체계 구축사업
  - 발 주 처 : 건설교통부
  - 사업기간 : 1998년 시범사업(대구 남구) 수행후 년차별 사업수행중
  - '98(시범), 99(12개 지자체), 2000(60개), 2001년(27개)
- 주제도(토지특성도)전산화사업
  - 발 주 처 : 정보통신부(정보화근로사업)
  - 사업기간 : 제1차('98. 11 ~ '99. 6), 제2차('99. 8 ~ 2000. 3)
  - 전 국토의 50%에 대한 토지특성도 및 지번도 제작

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국가GIS 구축사업 수행실적 (3)

- **지하시설물도전산화사업**
  - 발 주 처 : 정보통신부(정보화근로사업)
  - 사업기간 : 1998. 11 ~ 1999. 9
  - 서울 등 19개 거점도시의 지하시설물도 전산화사업 검수·감리
- **공간영상정보시스템구축 시범사업**
  - 발 주 처 : 정보통신부(한국전산원)
  - 사업기간 : 1999. 11 ~ 2000. 11
  - 서울과 부산 도시권(총 4,500㎢)의 영상지도 제작 및 관리시스템 개발

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국가GIS 구축사업 수행실적 (4)

- **국가지리정보유통체계 구축사업**
  - 발 주 처 : 건설교통부
  - 사업기간 : 2000. 6 ~ 2002. 6
  - GIS정보유통모델 및 국가지리정보 유통센터 구축
- **산업입지정보센터 운영**
  - 발 주 처 : 건설교통부
  - 운영기간 : 2000. 2 ~ 계속
  - 건설교통부의 산업입지정보센터를 위탁받아 운영·관리하며, 각종 산업입지정책분석 및 통계분석 제공

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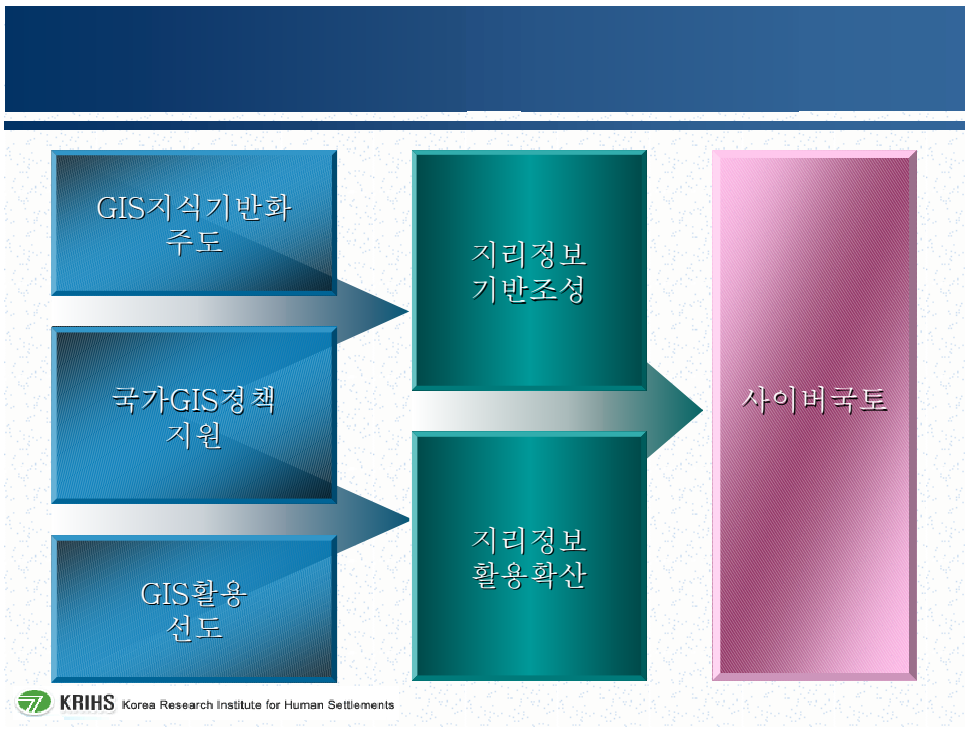
GIS지식기반화
주도
국가GIS정책
지원
GIS활용
선도
지리정보
기반조성
지리정보
활용확산
사이버국토
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4. GIS and Photogrammetry : The impact of new sensors/systems

(Ayman Habib, Univ. of Calgary)

Geographic Information Systems (GIS): Impact of Recent Advances and Needs

Ayman F. Habib
Department of Geomatics Engineering
University of Calgary, Canada

Overview

- Introduction, benefits, and contributing disciplines.
- GIS as a set of interrelated subsystems.
- Impact of recent technological advances and needs on GIS.
- GIS in Canada.
- Future of GIS.
- The role of national and international GIS policies.
- Concluding remarks.

GIS: Introduction

- GIS can be seen as a system of hardware, software, and procedures designed to support the capture, management, manipulation, analysis, modeling, and display of spatially-referenced data for solving complex planning and management problems.
  - Although many other computer programs can use spatial data (e.g. AutoCAD and statistics packages), GIS include the additional ability to perform spatial operations and queries.

Why is GIS Important?

- GIS integrates spatial and other kinds of information within a single system.
  - It offers a consistent framework for analyzing geographical data.
- By putting maps and other kinds of spatial information into digital form, GIS allows us to manipulate and display geographical knowledge in new and exciting ways.
- GIS makes connections between activities based on geographic proximity.
  - These connections are often unrecognized without GIS, but can be vital to understanding and managing activities and resources.
- GIS allows access to administrative records (e.g., property ownership, tax files, utility cables, pipes) via their geographical positions.

Why is GIS Hot/Cool?

- There is a high level of interest in new developments in computing.
- GIS gives a "high tech" feel to geographic information.
- Maps are fascinating and so are maps in computers.
- GIS is an important tool in understanding and managing the environment.

GIS: Major Application Areas

- Natural resource management.
  - Environmental impact analysis (EIA).
- Street network management.
  - Vehicle routing and scheduling.
- Land parcel management.
  - Zoning and subdivision plan review.
- Facilities management.
  - Balancing loads in electrical networks.

GIS: Contributing Disciplines

- GIS has been called an "enabling technology" because of the potential it offers for a wide variety of disciplines dealing with spatial data.
- Each related field provides some of the techniques which make up GIS.

- Geography.
- Photogrammetry.
- Statistics.
- Computer science.
- Cartography.
- Surveying.
- Operations research.
- Civil engineering.
- Remote Sensing.
- Geodesy.
- Mathematics.
- Environmental.

GIS as a Set of Interrelated Subsystems

- Data processing subsystem.
  - Acquisition, input, and storage.
- Data analysis subsystem.
  - Retrieval and analysis.
  - Information output.
- Information use subsystem.
  - Interaction among researchers, managers, and planners.
- Management subsystem.
  - Interaction between GIS developers and users.

Recent Advances/Needs in Technology

- Data acquisition hardware:
  - Data is captured by measuring devices in a digital form and directly downloaded to databases.
    - Total stations.
    - Imaging sensors (with varying geometric and spectral resolutions).
  - Navigation instruments determine location supplementing the geodetic control networks.
    - Global Positioning Systems.
    - Inertial Navigation Systems.
- GIS hardware/software:
  - Data/information manipulation and display.
- Increased awareness of GIS potential.

GIS: Impact of Recent Advances/Needs

- Acquisition Level:
  - High resolution satellite imagery.
  - As data resolution increases:
    - Costs fall.
    - Service becomes more reliable.
    - User demand increases.
    - Satellite remote sensing is becoming more important in supplying data for GIS use.
  - Already the supply of data vastly exceeds our ability to analyze it.

High Resolution Satellite Imagery

IKONOS

ORBVIEW

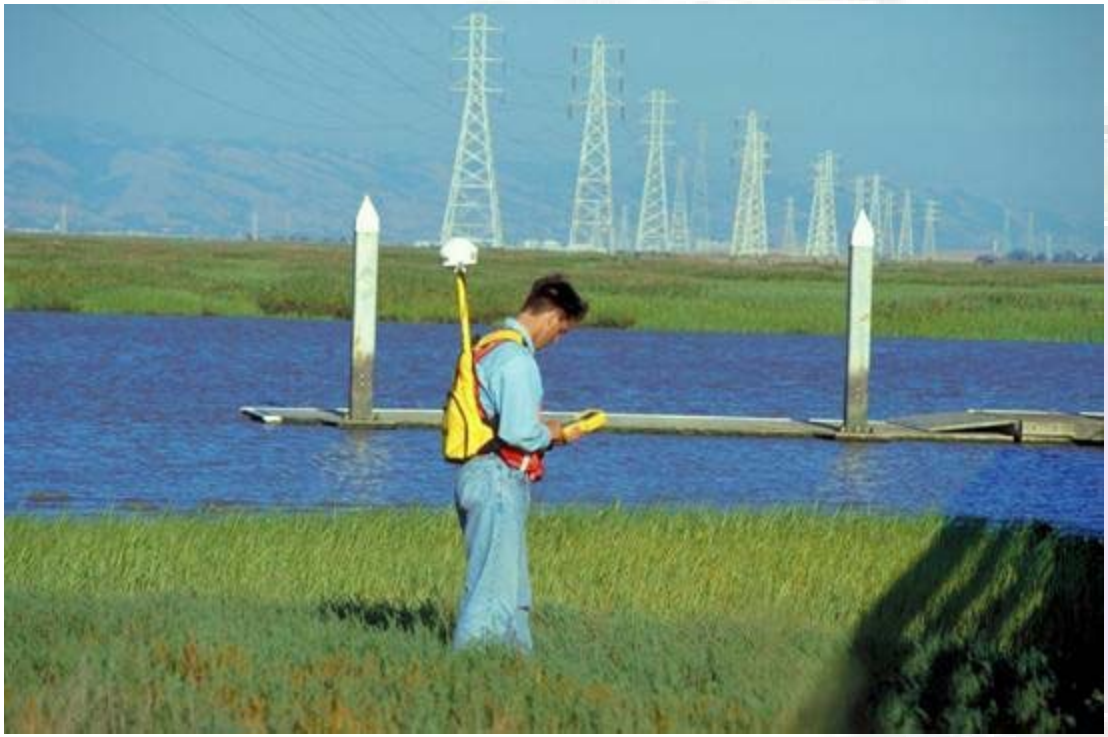
GIS: Impact of Recent Advances/Needs

- Acquisition level:
  - Better methods of scanning, archiving large amounts of data are needed.
  - No one source of data will provide the information required for all kinds of analysis.
  - New technologies for the fabrication of miniature sensing devices.
    - Terrestrial Mobile Mapping Systems (MMS).
    - Portable mapping systems.

Terrestrial Mobile Mapping Systems

- **Rack**
  up to 4 cameras with
  4 possible combinations
- **GPS Receiver**
- **Inertial Navigation System**

Portable Mapping Systems



GIS: Impact of Recent Advances/Needs

- Uncertainty level:
  - Increasing attention has to be paid to data error and uncertainty since there is:
    - More data and more forms of data are gathered.
    - Increasing pressure to combine these data for analysis.
  - Spatial uncertainty.
  - Topological uncertainty.
  - Temporal uncertainty.
  - Attribute uncertainty.

GIS: Impact of Recent Advances/Needs

- Distribution level:
  - Dissemination is necessary for reducing costs, solving widespread problems, and fully utilizing available technology.
  - Security considerations, political divisions, and other factors will continue to inhibit sharing.
  - Problems will be increasingly recognized as crossing international boundaries and having global implications.
    - More global databases will be built.
  - National and international GIS policies are needed.

GIS: Impact of Recent Advances/Needs

- Distribution level:
  - Private businesses will compete with government agencies in supplying data to both government and the public.
    - Questions will arise regarding the national security.
    - Questions will increase about how to best serve the public interest in such cases.
    - Data gathering by government will always be under fire because of its cost.

GIS in Canada

- Started close to thirty years ago.
- Canada has world-leading capabilities in the following areas:
  - Transportation:
    - Ambulance drivers, firefighters and police are given the quickest possible route to accidents and emergency situations (911 System).
  - Infrastructure Management:
    - Utility companies have used GIS to monitor and manage information regarding pipelines and electricity grids, power lines, generation and distribution stations and transformers.

GIS in Canada

- Canada has world-leading capabilities in the following areas:
  - Land Management and Reform:
    - Government agencies are using GIS to implement property taxation programs, assess land-zoning and land-use policies.
  - Environmental Applications:
    - Canada has installed GIS hardware and software in Ukraine and Belarus to assess current environmental conditions and develop long-term rehabilitation programs.

GIS in Canada

- Canada has world-leading capabilities in the following areas:
  - Natural Resource Monitoring:
    - Establishing GIS programs to monitor forests, assess site access routes, and manage reforestation efforts.
  - Strategic Planning and Business Development:
    - Using GIS to monitor health and economic indicators in different parts of the country.
    - Using GIS to assess market potential, develop marketing campaigns, and identify the best possible locations for manufacturing facilities and retail outlets.

Future of GIS

- An active GIS market has resulted in:
  - Lower costs.
  - Continual improvements in the hardware and software components of GIS.
- These developments will, in turn, result in a much wider application of the technology throughout government, business, and industry.
  - Need for a clear and well-defined National/International GIS policies.

Future of GIS

- GIS technology gives researchers the ability to examine the variations in Earth processes over days, months, and years.
  - New needs are identified.
  - Two-way communication between GIS and contributing disciplines.
  - Reexamine traditional activities in contributing disciplines.

Development of GIS Polices

- Different countries have focused interest in the development of GIS in different ways.
- Several aspects vary from country to country:
  - Perception of priorities in GIS.
  - Scale of funding.
  - Governmental/institutional context.
  - Extent of involvement of the private sector.
  - Emphasis upon applied as opposed to fundamental research.

Importance of National Strategy

- Clear national strategy would:
  - Speed the process of fusion, e.g. by reorganization of government departments
  - Avoid duplication, mistakes, false starts.
  - Provide much needed support for research and development.
  - Promote training and education programs.

Importance of International Strategy

- Clear international strategy would:
  - Define unified standards for Quality (uncertainty) assessment.
    - Spatial data.
    - Temporal data.
    - Attribute data.
  - Define standards for sharing data/information.
    - Security.
    - Protection of rights.
  - Effectively guide global research and development initiatives.
    - For example: Polar regions, global changes.

National GIS Initiatives in Canada

- Geo-Connections funded by the government of Canada in 1999 to:
  - Facilitate the creation of the ***Canadian Geo-spatial Data Infrastructure (CGDI),*** which will both harmonize Canada's geo-spatial data bases and make them accessible on the internet, and
  - Coordinate the investments and developments of the federal, provincial, territorial and private sector partners, who are creating the standards, protocols, access and maintenance processes of the fast growing collections of geo-spatial data.

International View

- U.S. National Center for Geographic Information and Analysis
  - Funded by the National Science Foundation.
  - Created to promote basic research in GIS and to improve the education of GIS professionals.
- UK Regional Research Laboratories
  - Objectives include carrying out basic and applied GIS research, training, providing data services, and promotion of the use of GIS in general.
- The Netherlands
  - Research consortium funded by the Netherlands Science Research Council.
- France
  - Creation of the "*MAISON DE LA GEOGRAPHIE*" in Montpelier providing a network linking 49 research teams in France.

Concluding Remarks

- Recent technological advances are significantly affecting GIS activities.
  - Operational level.
  - Research and development level.
- There is no separation between data acquisition and GIS activities.
  - GIS and contributing disciplines are becoming closely interrelated.
- There is a need for a unified national and international policies for GIS.

Photogrammetry: Impact of Recent Advances and Needs

Ayman F. Habib
Department of Geomatics Engineering
University of Calgary, Canada

Overview

- Introduction.
- Impact of recent technological advances:
  - Terrestrial Mobile Mapping Systems.
  - Sensor/data integration.
  - Non-traditional imaging sensors (line cameras).
  - Low cost digital cameras.
- Concluding remarks.

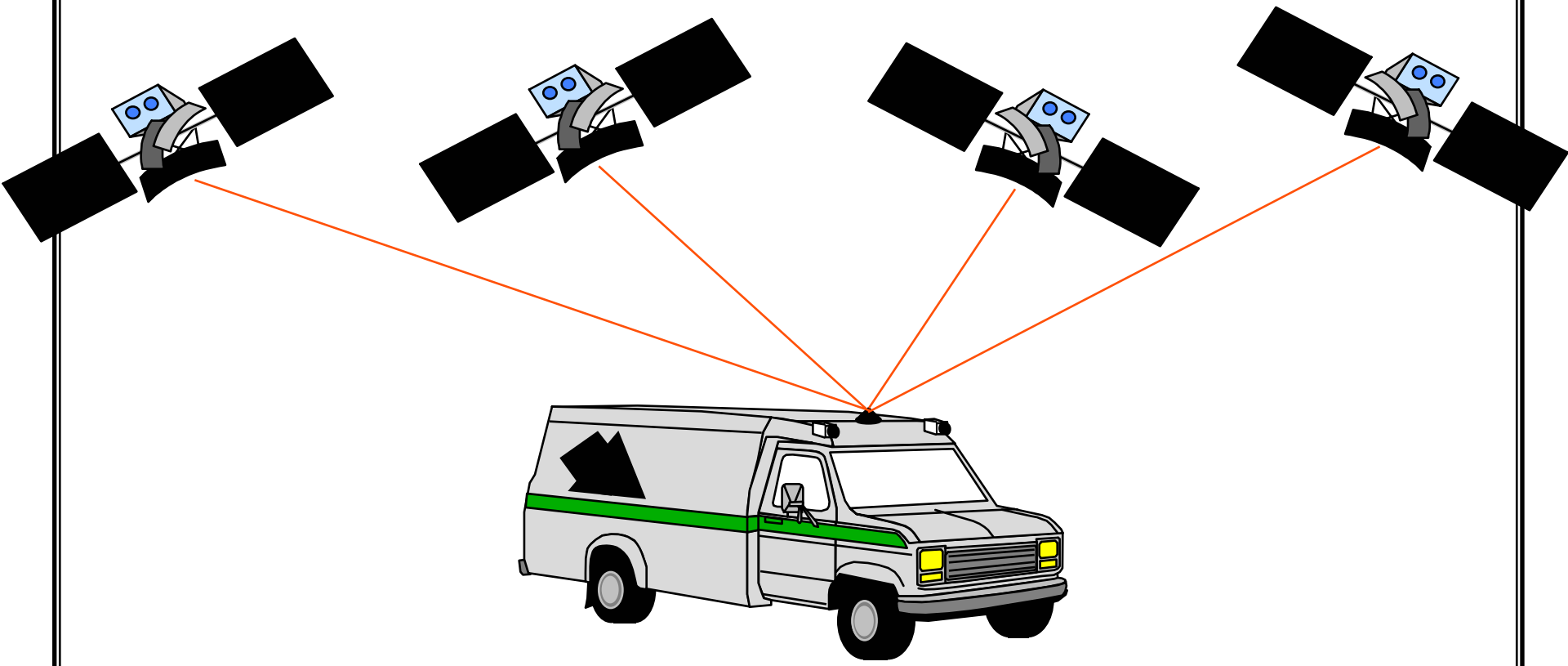
Photogrammetry

- Classic Definition:
  - The art and science of determining the position and shape of objects from photography.
- Contemporary Definition:
  - The art and science of tool development for automatic generation of spatial and descriptive information from multi-sensory data and/or systems.

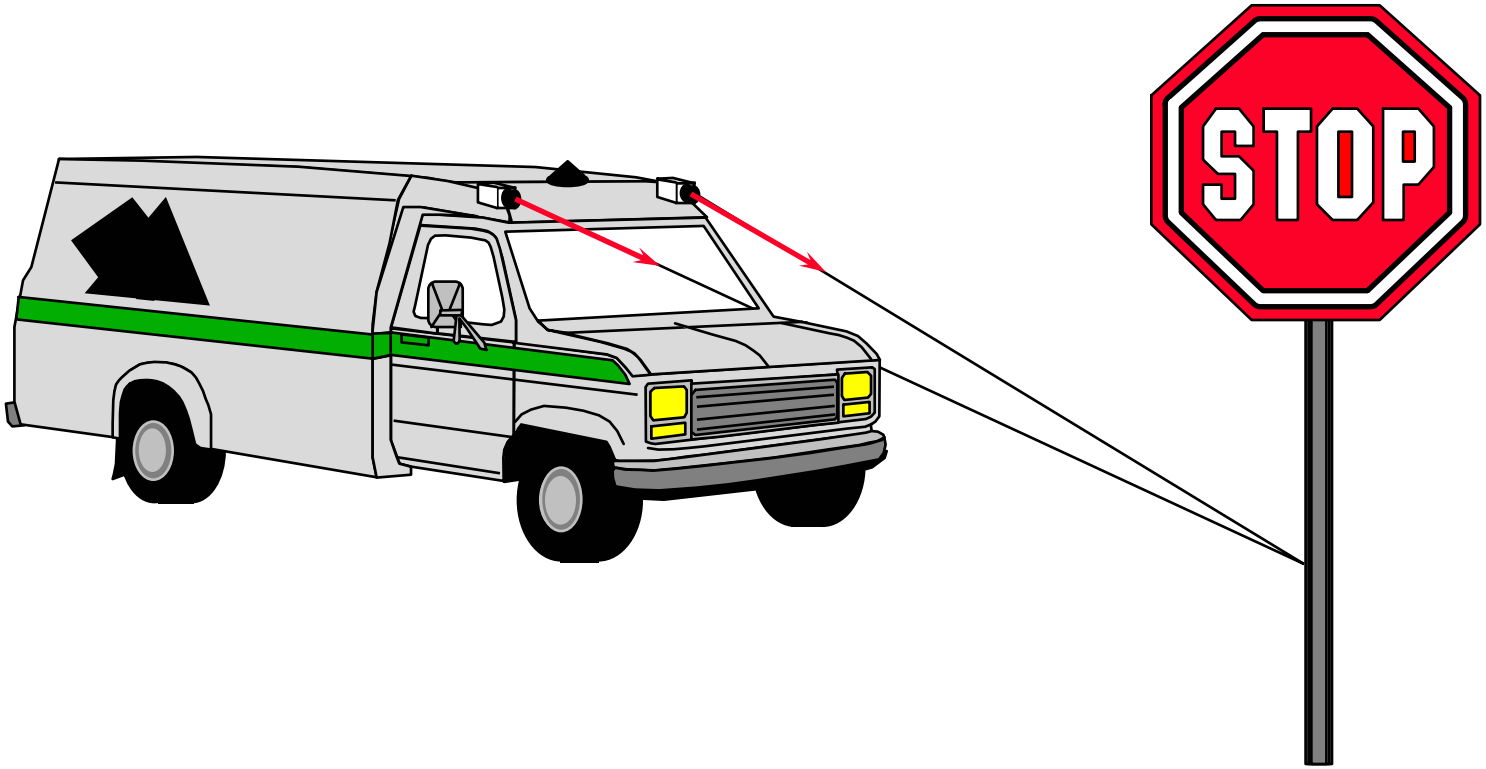
Mobile Mapping Systems

- Definition
  - Mobile Mapping Systems (MMS) can be defined as moving platforms upon which multiple sensors / measurement systems have been integrated to provide three-dimensional near-continuous positioning of both the platform's path in space and simultaneously collected geo-spatial data.
- Includes therefore
  - Planes, trains, automobiles.

MMS: Positioning Component



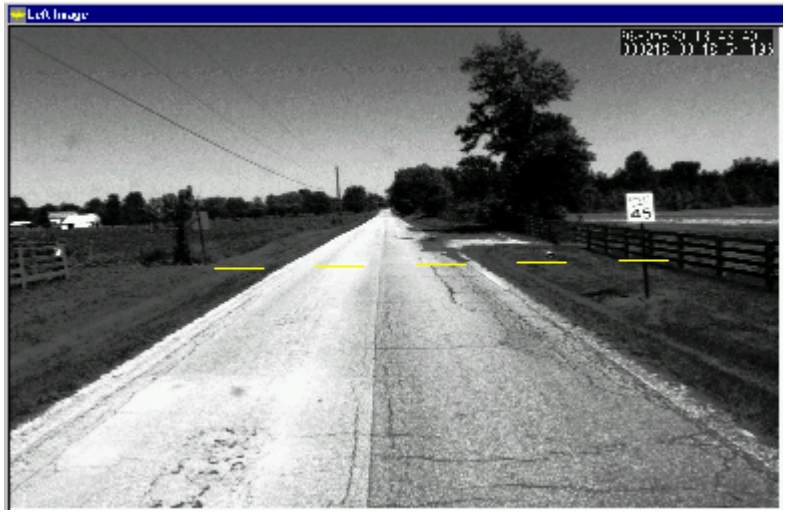
MMS: Stereovision Component



MMS: Working Example

- **Rack**
  up to 4 cameras with
  4 possible combinations
- **GPS Receiver**
- **Inertial Navigation System**

Stereo-image Pair
Image Coordinate Measurements



Traffic Signs

sign type

height above pavement

offset from road edge

coordinate locations

size of sign

Asset Management

Collecting inventories

Database integration

On-going maintenance

Current Research Activities

- Current photogrammetric research has evolved as a result of recent technological advances, for example:
  - Automatic recognition objects of interest.
  - Data integration from terrestrial and aerial platforms for change detection applications.
  - Dealing with non traditional imaging sensors.
  - Working with low cost digital cameras.

Sign Recognition: Input Imagery

Identification of Predefined Signatures

Original

=

Red

+

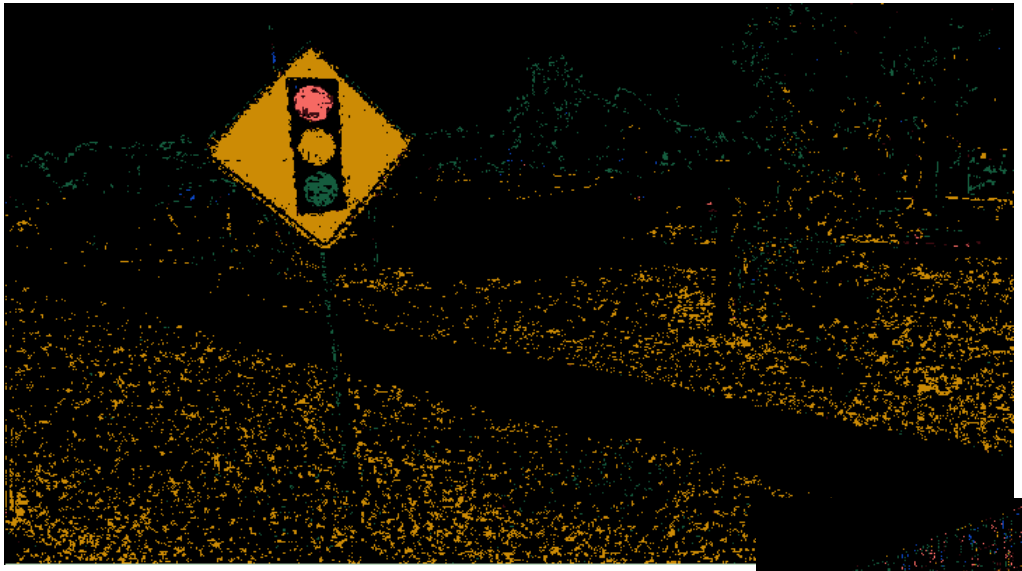
Green

+

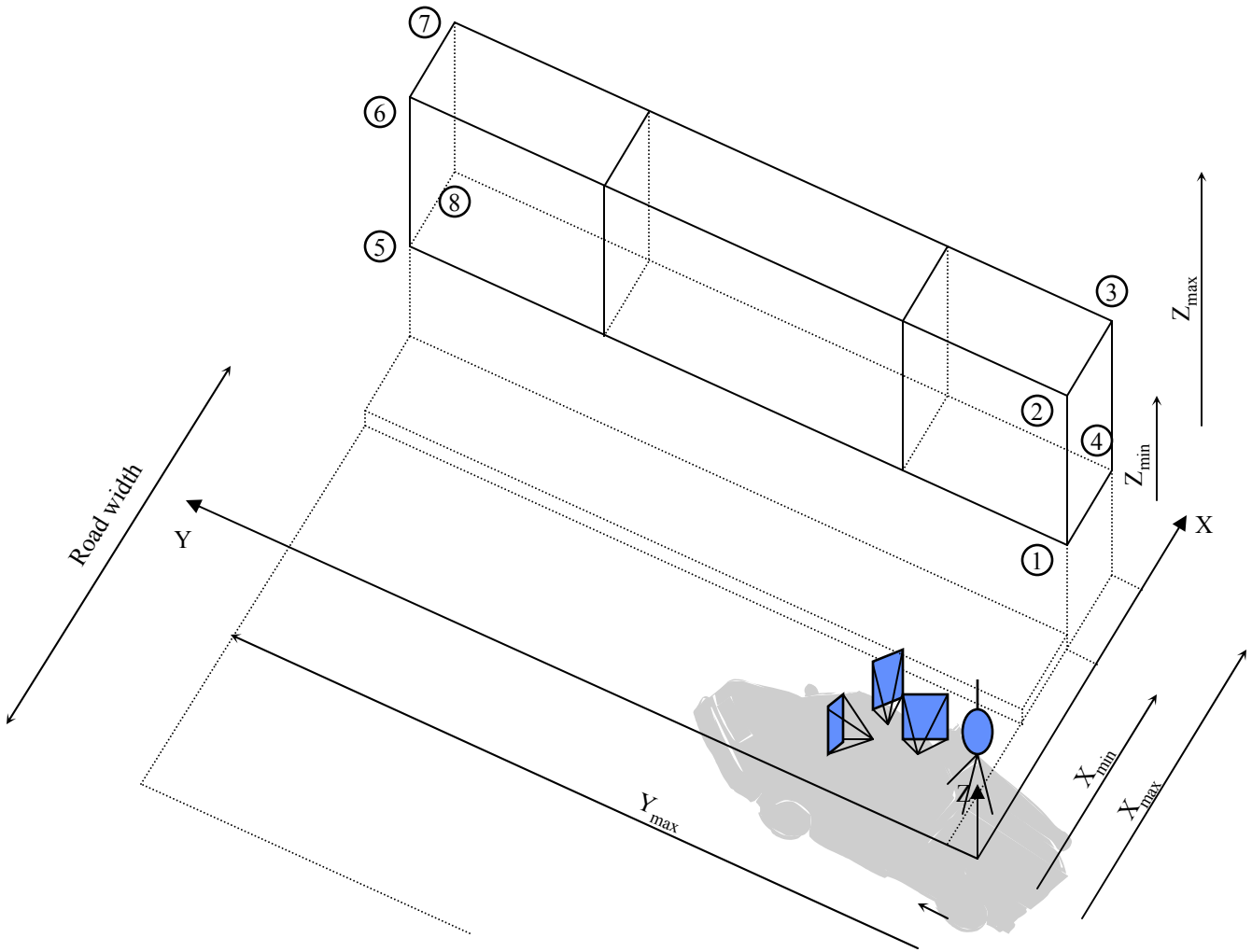
Blue

Yellow Binarization

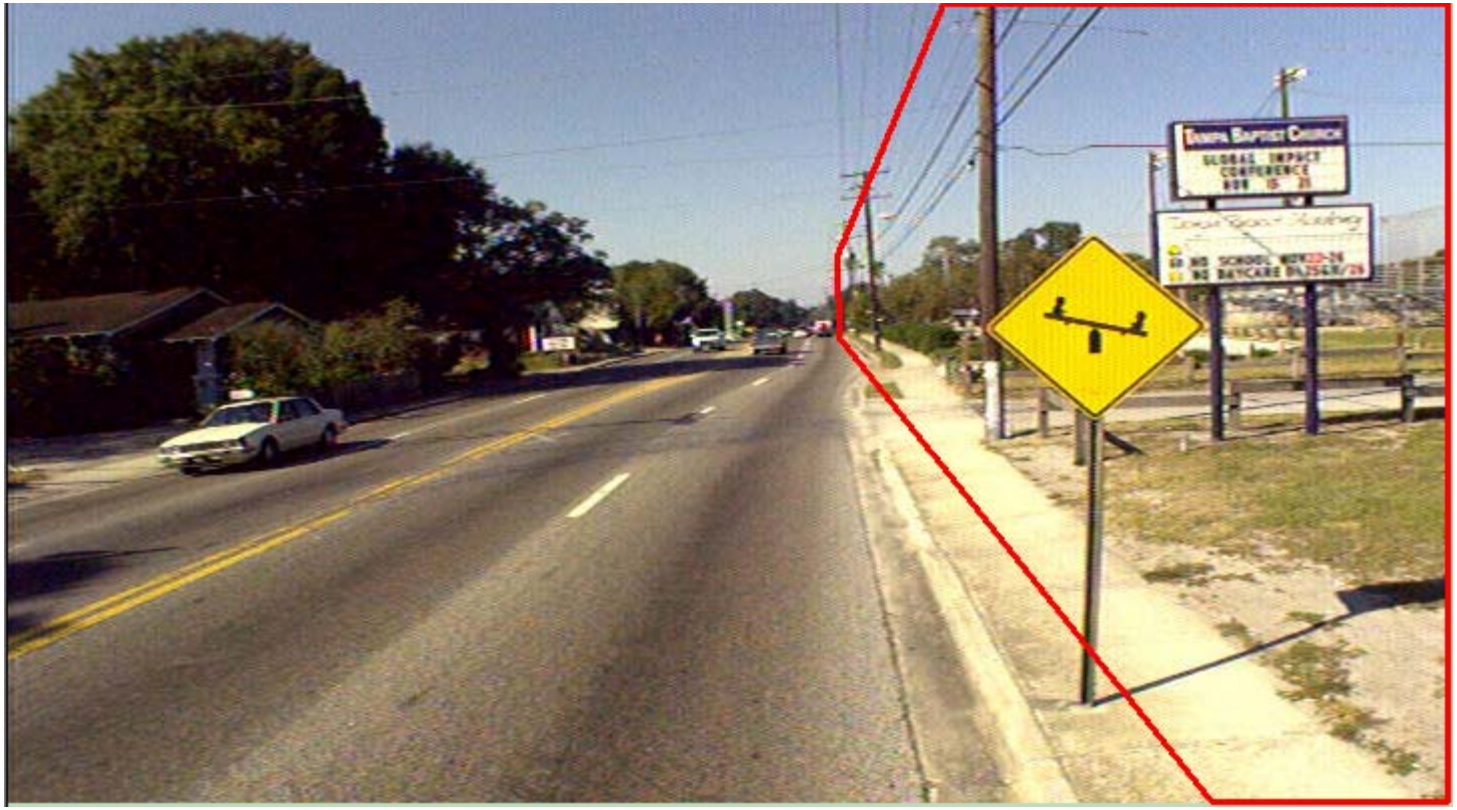
Signature Classification and Segmentation



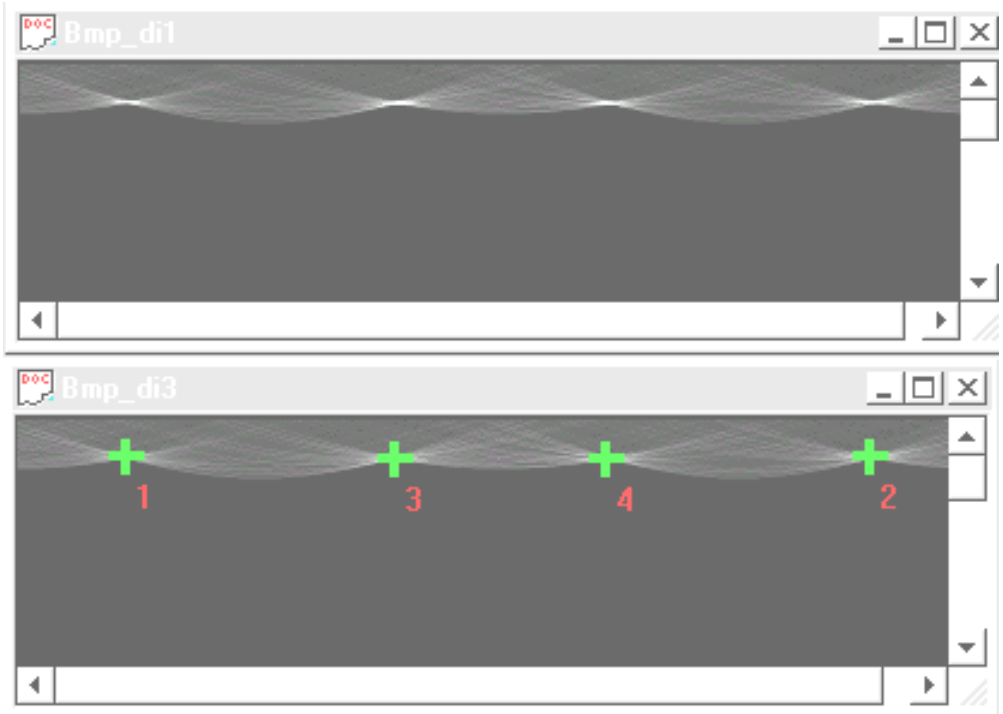
Area of Interest



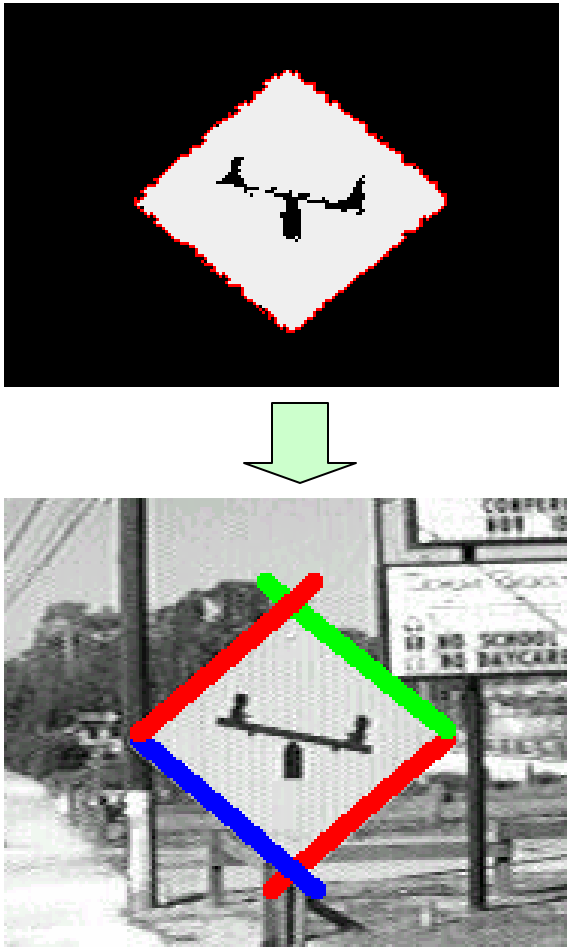
Area of Interest



Organized Boundaries

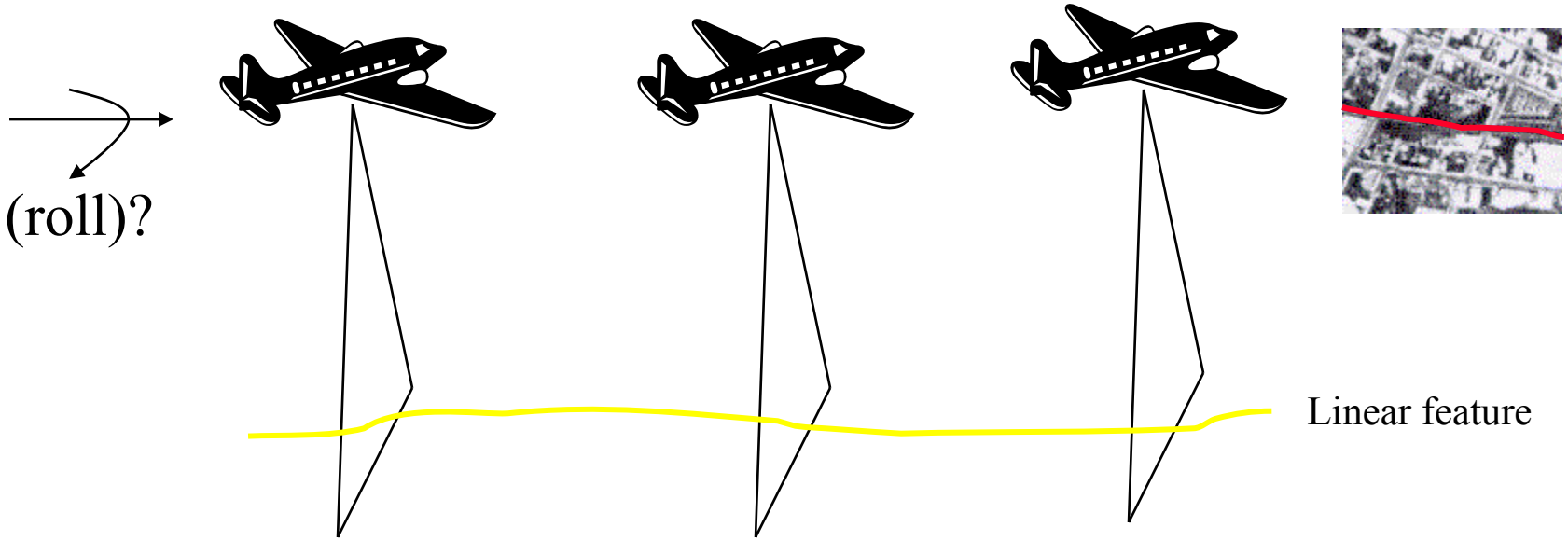


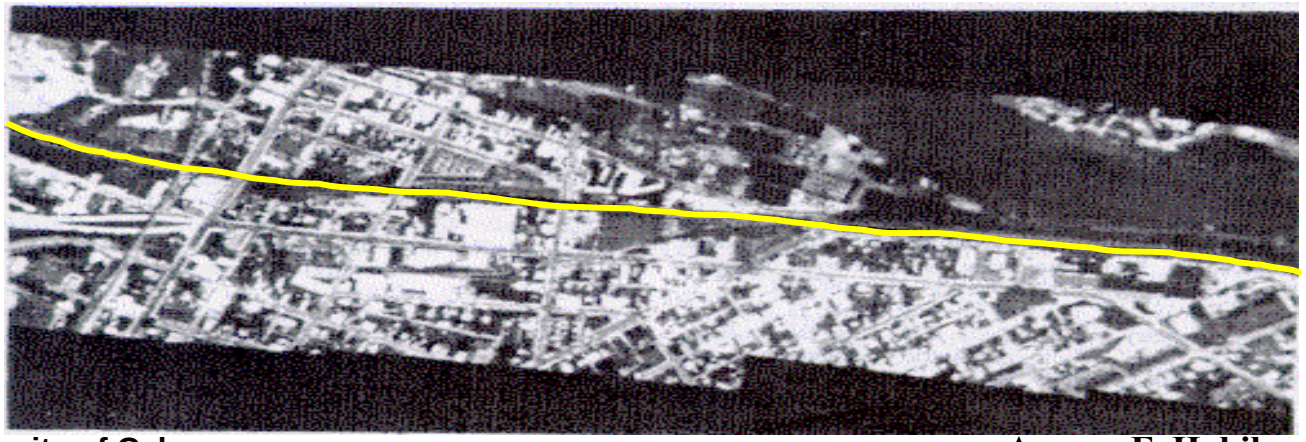
Hough image & Detected Peaks



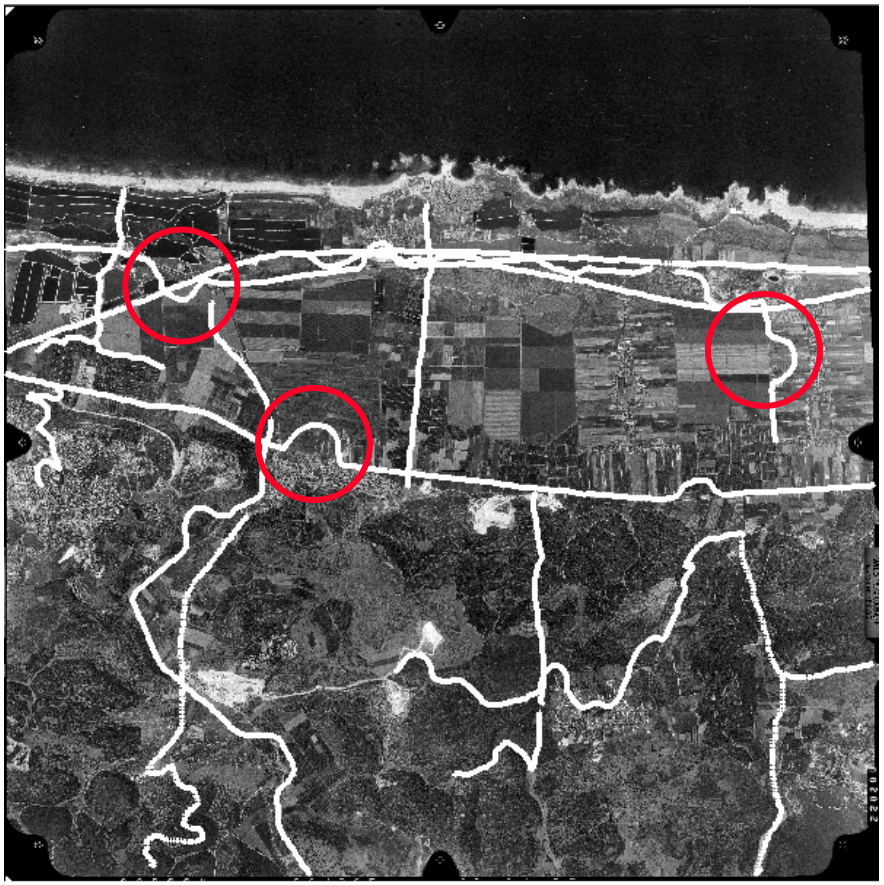
Generated Hypotheses

GPS Controlled Strip Triangulation with Linear Features

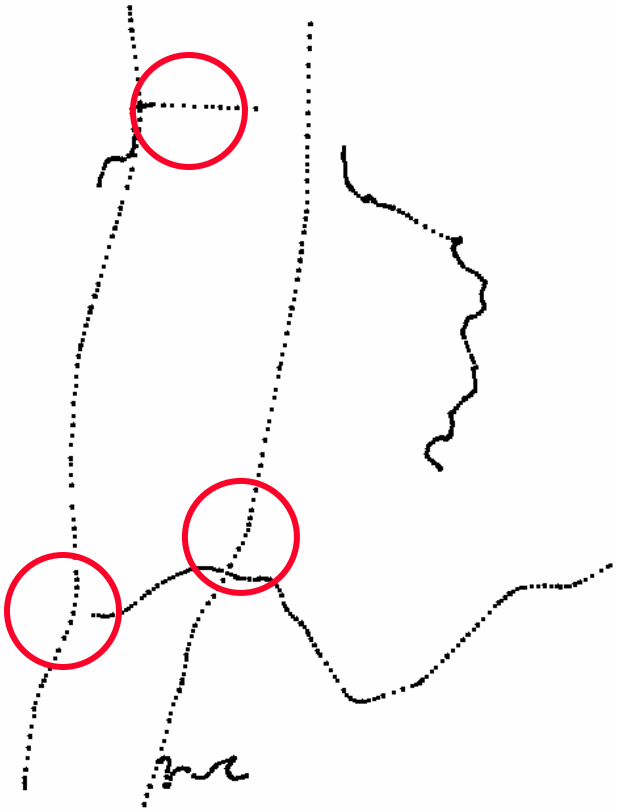




Aerial/Terrestrial Data Integration

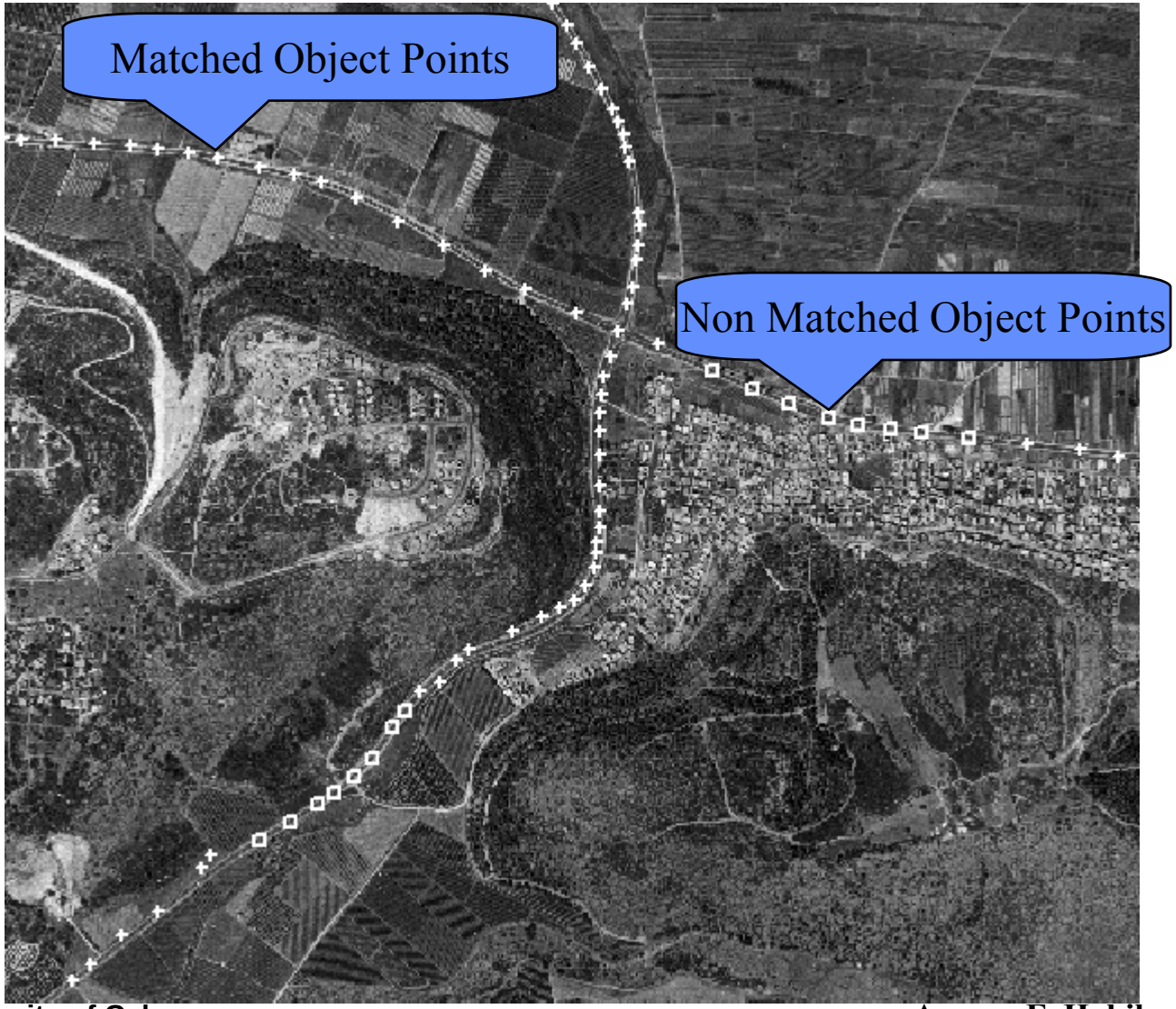


Digitized Image Space Features



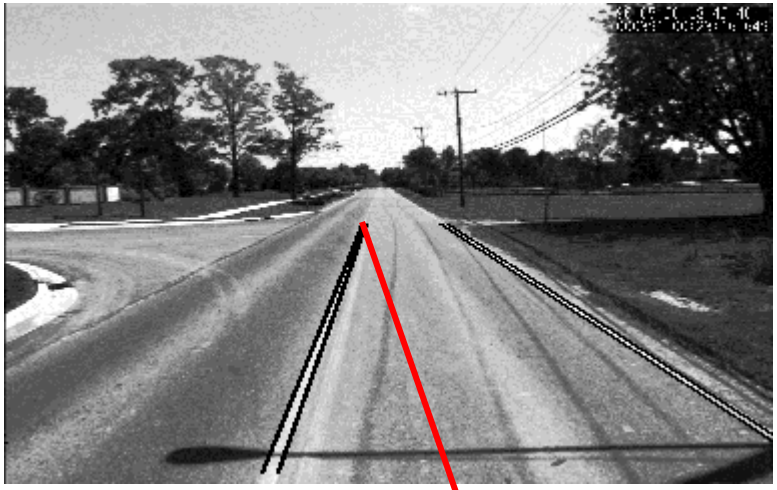
Object Space Control Features

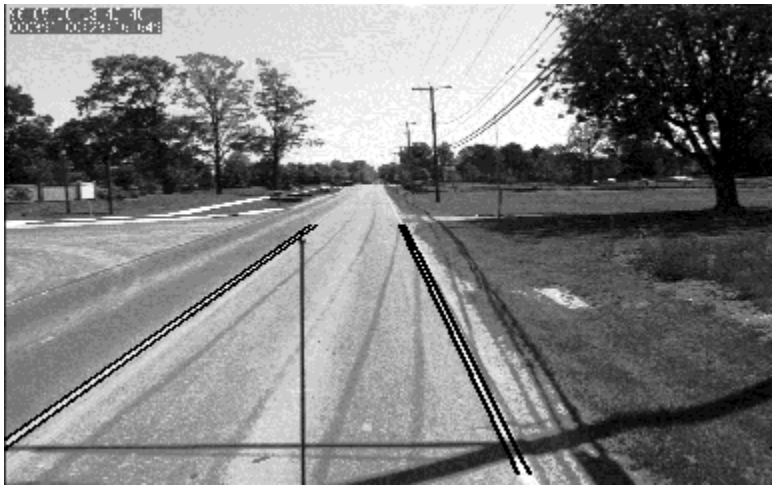
Change Detection

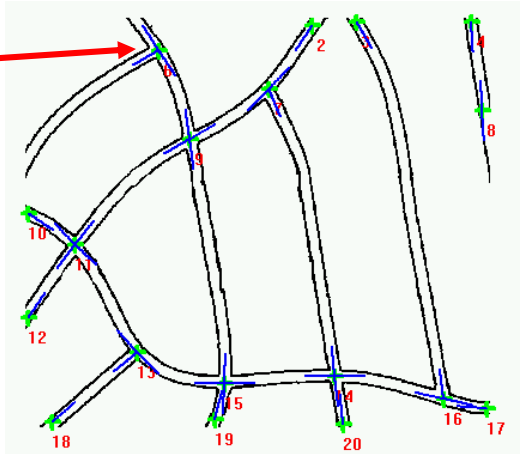


Road Network Reconstruction

Conflating map data to van data





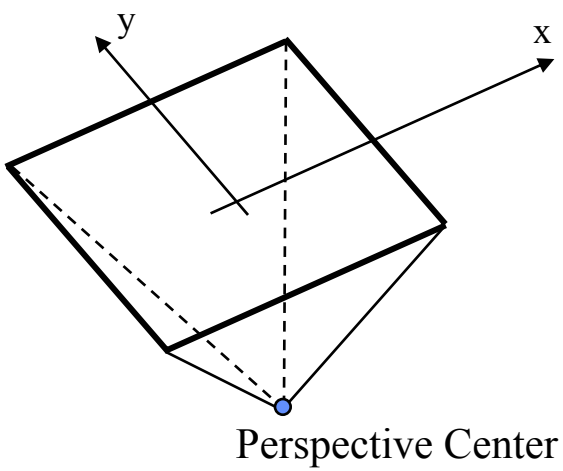


DLG roads layer with detected road intersections

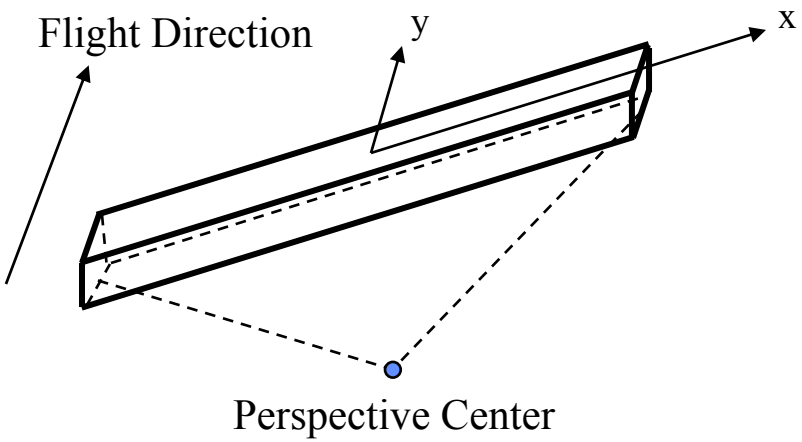
Non Traditional Imaging Systems

- Limitation of digital frame cameras.
  - limited array size.
  - Analogue camera: Format size = 230 x 230 mm.
  - Equivalent digital camera: Pixels size (7.5μm).
    - 32k x 32k array.
    - 1024 MB storage requirement for each image.
    - Too large array.
- Alternative: Linear array scanners.
  - Single push broom scanners (SPOT).
  - Three line scanners (MOMS).
  - Panoramic linear array scanner.

Push Broom Scanners

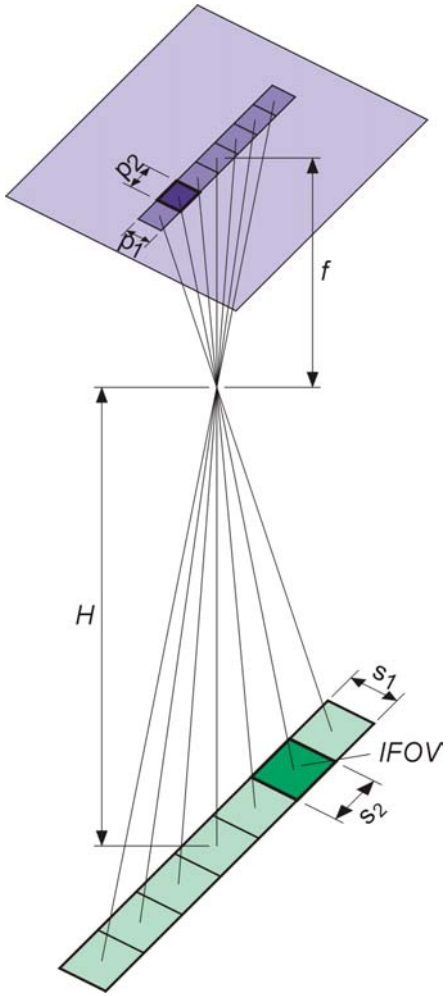


Frame Camera

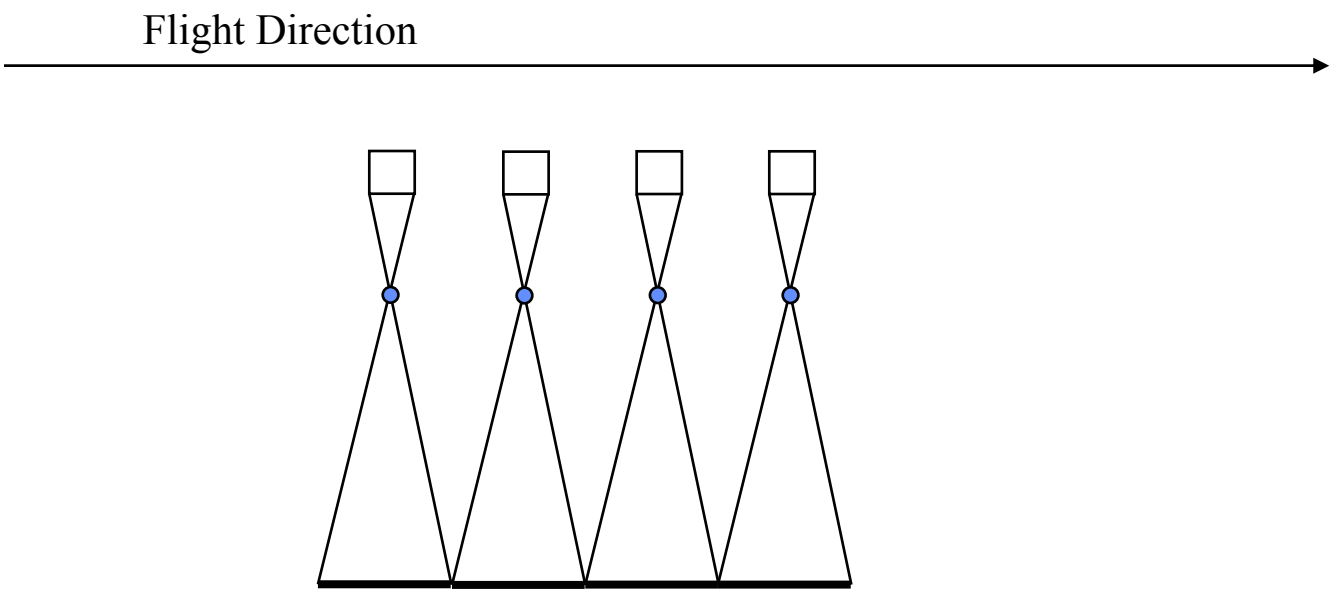


Single Push Broom Scanner

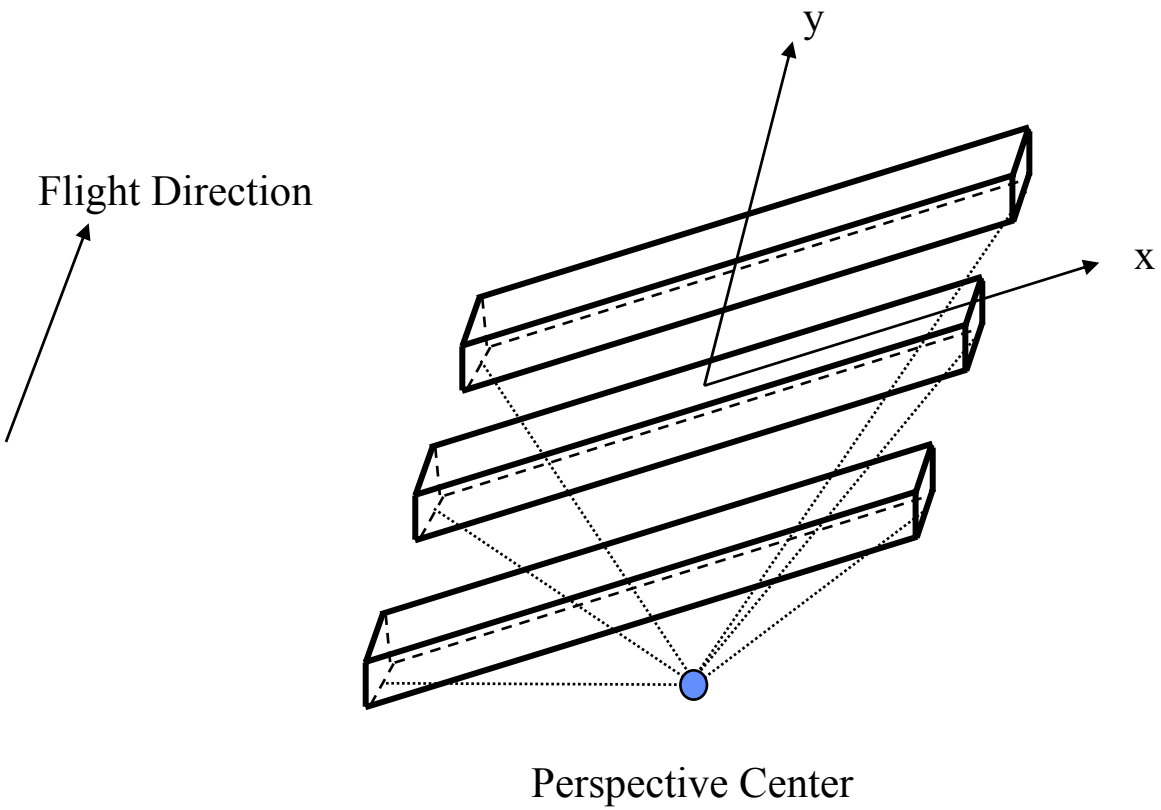
Principle of Single Push Broom Scanner



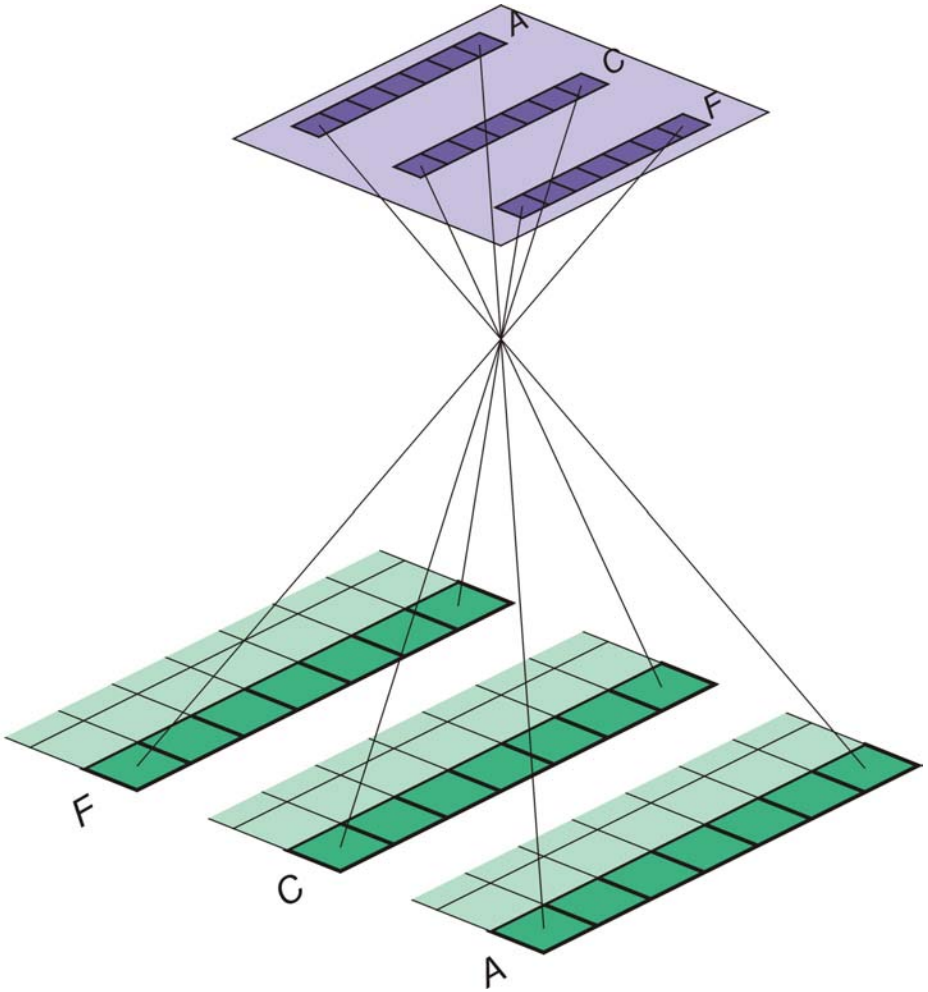
Single Push Broom Scanner



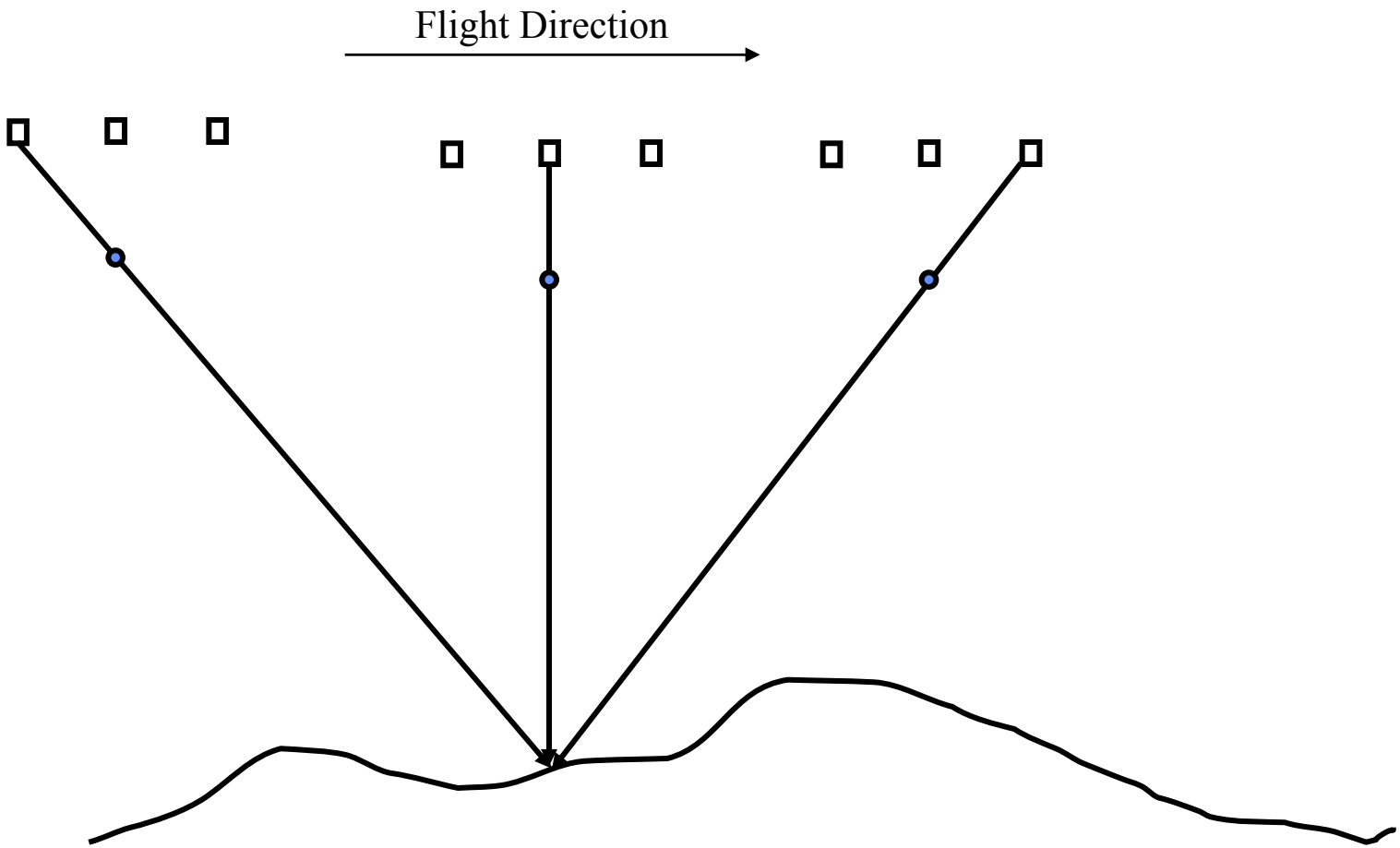
Three Line Scanner



Principle of Three Line Scanner



Three Line Scanner (Stereo Coverage)



What Can be Done?

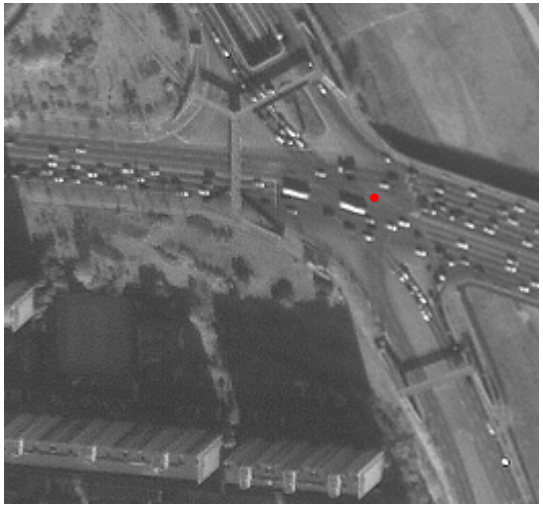
- Integrate data from:
  - High resolution satellite imagery.
  - Aerial imagery.
  - Navigation data.
  - Terrestrial data from MMS and/or GIS databases.
- Major issues:
  - Co-registration (Multi-Sensor Aerial Triangulation).
  - Change detection capabilities.

Multi-Sensor Aerial Triangulation

LANDSAT/PAN(15m)

SPOT/PAN(10m)

KOMPSAT-1/EOC(6m)

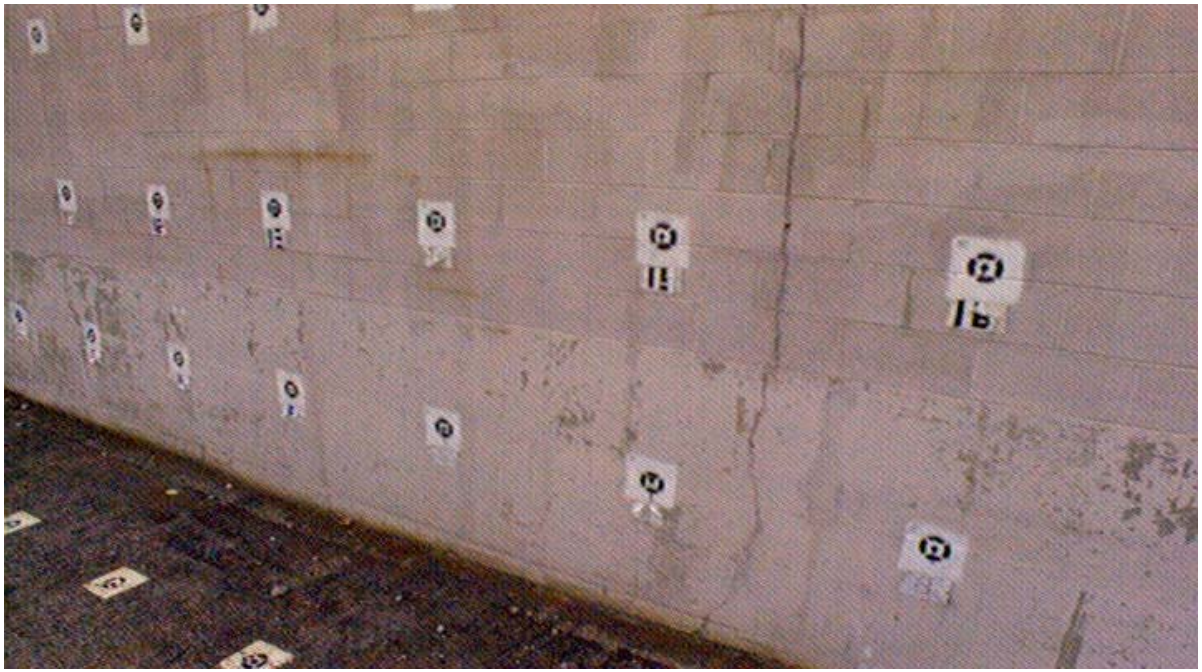


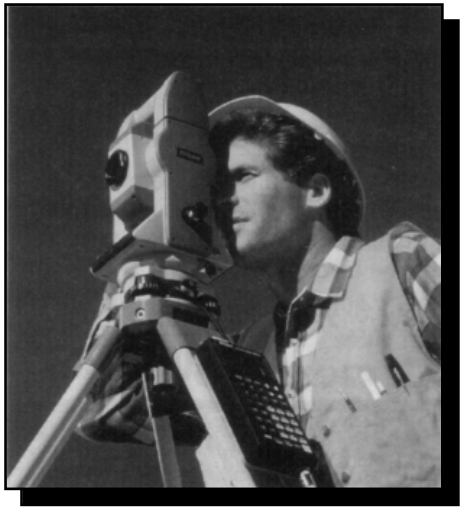
IKONOS/PAN(1m)

Low Cost Digital Cameras

- Low cost digital cameras with high radiometric and geometric resolution are becoming available.
- Their application to spatial processing activities is limited to professional Photogrammetrists and surveyors.
  - Complicated calibration procedure.
- Issue:
  - How can we expand potential users to amateurs working with digital cameras?

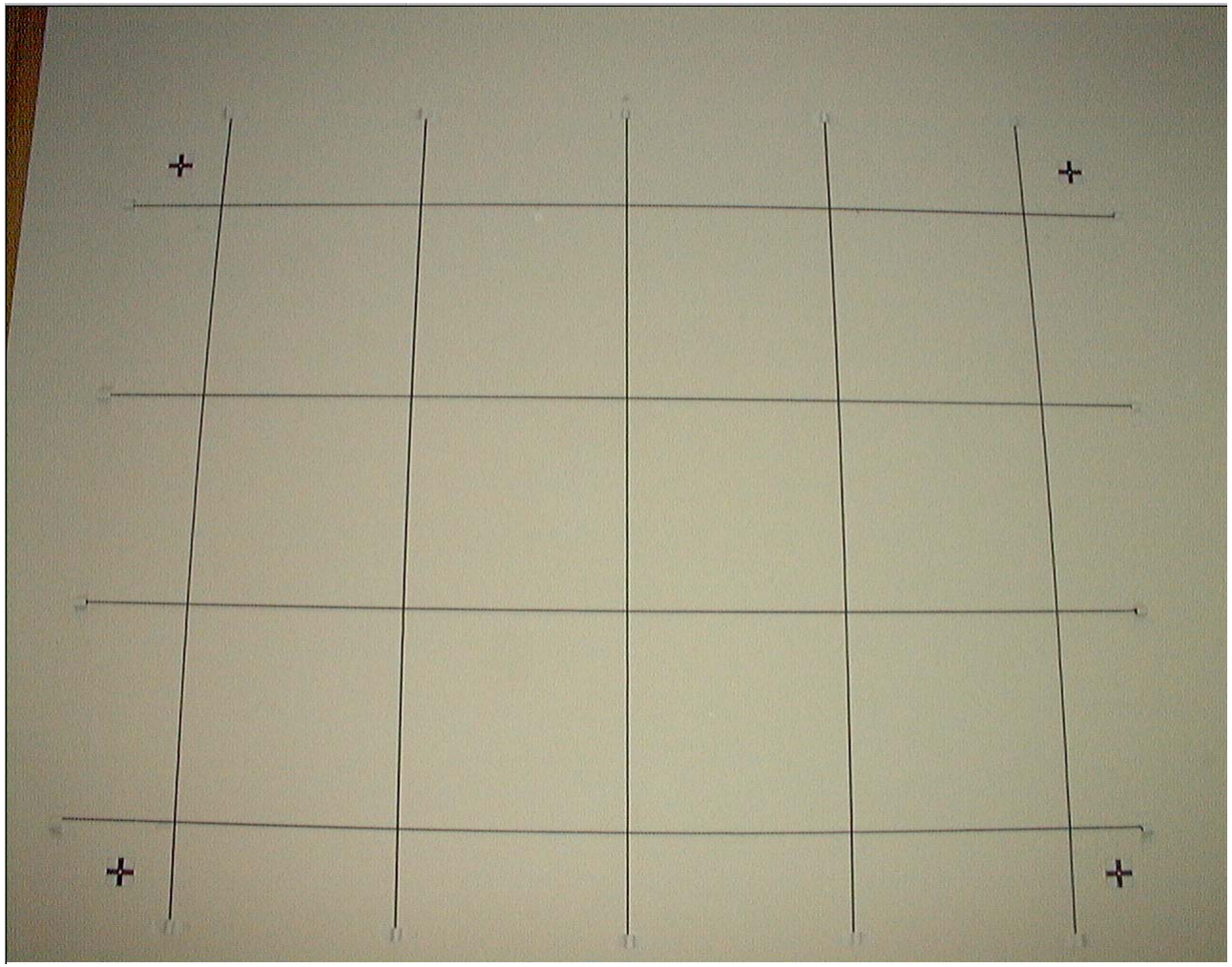
Traditional Test Field



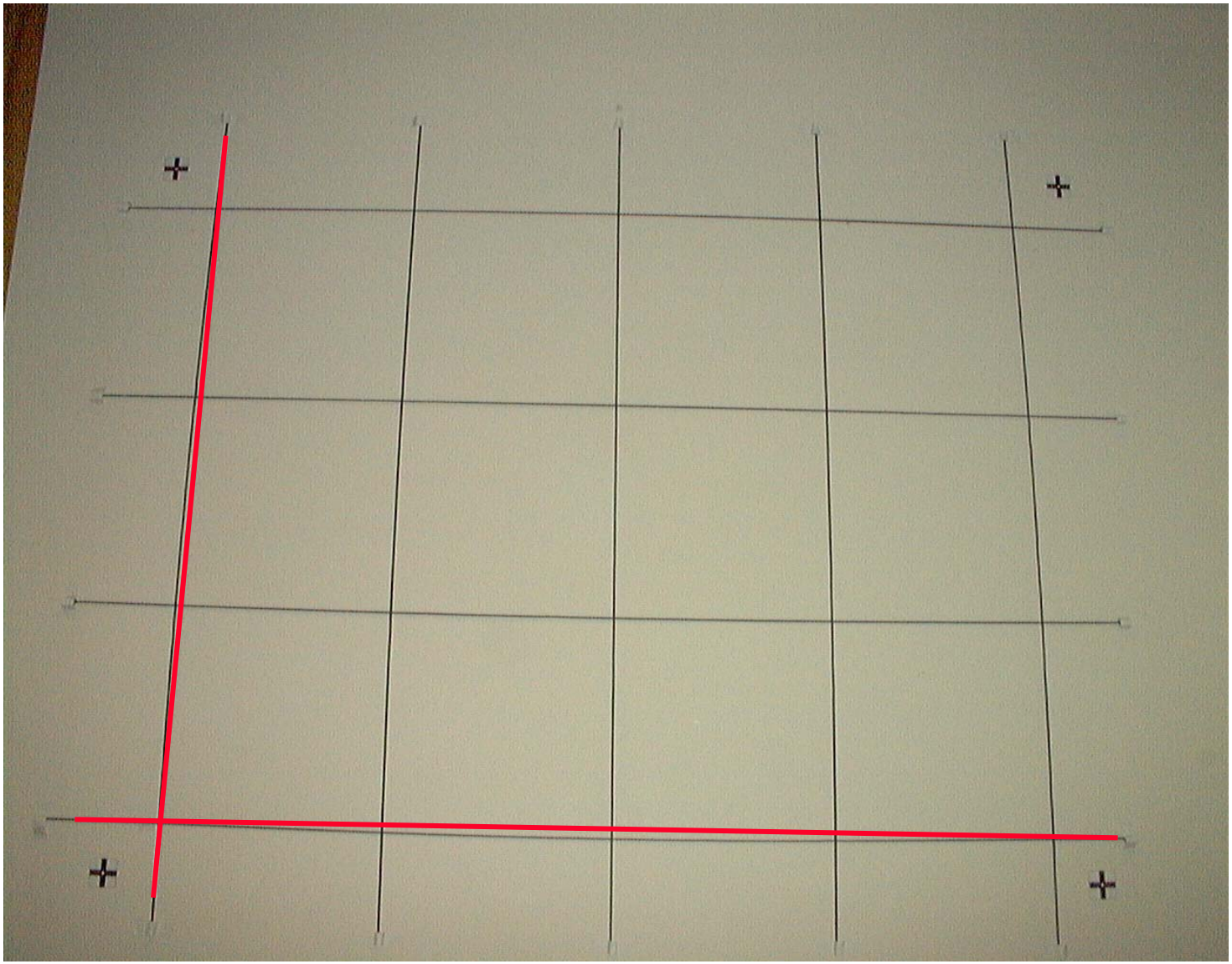


Theodolite Intersection

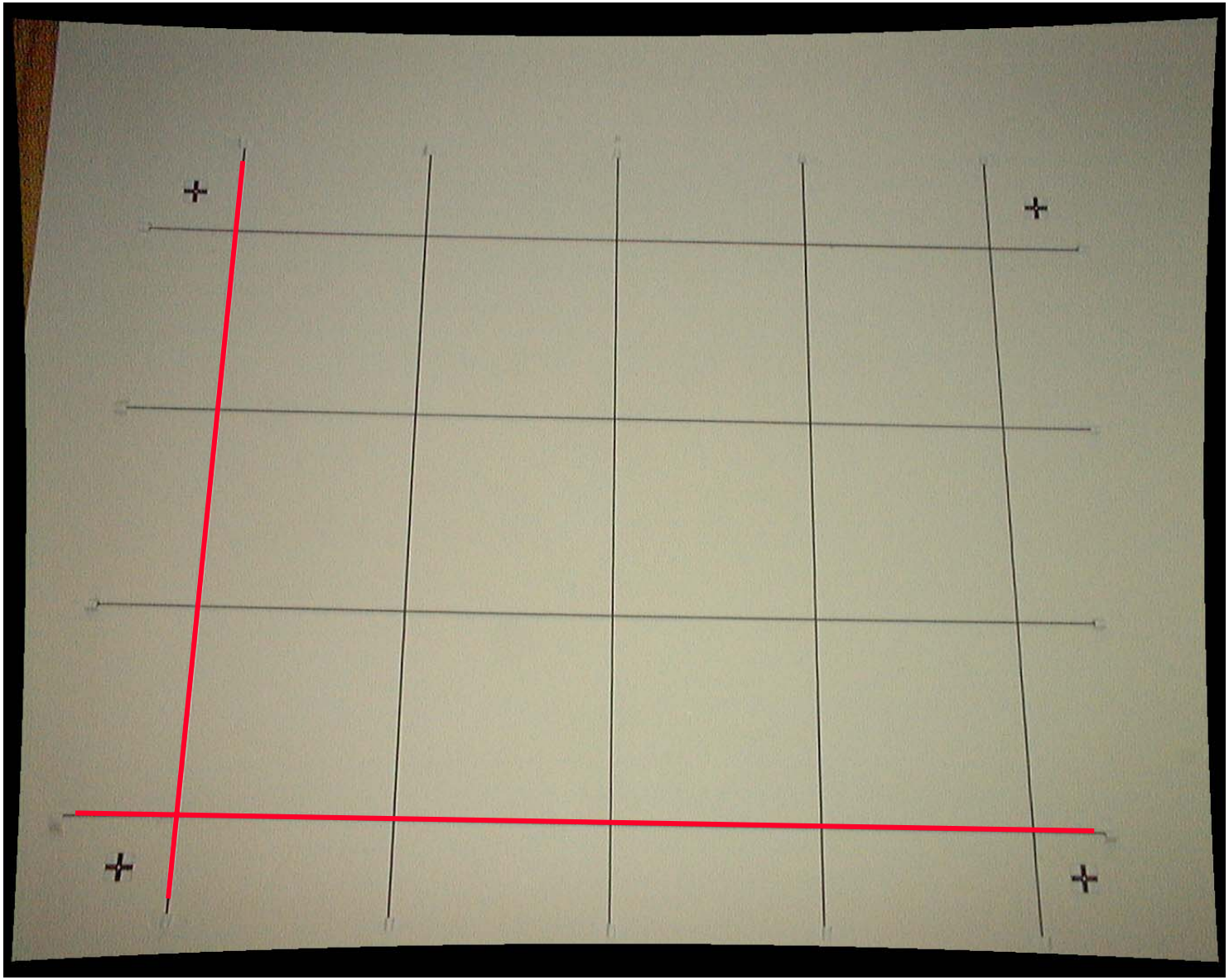
Suggested Test Field



Before Calibration



After Calibration



Concluding Remarks

- Recent technological advances are significantly Photogrammetry activities.
  - Operational level.
  - Research and development level.
- There is no separation between data acquisition and GIS activities.
  - GIS and contributing disciplines are becoming closely interrelated.
- Urgent need for revisiting traditional photogrammetric activities.
  - Investigate the effect of new data/sensors.

5. 국가GIS 기술개발을 위한 로드맵

(박재문, 정보통신부 정보화지원과장)

국가 GIS 기술개발 방향

2002. 11. 8.

정보통신부 정보화지원과

목 차

- NGIS 기술개발 계획
  - NGIS 기술개발 목표 및 중점 추진과제
  - NGIS 기술개발 추진 전략
- GIS 기술개발 내용
  - GIS 기술발전 로드맵
  - GIS 기술개발 방향
  - GIS 기술개발 세부내용
- 향후 GIS 기술개발 방향
  - 위치기반서비스(LBS) 기술
  - 개방형 공간정보관리(OpenSIM) 기술
  - 통합센서 공간영상 처리 기술
  - 지오미디어 처리 기술
  - 공간영상 서비스 기술

1 NGIS 기술개발 계획

NGIS 기술개발 목표

- 국가차원의 GIS 기술개발에 대한 지속적인 투자로 국가 GIS 사업의 성공과 해외 기술수출 원천을 제공
- 지리정보의 수집·처리·유통 ·활용 등과 관련된 다양한 분야 핵심 기반기술을 단계적으로 개발
- 산 ·학 ·연 합동의 분야별 공동기술개발 및 국가기술정보망을 구축 ·활용

NGIS 기술개발 중점 추진과제

- 첨단 기술동향 분석으로부터 기술 개발 목표 도출
  - 상호운용성 및 재사용성을 위한 공간정보 기술
  - 위치기반서비스 등의 이동통신 연계 공간정보 기술
  - 분산환경에서의 공간정보 기술
  - 공유 및 상호운용을 위한 응용 기술
  - 그외 첨단기술로서 민간에게 파급효과가 큰 기술

- NGIS 사업지원을 위한 공통 기술 개발
  - 기본 지리정보의 구축 관련 기술
  - 기본 지리정보의 유통 기술
  - 정부예산 절감을 위한 재사용 응용 시스템 개발 기술

NGIS 기술개발 추진전략

- 최신기술 동향을 반영한 지속적인 투자로 NGIS 사업의 성공과 해외 기술수출 원천을 제공

- 국가의 역할
  - 민간의 초기투자 위험부담 해소
  - 기술개발촉진을 위한 장려
  - 자유경쟁을 위한 표준화 추진

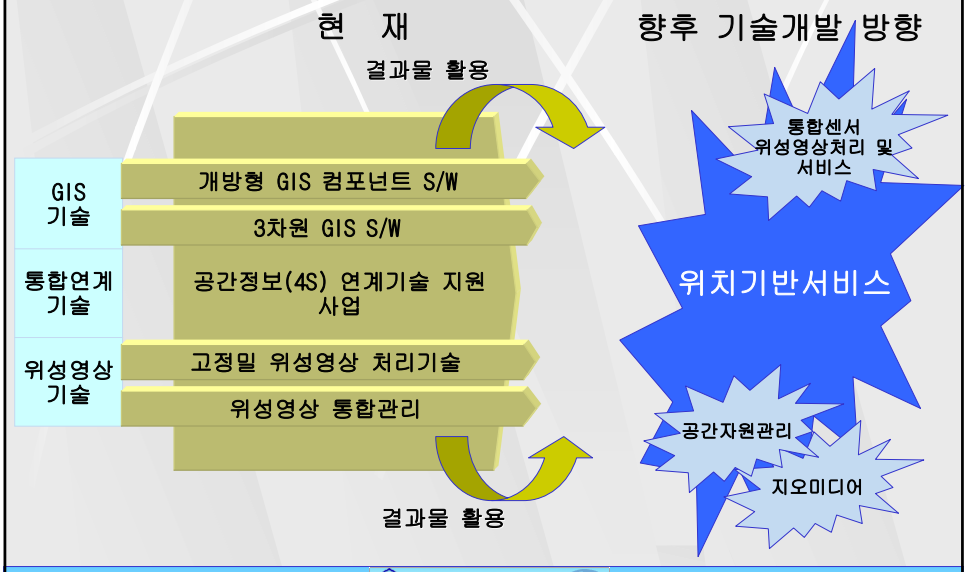
- 국가에서 추진한 공간정보 기술을 축적 및 보급할 수 있는 GIS 기술센터 구축·활용

2 GIS 기술개발 내용

GIS 기술발전 환경변화 예측

구분	2002~2004	2005 ~ 2007	2008 ~ 2010
특징	- 단순 공간 정보의 전달 - 핸드폰 및 PDA 위주의 LBS - 화소기반 공간 영상 처리 - 문자/이미지 컨텐츠	- 양방향 공간 미디어 상호작용 LBS - I-CRM기반 LBS 전자상거래의 발전 - 시공간/비디오/그래픽 컨텐츠 통합 - 고정밀 위치획득 기술	- 다중 공간 미디어 실시간 분산 처리 - WearablePC 기반 대화형 LBS - 디지털 공간영상정보 표현의 실감화 - 인간중심 LBS 모델
개인화	-사용자 위치 기반 맞춤 서비스 -단순한 사용자 프로파일 관리 -화자인식 기본기능	-양방향 상호작용 서비스 -Security에 의한 접속 데이터 권한 제한 -동적인 정보관리 기술 -정보의 2D 표현 기술	-지능형 사용자 관리 기능 -Privacy 보호에 따른 서비스 차별 -인간중심의 사용자 모델링 -정보의 3D 기술
멀티미디어화	-바디오/공간정보 처리 -한 3D 모델링/애니메이션 -문자/이미지 컨텐츠 -고속 벡터 표현기술 -3D 그래픽 기반의 단일 사용자 환경	-비디오/그래픽/시공간정보 처리 -동영상 컨텐츠 -3차원 공간영상 정보 표현 기술 -네트워크기반의 다중사용자 툴	-다중 공간 미디어 정보 처리 -디지털 공간영상정보 표현의 실감화 -다중사용자/다중환경 VR 콘텐츠
이동성	-단방향 모바일 공간 미디어 처리 -Cell 기반 특정지역에서의 서비스 -정보검색 Agent	-양방향 모바일 공간 미디어 처리 -Cell/GPS 기반 특정 지역에서의 서비스 -이동단일데이터베이스 접근 -LBS 및 ICRM 기반 기술	-Wearable 공간 미디어 처리 -GPS 기반 Global 서비스 -이동 이종 데이터베이스 접근 -대화형 LBS 및 gCRM
통합화	-바디오/공간정보 통합 -목적 지향 서비스 -광학센서간 통합 -제한된 양 및 영역 -대용량 공간정보처리	-바디오/그래픽/시공간정보 통합 -개방형 서비스 -이종 센서간 통합 -대용량 및 제한된 영역의 음성처리 -공간정보 상호연계 처리기술	-다중 공간 미디어 정보 통합 -분산 개방형 서비스 -센서간 완전 통합 기술 -대용량 및 무제한 영역의 음성처리 -통합공간정보처리 응용기술
지식화	-미디어 저장,검색,전송 기능 -문자 중심 검색, 정보제공 -화소기반 영상처리 -키워드/키맥트 검색	-시공간 분석 및 질의처리 기능 -지식기반 정보추출 -음성 인식에 의한 검색, 정보 제공 -실시간자동분류	-고급 의사 결정 지원 기능 -분산형 공간정보 추출 -문서 이해 기술 개발
실시간	-단방향 스트리밍 기술 -망 기반 부하 분산 -Best Effect 기반 품질보장	-양방향 스트리밍 기술 -콘텐츠 기반 부하 분산 -자원위주 품질 보장	-인터랙티브 스트리밍 기술 -실시간 공간정보 구축 -서비스 품질 보장 기반

GIS 기술개발 방향

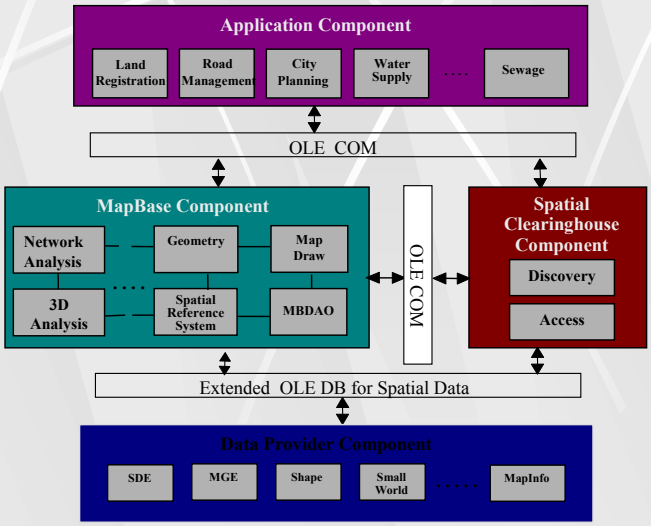


개방형 GIS 컴포넌트 S/W

지자체 실무에 적용이 가능한 GIS 응용 정보시스템을 부품으로 조립하여 적은 비용으로 손쉽게 개발/활용할 수 있는 OLE/COM 기반의 Component 소프트웨어 개발

- 데이터제공자 컴포넌트
  지자체 실무에서 기존에 이용되고 있는 공간 데이터베이스 정보를 On-Line으로 접속하여 자료를 획득하는 Component
- 핵심 공통 컴포넌트
  GIS응용 S/W 시스템에서 실무업무에 공통적으로 적용되는 GIS 핵심 기능 Component와 표준 인터페이스
- 지자체 응용 컴포넌트
  도로관리, 도시계획, 토지/지적관리, 상수도관리, 하수도관리 등 지자체에서 필요한 업무를 GIS 기능을 통해서 자동화한 Component
- 정보유통 컴포넌트
  분산환경에서 공간정보를 유통할 수 있는 소프트웨어 개발 및 핵심공통 컴포넌트 등의 개발 성과를 활용할 수 있는 서비스 Component

개방형 GIS 컴포넌트 S/W



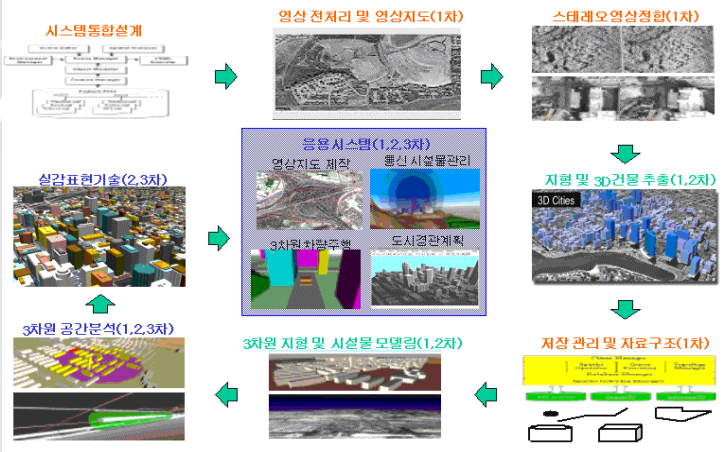
3차원 GIS S/W

고해상도 영상으로부터 도시의 지형 및 주요 시설물의 3차원 정보를 구축하고, GIS 및 증강현실기술과 연동하여 공간정보의 저장, 처리, 가공, 분석이 가능한 S/W 및 실용화 시스템 개발

- 3차원 GIS 핵심 컴포넌트 개발
  - 전처리 및 영상지도 제작 컴포넌트 개발
  - 3차원 공간데이터 처리, 분석, 저장, 검색 컴포넌트 개발

- 3차원 GIS 실용화 시스템 설계
  - 다차원 지리정보의 유기적 통합 관리 기술 개발
  - 입체 시설물 및 3차원 지형의 다단계 동적 모델링 기술 개발
  - 영상기반 3차원 형상 추출 및 후처리 가공 기술 개발
- 활용 내용
  - 3차원 공간분석을 통한 중요 정책 및 의사 결정 지원
  - 실시간 3차원 GIS 서비스를 통한 인터넷 관련 산업 다양화

3차원 GIS S/W

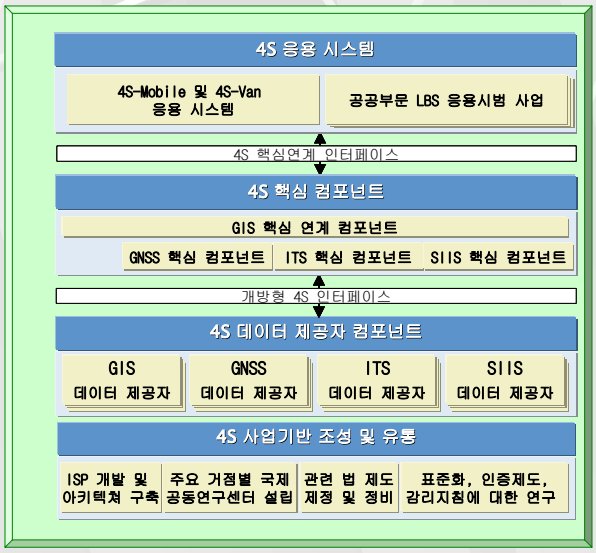


공간정보(4S) 연계기술 지원사업

4S(GIS, SIIS, GNSS, ITS)의 통합연계와 고도정보서비스를 위한 기술을 개발하고 국가적 4S 활성화를 위한 기반연구 및 기술지원체계 구축

- 4S 연계 기술 개발 : 4S 핵심 기능들을 컴포넌트로 개발
- 4S-Van 기술 개발 : 고품질의 공간정보 구축을 위한 차량 탑재 H/W
- 모바일 환경에서 공간데이터 통신 서비스를 위한 4S-Mobile 응용 S/W 개발 및 통합환경 구축
- 모바일 환경에서 공공부문 작업을 지원하는 단말기 (웹패드) 개발
- 재난재해 관리를 위한 컴포넌트 및 시스템 개발 : 공공부문 LBS 의 기반 기술 제공
- 4S 기반조성 연구 : 4S ISP 수립, 법제도 연구, 인증.감리 연구

공간정보(4S) 연계기술 지원사업



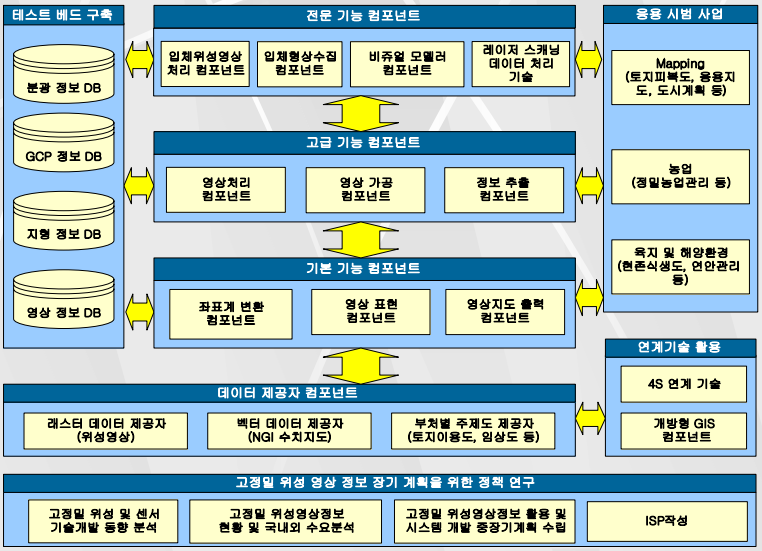
고정밀 위성영상 처리기술

고정밀 위성영상 처리·분석 핵심기술을 컴포넌트 S/W로 개발하여 아리랑 2호 영상에 즉시 활용 가능한 선진국 수준의 기술 확보와 국내 공간영상정보 관련 산업의 활성화 도모

- 주요개발결과
  - 위성영상 표준자료 구조 및 공통 뷰어 구현
    : 국제 표준에 따른 표준 자료구조 구현 및 뷰어 콘트롤 개발
  - 컴포넌트 기반 고정밀 위성처리 엔진
    : 일반, 고급, 전문 사용자들을 위한 9개의 기능별 컴포넌트 및 1개 기반 기술 클래스 개발
  - 고정밀 위성영상 처리 기술 검증용 Test-bed 구축

- 주요활용방안
  - 고정밀 위성영상 및 아리랑 2호 영상처리 및 분석
  - NGIS와 연계하여 각 부처에서 필요로 하는 위성영상 처리 소프트웨어를 컴포넌트로 조합하여 제공
  - 위성영상 자료를 도시계획, 토지실태조사, 재난/재해 분석, 환경감시 등에 활용

고정밀 위성영상 처리기술



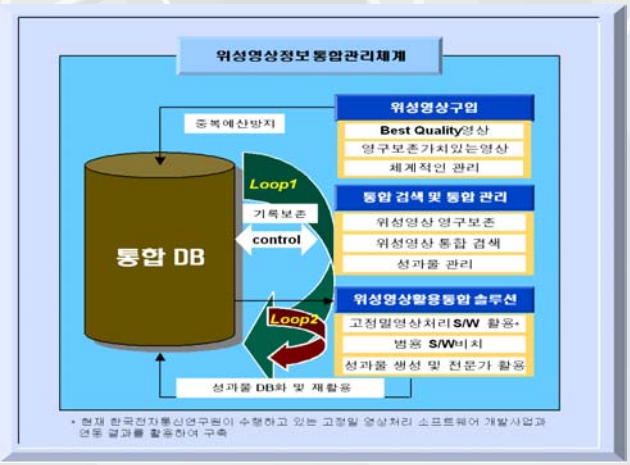
위성영상정보 통합관리사업

국가적 차원에서 위성영상/성과물의 기록보존 및 공동활용을 위한 위성영상 통합관리체계를 구축

- 위성영상 및 관련정보 통합구축, 기록보존체계 수립
  - 영구적 기록보존체계의 수립으로 위성영상정보 관리체계 효율화
  - 원시 위성영상정보, 사업성과물의 통합구축
  - 위성영상정보 중복취득/개발 방지

- 위성영상정보/솔루션 제공 서비스체계 구축 및 관련 기술개발
  - 네트워크를 통한 위성영상정보와 성과물의 통합 검색
  - 위성영상 활용 S/W Tool 공급, 위성영상 및 성과물 제공
  - 수신데이터 처리기술 개발 및 구축데이터의 관리를 위한 압축, 저장, 전송기술 개발

위성영상정보 통합관리사업

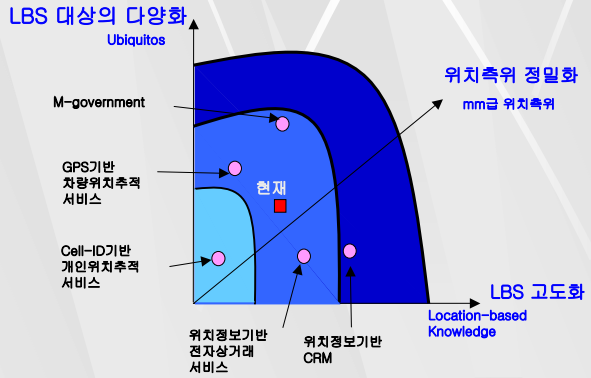


3 GIS 기술개발 방향

위치기반서비스(LBS) 기술

휴대폰, PDA 및 IMT-2000 등의 다양한 무선 통신 단말기 및 이동 통신망을 위한 LBS 원천 기술 및 핵심 기술 개발

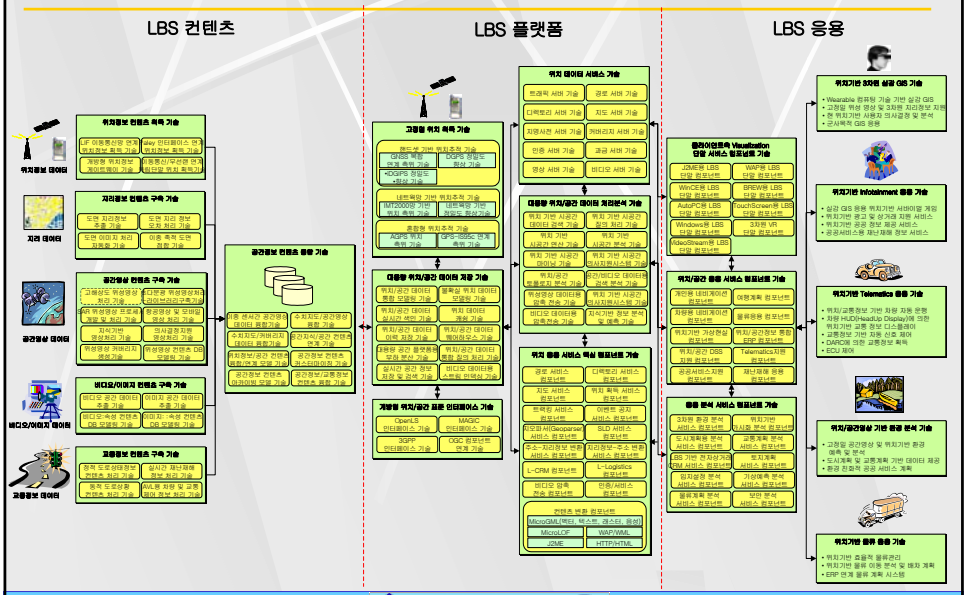
- 미래 LBS 환경 변화



위치기반서비스(LBS) 기술

- 고정밀 위치정보 측위 기술 개발
  - 핸드셋(GNSS) 기반, 통신망 기반, 혼합형 LDT 요소 기술 연구
  - 개방형 위치정보 게이트웨이 인터페이스 연구
- 실시간 위치정보 응용 플랫폼 기술 개발
  - 위치정보 및 이동객체 데이터 처리 플랫폼 기술 연구
  - 대용량 위치정보 실시간 처리 기술 연구
  - 개방형 위치정보 응용 플랫폼 인터페이스 연구
- 개방형 위치정보 응용 서비스 기술 개발
  - 개방형 위치정보 응용 핵심 공통 컴포넌트 기술 연구
  - 개방형 위치정보 응용 서버 기술 연구
  - WAP, Java, KVM, XML, Web 위치정보 서비스 기술 연구

위치기반서비스(LBS) 기술



기타 기술개발 내용

- 개방형 공간정보(OpenSIM) 기술
  - GIS를 기업 정보 관리 시스템(ERP)과 통합함으로써, 기업 일반 자원과 공간 자원을 통합관리하여 기업 및 정부의 경쟁력을 제고시키기 위한 기술
- 통합센서 공간영상 처리기술
  - 다양한 공간영상정보를 통합하여 해석/처리할 수 있는 기술을 개발함으로써, 다양한 소요 목적에 대응하는 최적의 공간정보를 생성 및 제공하기 위한 기술
- 지오미디어 처리기술
  - 공간정보와 결합된 그래픽, 이미지, 동영상, 음향 등의 복합 미디어가 서로 유기적으로 연결되고 의사소통하며 상호작용함으로써 극대화된 지리정보 환경을 제공하는 시스템
- 공간영상서비스기술
  - 공간영상정보에 대한 컨텐츠 제공, 검색 및 주문서비스를 제공하고, 사용자의 수준에 맞는 맞춤형 서비스를 제공하는 서비스

정보통신부 24

6. 4S 기술 및 비디오 GIS 기술 등 최신 기술개발

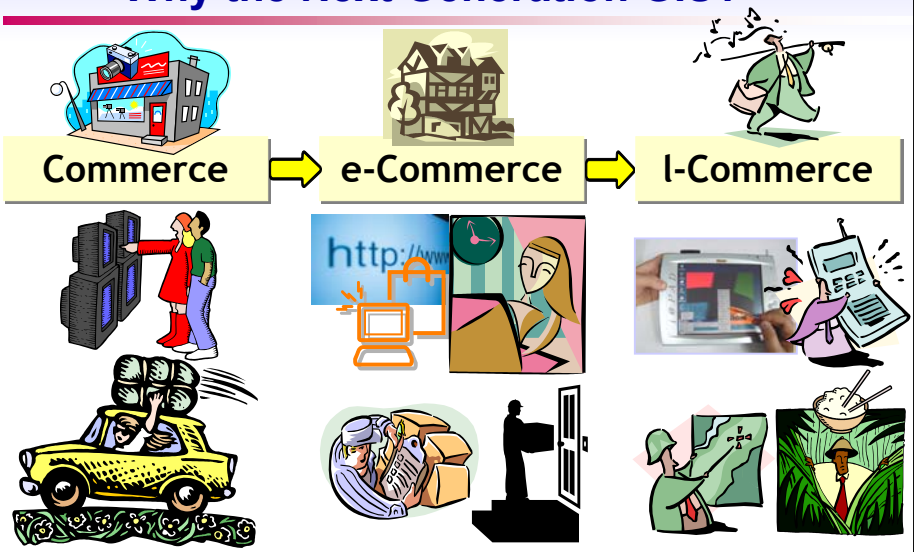
(이종훈, 한국전자통신연구원)

The Present Status of Technological Development for the Next Generation GIS

Jong-Hun Lee

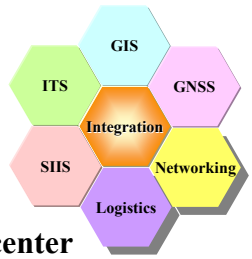
Director
Spatial Information Technology Center
Computer & Software Research Laboratory
Electronics & Telecommunications Research Institute

Why the Next Generation GIS?



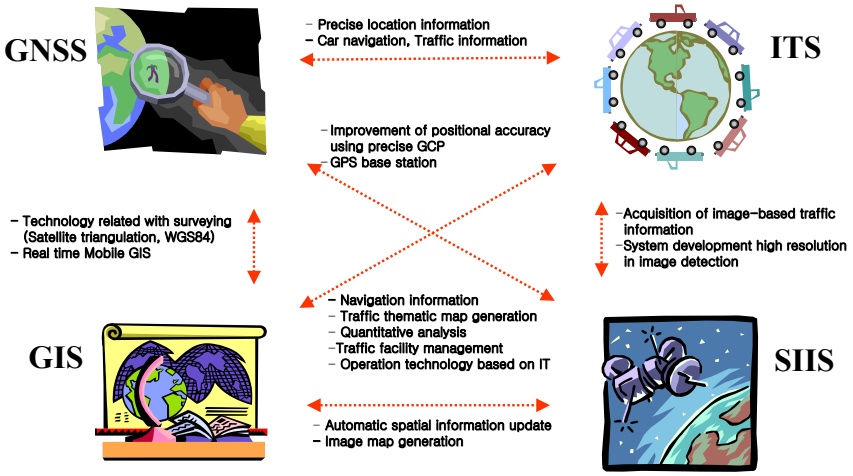
Activities of SITC, ETRI

- developing the technologies on
  - GIS(Geographic Information Systems)
  - SIIS(Spatial Imagery Information Systems)
  - SIA(Spatial Information Application)
  - 4S(GIS, SIIS, GNSS, ITS) Integration



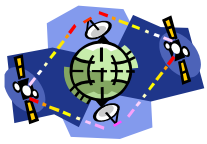
- about 40 researcher are working for the center
- contributing to the development of efficient national information infrastructures and further to a rise in international competitiveness by presenting spatial technologies of national importance

Relation of Spatial Information

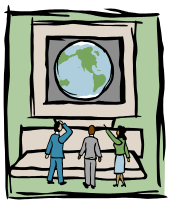


Next Generation GIS Researches in SITC

Location-Based Services



3D GIS Software
High Resolution Satellite image Processing
Integrated Satellite Imagery Information Management
4S Integration



Open Component-based GIS S/W

Open Component-based GIS S/W(1)

Goals

- Development of **Open GIS Component S/W**
- Features
  - Open GIS architecture : Universal data access for various spatial data source
  - OLE/COM based GIS component software : Development of diverse GIS applications by assembling functional components

Advantages

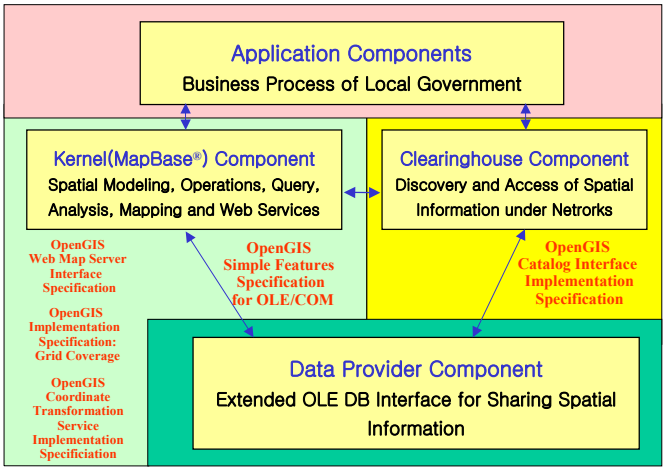
- Reduction of developing cost and duplicated investment of GIS applications
- Acquiring interoperability among the legacy database
- Spatial information services of fine quality through internet

Open Component-based GIS S/W(2)

Open GIS Component S/W

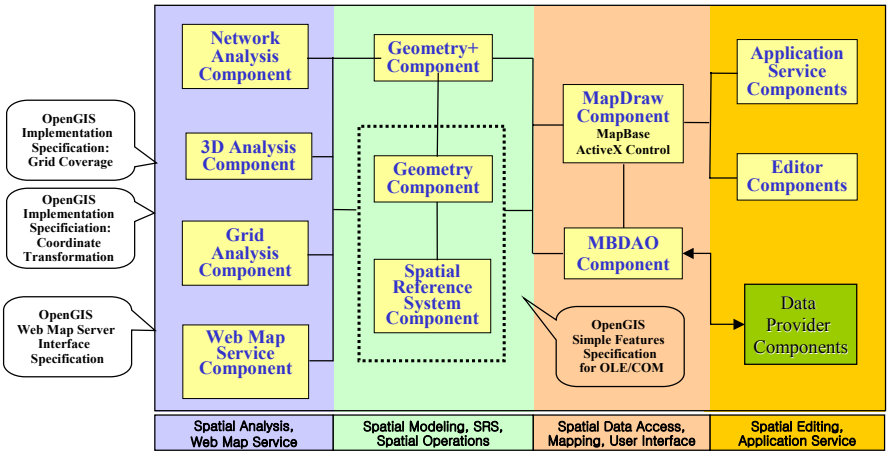
Open Component-based GIS S/W(3)

Open GIS Component Architecture



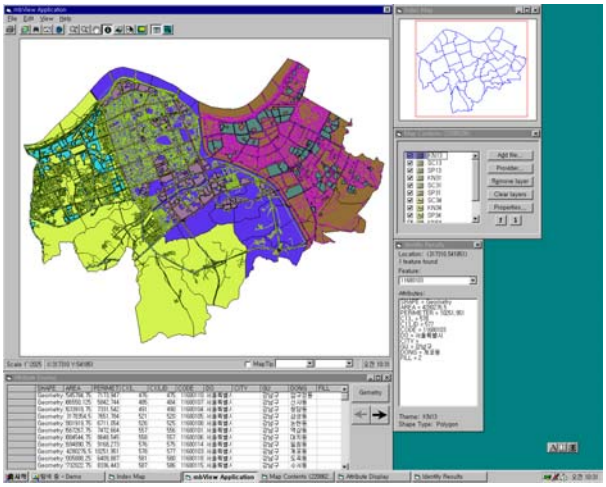
Open Component-based GIS S/W(4)

MapBase® Component



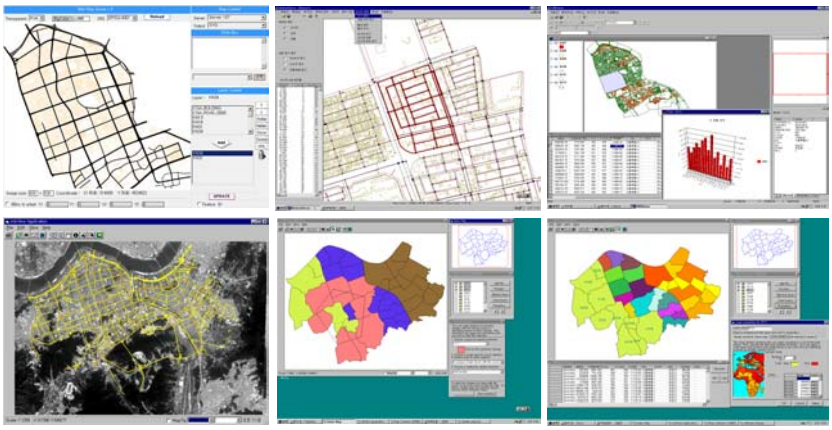
Open Component-based GIS S/W(5)

Client Program of MapBase® Component



Open Component-based GIS S/W(6)

Use Example



3D GIS Software(1)

Goal

Development of software which build 3D geographic data of terrain and facility in urban area from the high-resolution satellite imagery, and process, analyze and distribute spatial information with GIS and Virtual Reality technology.

Ultimate Goal

Media GIS

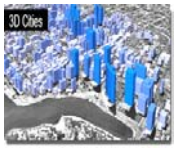
The ultimate goal in the future is the integrated media geographic environment in which graphic, video, image, sound, and text are linked with spatio-temporal information and communicate each other.

3D GIS Software(2)

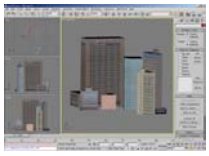
Technical Flows

Stereo Satellite Image Processing

Extract 3D Facilities



Editing and importing



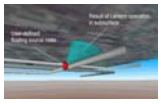
Application Systems

Radio Propagation Mng.

City Planning

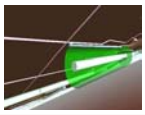
Video GIS

Pipeline Management



VR Environment

3D Spatial Analysis



Modeling

3D GIS Software(3)

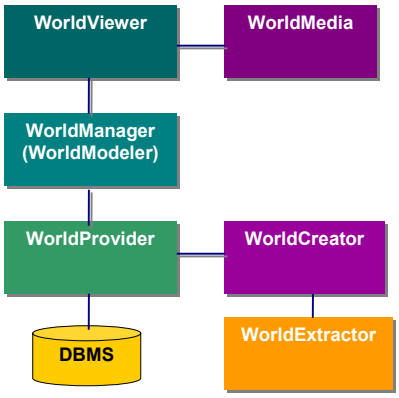
Architecture & Key Features

Component-based architecture easily adapted to Web-applications!

- Link DEM, building, road
- Texture mapping
- Free navigation
- Picking

- Multi-level modeling
- Utilizing XML
- Complex shape support
- Spatial analysis

- OGC OLE/COM
- Spatio-temporal operation
- 3D spatial indexing
- Spatial query processing



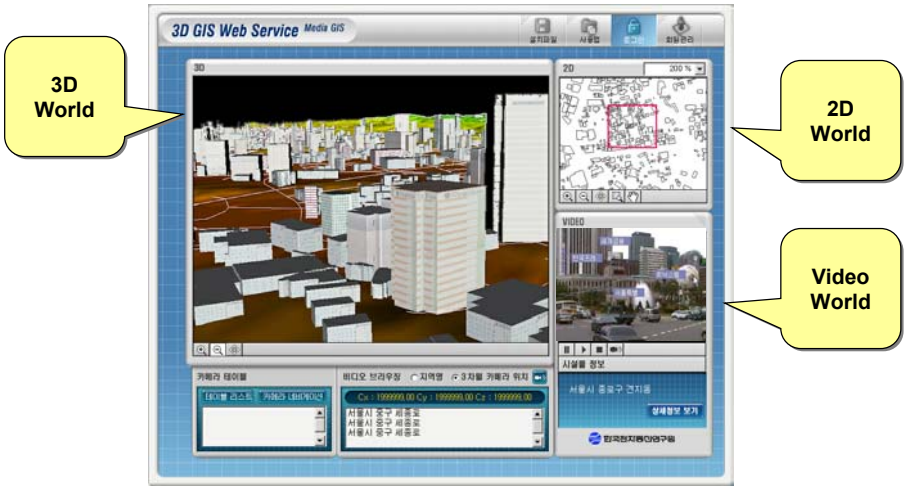
- Video-based GIS
- Object in video selection
- Web application
- Mobile application

- Shp, obj file import
- 2D & 3D object editing
- Attributes editing
- Shp, XML, dxf, DB export

- Spatial imagery processing
- 3D shape extraction
- DEM extraction

3D GIS Software(4)

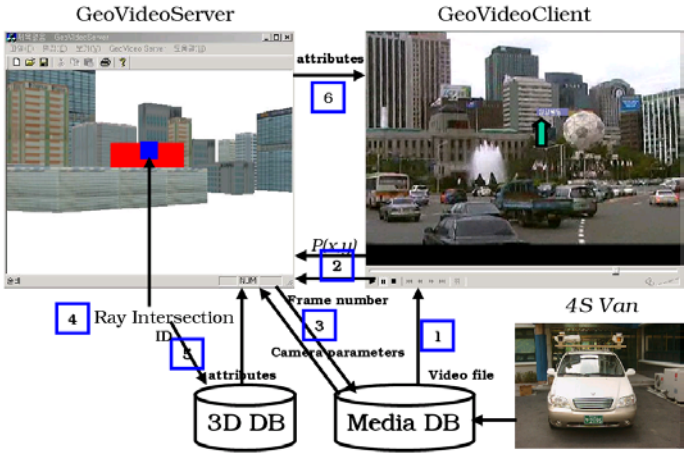
2D/3D Geographic World Linked to Video Augmented World



3D GIS Software(5)

GeoVideo : ETRI developed VideoGIS

Concepts and system architecture is applied to domestic(Korea) and overseas patent now.



3D GIS Software(6)

GeoVideo in Web Environment

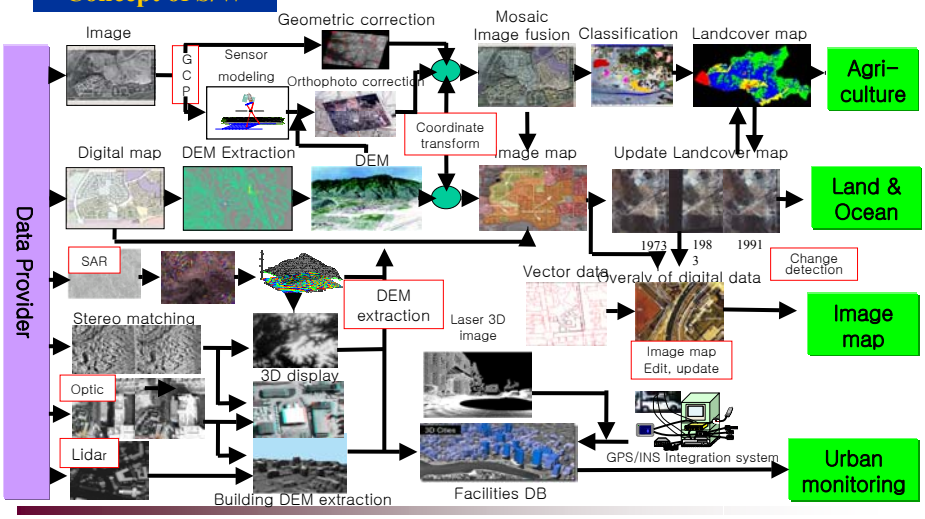
High Resolution Satellite Image Processing(1)

Goals

- Component S/W development
- Core technology of high-resolution satellite image processing and analysis
- Technology development for KOMPSAT-2 application
- Construction of test-bed

High Resolution Satellite Image Processing(2)

Concept of S/W



High Resolution Satellite Image Processing(3)

Results

- Development of the processing and application technology for high resolution satellite imagery
- Preparation of the domestic technology for KOMPSAT-2 satellite imagery
- Construction of test-bed for the calibration/validation of the technology related to satellite imagery
- Suggestion of the policy for the satellite image application
- Support the S/W tools for construction of national framework data from satellite imagery and MMSS data for NGIS Project of Korea

High Resolution Satellite Image Processing(4)

Future Works

- RS data integration/fusion technology development
  - Various satellite and sensor integration/fusion technology
  - Multi-platform integration technology
  - Sensor independent data processing technology development
  - Optical vs. non-optical data fusion and application
- Domestic satellite supporting system development
  - Specific technology development for domestic satellites
  - Exclusive S/W development for KOMPSAT Series
  - Application system development for public institutions
  - Commercial S/W development to export

Integrated Satellite Imagery Information Management(1)

Goals

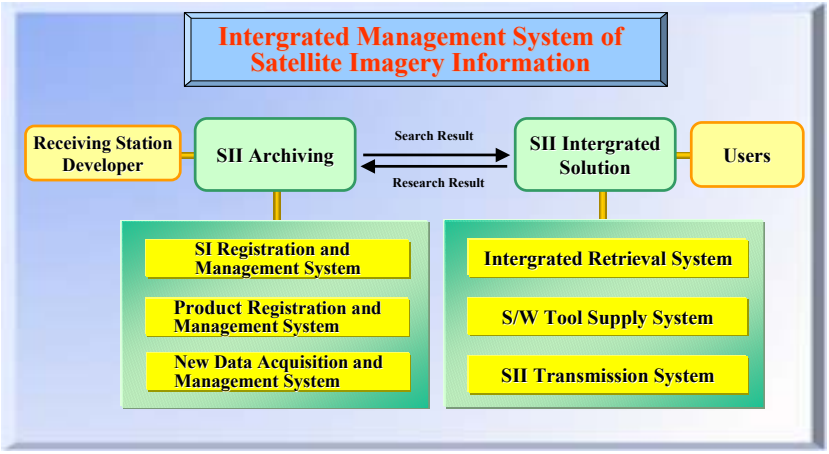
- Construction of integrated DB for satellite imagery and meta-data
- Construction of transmission system for satellite imagery and custom-ordered S/W

Project Topics

- DB construction by purchase of the past satellite imagery
- Construction of Web environment for serving users
- Development of technology for Landsat-7 reception
- Registration / management of products from research

Integrated Satellite Imagery Information Management(2)

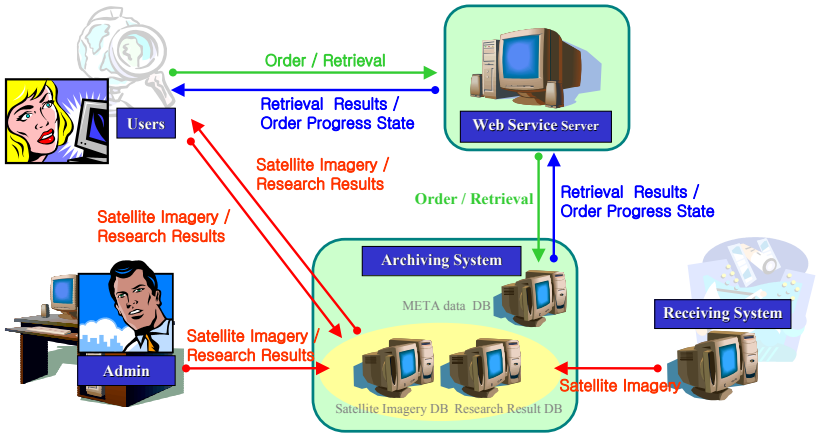
The Flow of Project



∴ SII : Satellite Imagery Information

Integrated Satellite Imagery Information Management(3)

The Concept of Project



Integrated Satellite Imagery Information Management(4)

Results of Project

Integrated Management System of Satellite Imagery Information

Receiving
- Landsat7 reception S/W
- Medium production S/W
- Photographing schedule S/W

Archiving
- Purchase of the past satellite imagery (Best Quality)
- Construction of archiving system

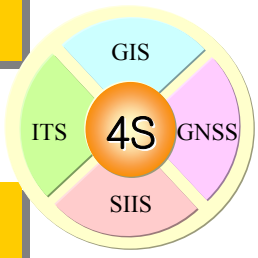
Services
- Retrieval and order on Web interface
- Catalog interface observing the OGC

Technology
- Storage management and retrieval for massive image data
- Image compression
- Geometrical correction for semi-/ automation

4S Integration and VideoGIS (1)

Goal

❖ Development of component-based technology for integration of 4S (GIS, SIIS, GNSS, ITS) legacy systems and VideoGIS

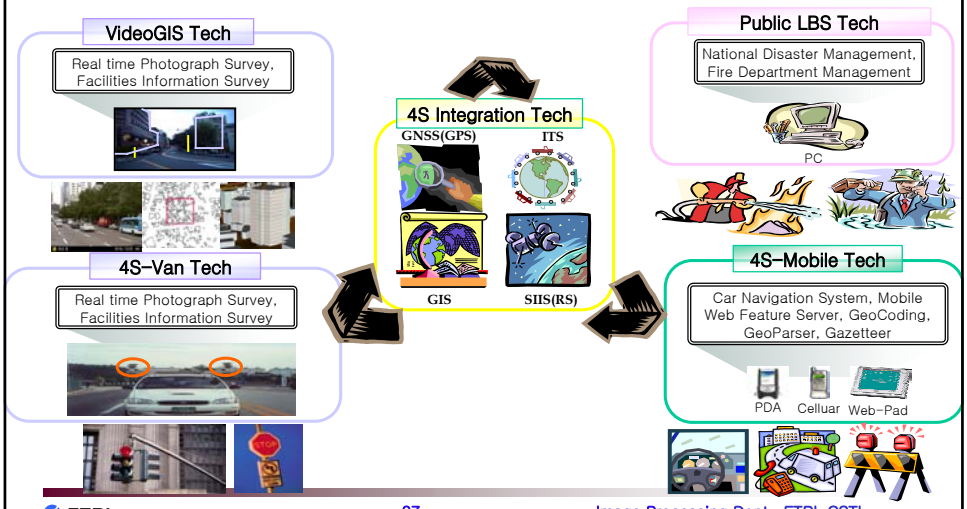


Technology

❖ Integration of Video and GIS Technology
❖ 4S-Van Component Technology
❖ 4S-Mobile Component Technology
❖ 4S Kernel/Integration Component Technology
❖ Public LBS Technology

4S Integration and VideoGIS (2)

Concept



4S Integration and VideoGIS (3)

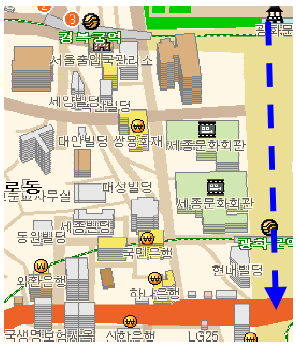
VideoGIS

- To construct geographic DB with low cost
  - Calculating 3D positions of geographic objects based on data from GPS/INS and stereo video
- To provide more realistic information of chosen geographic objects
  - Supporting video for a selected object from a 2D map (***MAP2Video***)
  - Locating corresponding 2D object/location selected from a video sequence (***Video2MAP***)
- To update geographic DB fast and accurately
  - Helping to locate damaged geographic objects
  - Correcting an existing map for newly built road and geographic objects
- To support detailed information of chosen geographic objects
  - Providing attributes of building or other geographic objects
- To provide stereo video for applications running on PDAs
  - Providing recorded stereo video via MPEG-7 standard

4S Integration and VideoGIS (4)

VideoGIS

- MAP → Video
  - Displaying video for a selected road/object from a 2D map



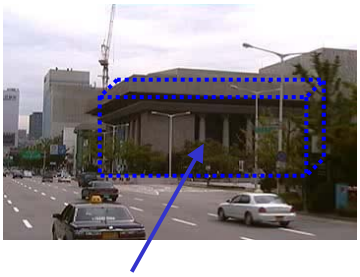
1. Select a road or an object in a MAP

2. Displaying the corresponding video

4S Integration and VideoGIS (5)

VideoGIS

- Video → MAP
  - Locating 2D positions of objects from a video sequence



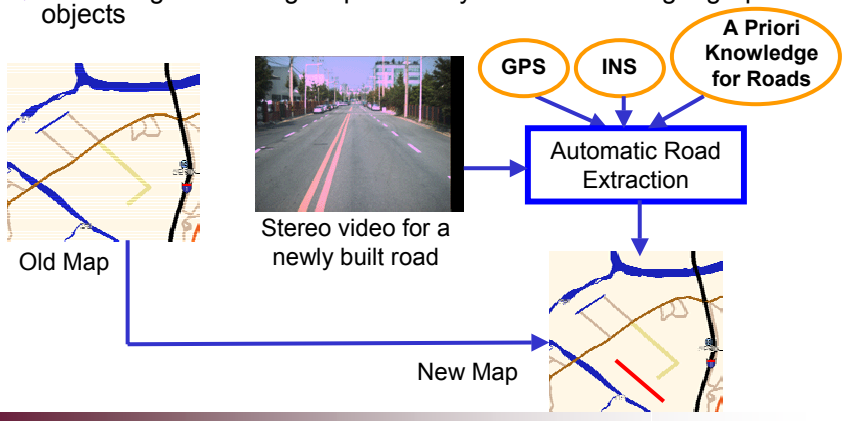
1. Selecting an object from a video sequence

2. Locating 2D position of the chosen object on a MAP

4S Integration and VideoGIS (6)

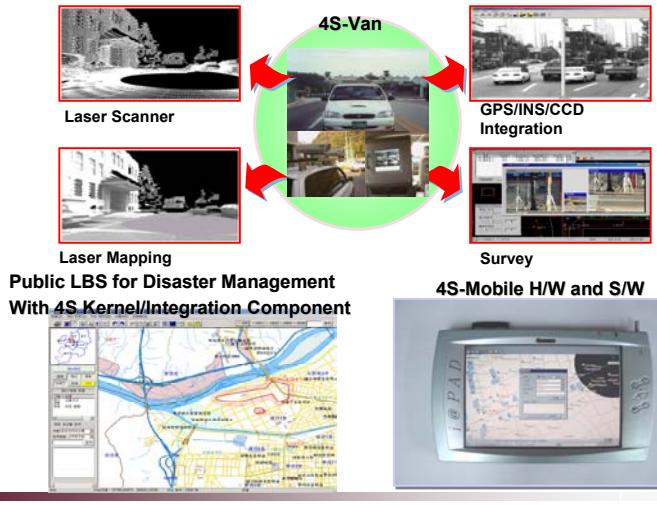
VideoGIS

- Updating Geographic DB via VideoGIS
  - Correcting an existing map for newly built roads and geographic objects



4S Integration and VideoGIS (7)

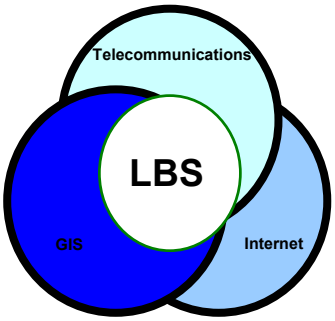
Results of 4S



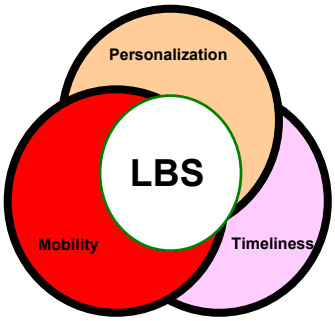
Location-Based Services(1)

What is LBS?

❖ From the Viewpoint of **Technology**

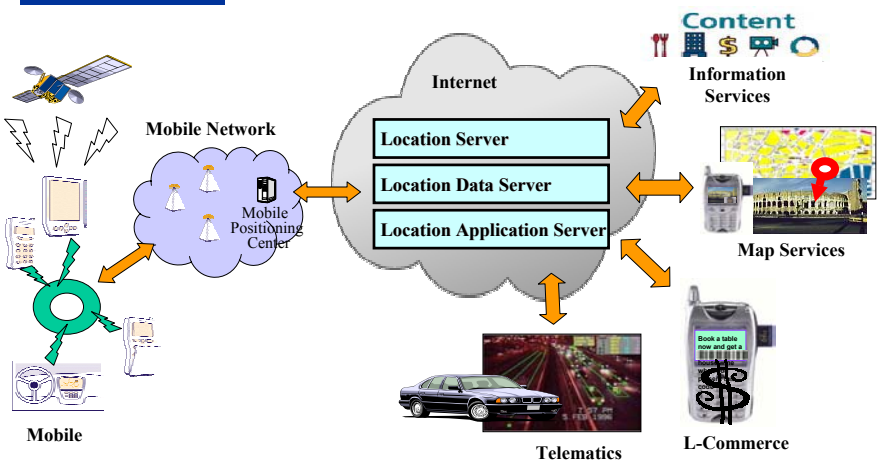


❖ From the Viewpoint of **Characteristics**



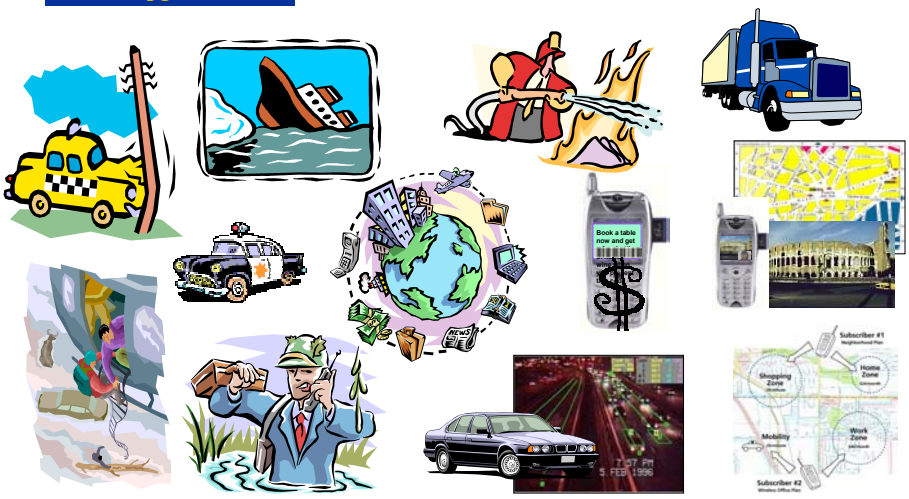
Location-Based Services(2)

LBS System



Location-Based Services(3)

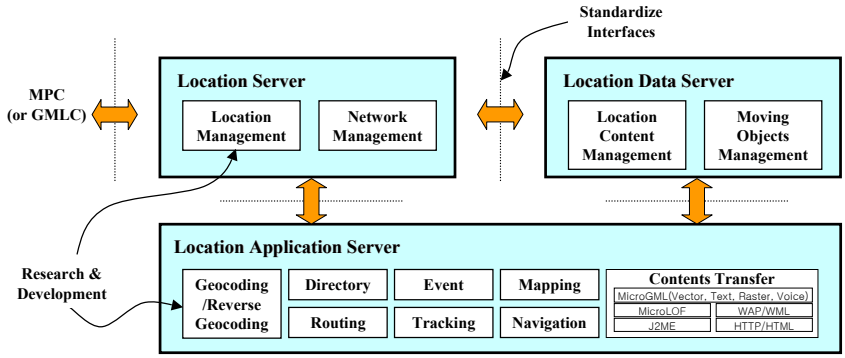
LBS Applications



Location-Based Services(4)

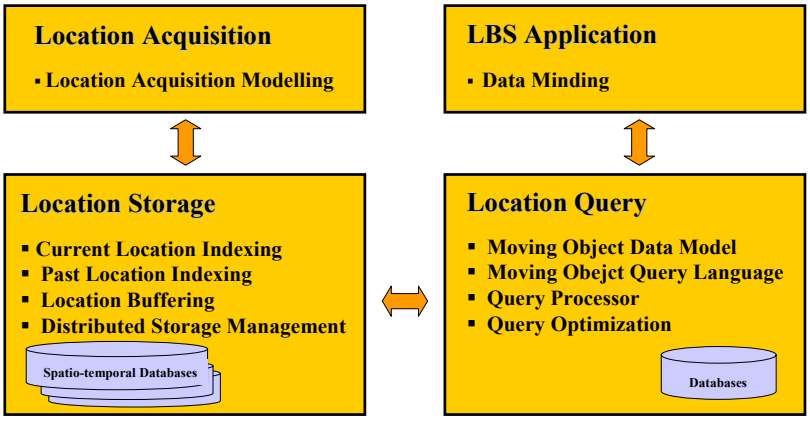
Final Goals

- Regulation & Standardization
- Research & Development



Location-Based Services(5)

Current Research Field : Moving Objects Management



Location-Based Services(6)

Future Directions

- Launching new R&D Projects (2003~)
- Defining the Stardard Interfaces comprising the Location Data Server and the Location Application Server
- Complying with the approaches of "Open-LS" proposed by OGC
- Developing the "OPEN MOBILE LBS PLATFORM TECHNOLOGIES" comprised of
  - Location Server
  - Location Data Server, and
  - Location Application Server
- Enhanching the functionality of Moving Object Management System
- Applying the developed technologies to the real-world applications

Thank You!

7. Analysis and Visualization of Large-Scale Multidimensional Data Sets

(Rochon, Gilbert, Univ. of Purdue)

Next Generation Remote Sensing

The 7th International Seminar & Workshop on GIS
Seoul, Korea
November 8, 2002

Gilbert L. Rochon, Ph.D., MPH

Associate Vice President, Collaborative Research & Engagement
Courtesy Professor, Earth & Atmospheric Sciences

Purdue University, Information Technology
West Lafayette, Indiana, USA

rochon@purdue.edu

- OUTLINE:
  - Aerial Reconnaissance
  - Orbiting Satellites
  - Earth Observing Satellites- A Brief History
  - Earth Observing Satellites- The Current Array
  - Future Remote Sensing
  - Next Generation Remote Sensing
  - Fusing Remote Sensing with Other Technologies
  - Remote Sensing Policy Issues
  - Real-Time Remote Sensing & Real-Time GIS
  - Remote Sensing & Sustainability

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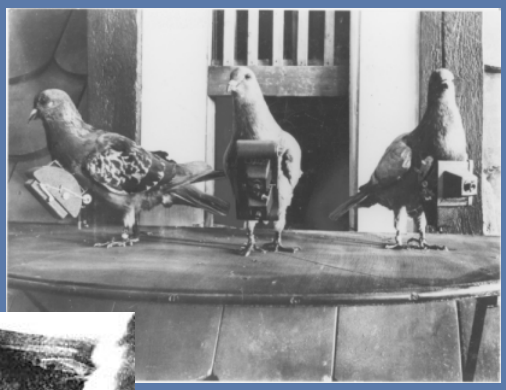
ITaP INFORMATION TECHNOLOGY AT PURDUE

- Aerial Reconnaissance
  - **Hot Air Balloons:1840's**
  - **Avian Remote Sensing**
  - **Aircraft**
    - U2 Plane
    - NASA Aircraft
    - Private Sector



Pigeon Fleet: Late 19th Century

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NASA Wallops Island
Hot Air Balloon

NASA Stennis Lear Jet

Airborne remote sensing has heretofore been the method of choice for high resolution over flights, utilizing experimental sensors & pre-launch testing of precursor instrumentation.

CALIBRATED AIRBORNE MULTISPECTRAL SCANNER (CAMS)

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U2 Spy Plane Versions-Lockheed

Fargo, North Dakota-
Image taken by U2

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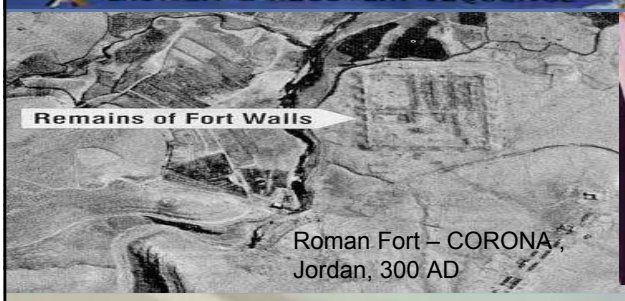
Satellite: 6-8ft.resolution approved by Eisenhower-1958 Declassified by Clinton-1995. 850,000 images: 1960-1972:Corona, Lanyard & Argon



Roman Fort – CORONA, Jordan, 300 AD

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- Orbiting Satellites
  - Military
  - Communications
  - Astronomy
  - Geo-positioning
    - Global Positioning System (GPS) - USA
    - GLONASS - Russia
    - Galileo – European Space Agency (ESA)
  - Earth Observation

Galileo: 30 satellites, orbiting at 23,616 km –Medium Earth Orbit (MEO), with real-time 1 m. positioning accuracy, expected to be fully operational in 2008

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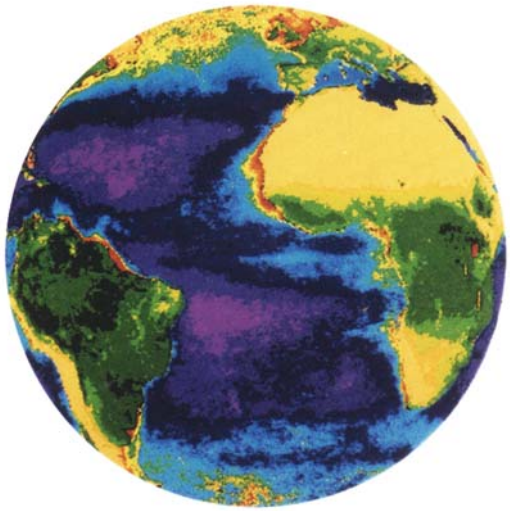
- Earth Observing Satellites: A Brief History

1958-1967

The TIROS Program

Television Infrared Observation Satellite



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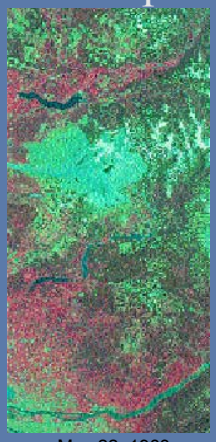
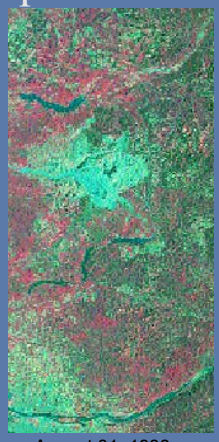
- Mount Saint Helens Eruption Sequence: MSS

Sept. 15, 1973



May 22, 1983



August 31, 1988

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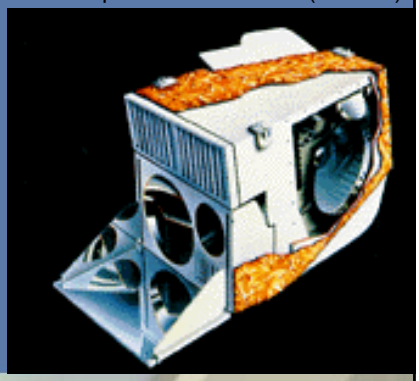
http://modland.nascom.nasa.gov/gallery/?Korea.A2000097.0235.825x1075.jpg

MODIS Image: April 6, 2000

Korea

36 Bands

Moderate Resolution Imaging Spectro-Radiometer (MODIS)



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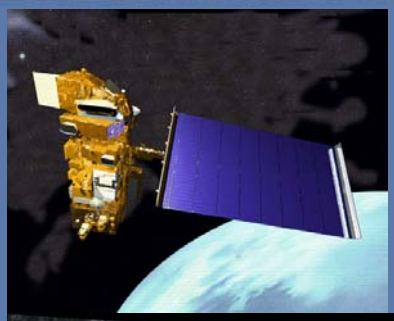
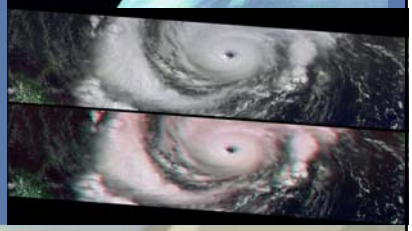
ITaP INFORMATION TECHNOLOGY AT PURDUE

- NASA's EOS Terra
  - ASTER-Advanced Spaceborne Thermal Emission & Reflection Radiometer
  - MODIS-Moderate Resolution Spectro-Radiometer
  - CERES-Clouds & the Earth Radiant Energy System
  - MOPITT- Measurements of Pollution in the Troposphere
  - MISR- Multi-Angle Imaging Spectroradiometer (Hurricane Lili-Off Louisiana Coast, Oct. 10, 2002)





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Time-Sensitive Disaster Assessment: The World Trade Center Military EC-3 Recon Photo

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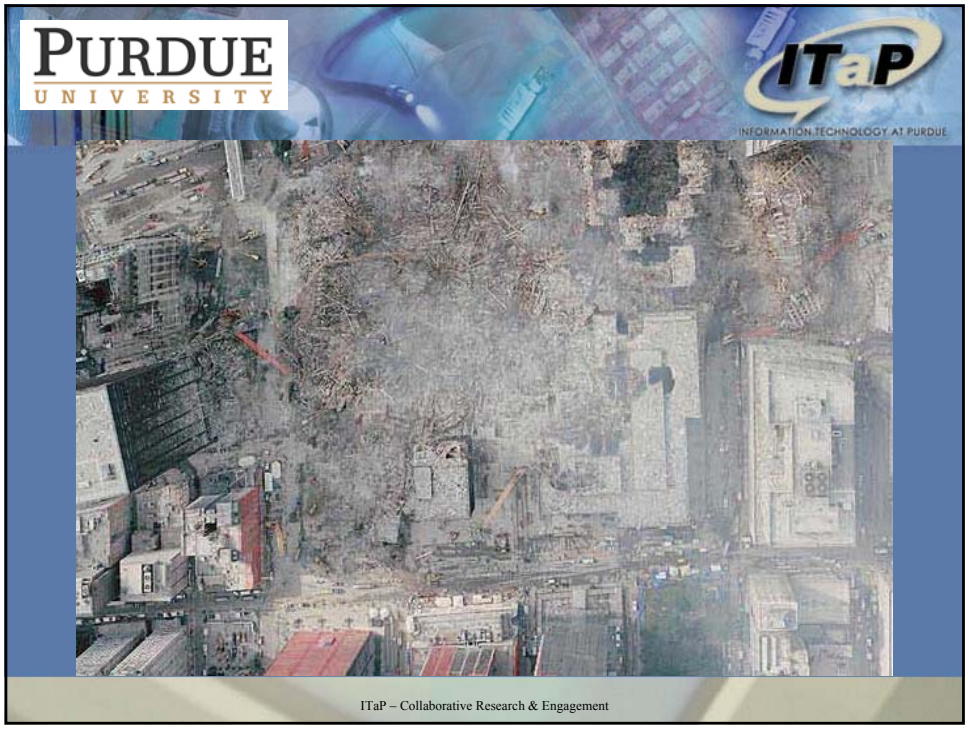
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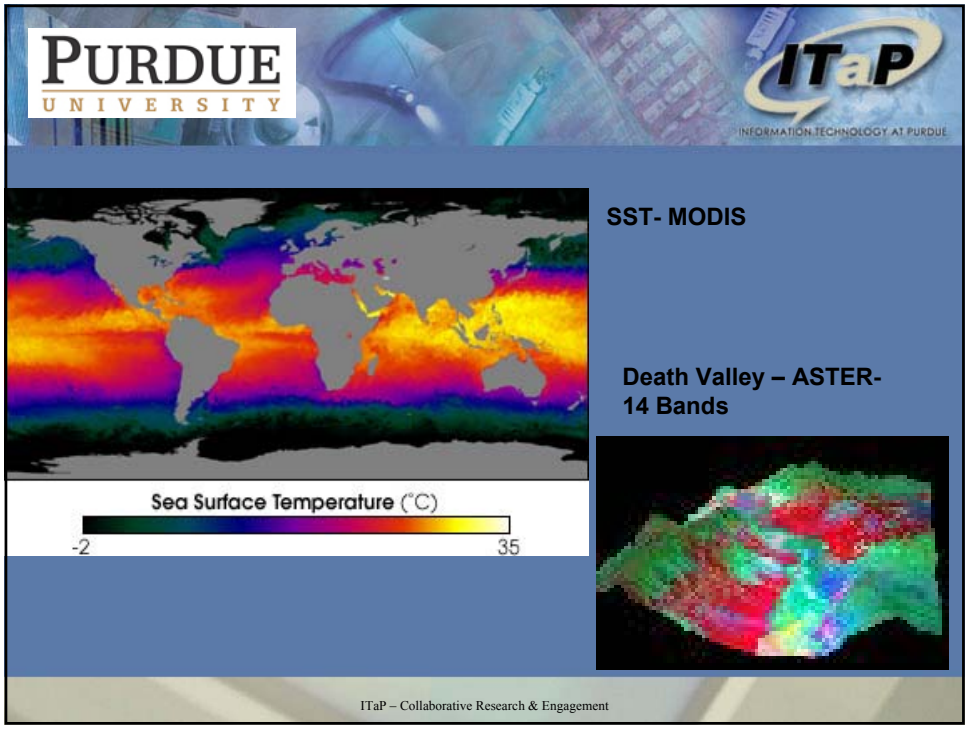
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SST- MODIS
Sea Surface Temperature (°C)
-2
35
Death Valley – ASTER-
14 Bands
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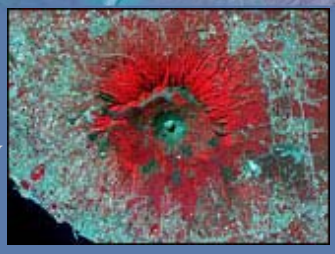
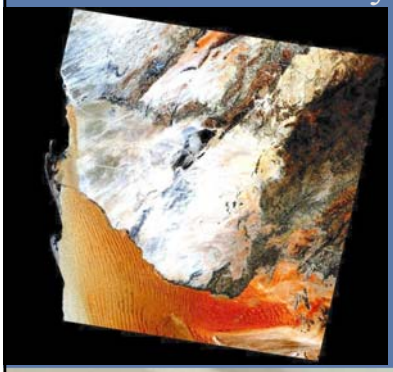
ITaP INFORMATION TECHNOLOGY AT PURDUE

- Earth Observing Satellites: The Current Array



Mount Vesuvius, Italy -ASTER



Landsat 7: Namibia Kuiseb River, Aug. 26,1999. Forms the northern border of the world's largest sand dunes.

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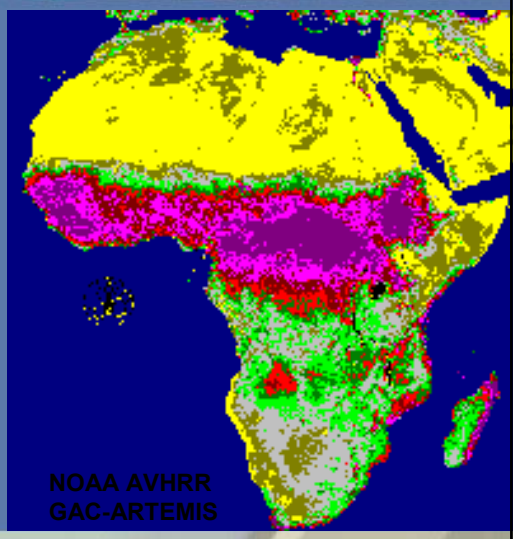
- DOC NOAA- US Dept of Commerce, National Oceanic & Atmospheric Agency
  - Landsat
  - AVHRR HRPT
    - GAC
    - LAC
  - GOES



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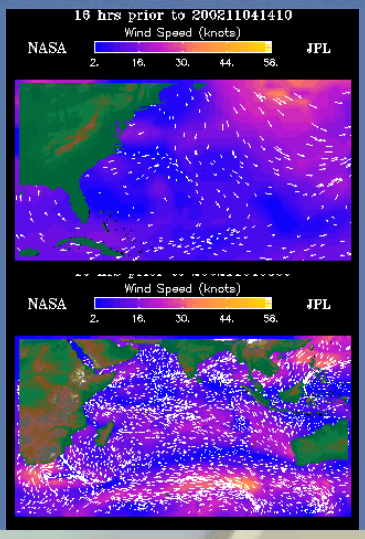
- NASA:
  - MODIS
    - Terra
    - Aqua (USA, Brazil & Japan)- atmospheric temperature, humidity, clouds, sea surface temp
  - GRACE (USA & Germany)- gravity field temporal and geographic variations
  - ICEsat- Ice sheet topography
  - ACRIMSAT
  - UARS
  - SORCE-solar irradiance
  - SeaWinds



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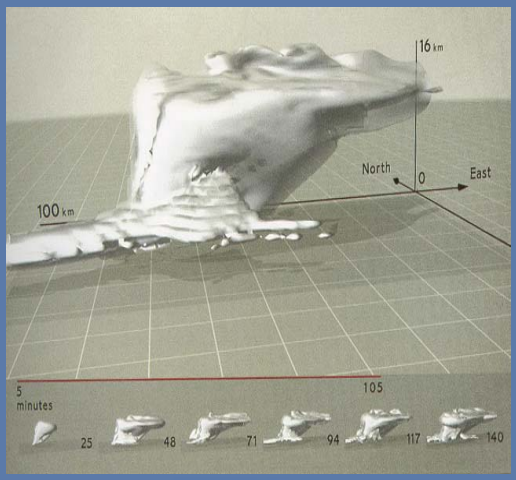
- Future Remote Sensing:
  - NASA
    - 2004- Aura: Tropospheric & Stratospheric Atmospheric Chemistry
    - 2004- Cloudsat: 3D Cloud Profiles
    - CALIPSO: 3D Aerosol Profiles



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- Indian Space Research Organization (ISRO)
  - IRS (1B, 1C, P3, P4)
  - INSAT (3A-3E)
  - Successor Systems:
    - Resourcesat- 5.8 m resolution - multispectral
    - Cartosat series- 2.5 m and 1 m spatial resolution sensors

Colorado River- IRS

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- Digital Globe: (Successor to QuickBird)
  - M5: A constellation of 4 satellites, each collecting 5m resolution multispectral (visible, near infrared and shortwave) data over a 185 km swath, with a revisit time of 4 days for land surfaces and coastal zones

Bangkok - Quickbird

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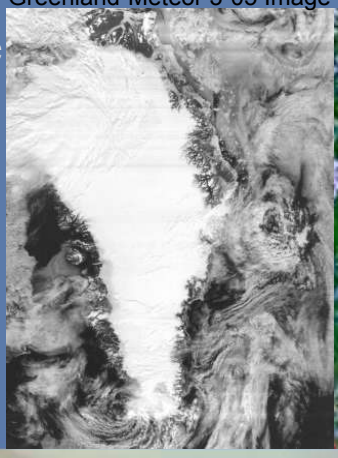
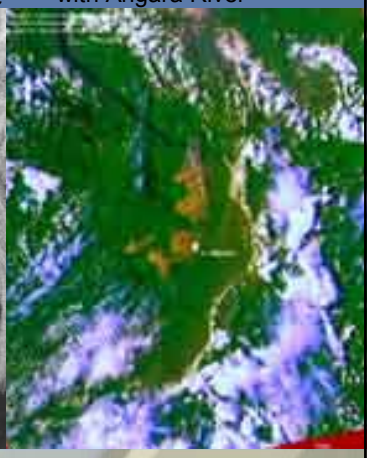
- Glavcosmos /Russian Aero Space Agency:
  - Meteor-First Launch 1969
  - Okean
  - Resurs
  - Electro

July 5, 2001
Greenland-Meteor 3-05 Image



Irkutsk, Eastern Siberia-with Angara River



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- Korea:
  - Korea Aerospace Research Institute (KARI) (Daejun), ETRI, KAIST and Multiple Universities – TRW contractors
  - KITSAT
  - Remote Sensing Research Lab of the Meteorological Research Inst. (METRI)
  - National Fisheries Research Institute (NFRDI) Remote Sensing

KOMPSAT - Korea Multipurpose Satellite

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- **ESA- European Space Agency**:
  - Mt. Aetna-Sicily Smoke Plume-Oct. 30, 2002 (Proba CHRIS)
  - Proba-Project for on Board Autonomy CHRIS (Compact High Resolution Imaging Spectrometer)
  - MERIS-Medium Resolution Imaging Spectrometer (Envisat)
  - ATSR- Along Track Scanning Radiometer (ERS-2)

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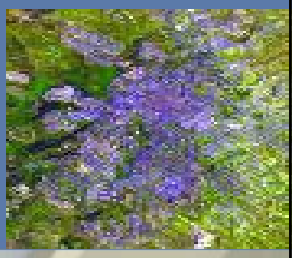
- NASDA – (National Space Development Agency of Japan): Monitoring ozone and greenhouse gases, pursuant to the Kyoto Protocol (mission-specific/small size)
  - JERS
  - ADEOS
  - ASTER (NASDA/NASA)
  - ODUS- Ozone Dynamics Ultraviolet Spectrometer
  - SOFIS-Solar Occultation
  - Fourier Transform Spectrometer

ASTER: 10/20/2002

The Isle of Jersey, Channel Island in the Bay of Mont St Michel off the north-west coast of France.

JERS-1

ASTER-Jerusalem



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- Jet Propulsion Laboratory (JPL): Contracted by NASA to the California Institute of Technology (Cal Tech)- for these missions, in collaboration with the University of Oklahoma, for monitoring air pollution emissions in real-time (20 compounds at a time, utilizing a reference library of 100 compounds)
  - FTIR (Fourier Transform Infrared Spectrometer)
  - TIRIS (Thermal Infrared Imaging Spectrometer

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- CNES (Centre Nationale
  - Systeme Probatoire pour L'Observation de la Terre (SPOT)
    - Haut Resolution Visible (HRV)
    - Panchromatic

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- CONAE (Argentina) – Sac-C
- Tubitak (Turkey)- EURASIASAT-1
- INPE (Brazil) – CBERS (Chinese Brazilian Earth Resource Satellite)
- CNSA (China) -Feng Yun
- ISA (Israel) –EROS (Res. 1.8m; 480 km orbit, 3-7 day revisit, depending upon latitude)

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Real-Time Remote Sensing

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→ site map → search → index → help

istanbul technical university

from 1773 to 2002 pioneer through the ages

Satellite Applications Center-Johannesburg

13m X band reception antenna installed in August 1995

NUS National University of Singapore

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- Real-Time Remote Sensing in the USA
  - USGS
  - Alaska SAR Facility
  - University of Wisconsin at Madison
  - University of Miami
  - Louisiana State University (LSU)
  - Purdue University:
    The Purdue Terrestrial Observatory (PTO)

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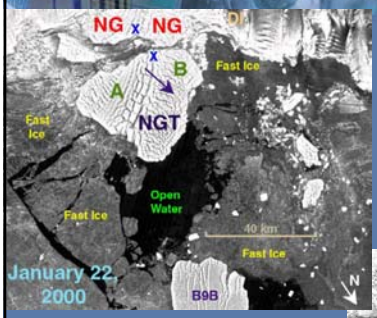
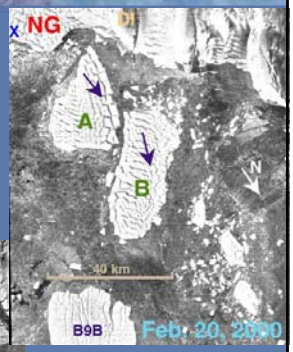
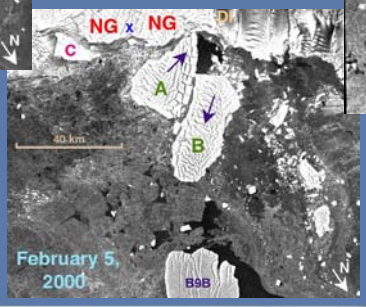


Sudden Disintegration Of the Ninnis Glacier Tongue, East Antarctica





Multi-temporal SAR (Synthetic Aperture Radar)

August 1, 2000
Dr Rob Massom, Antarctic CRC

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NPOESS
National Polar-orbiting Operational Environmental Satellite System

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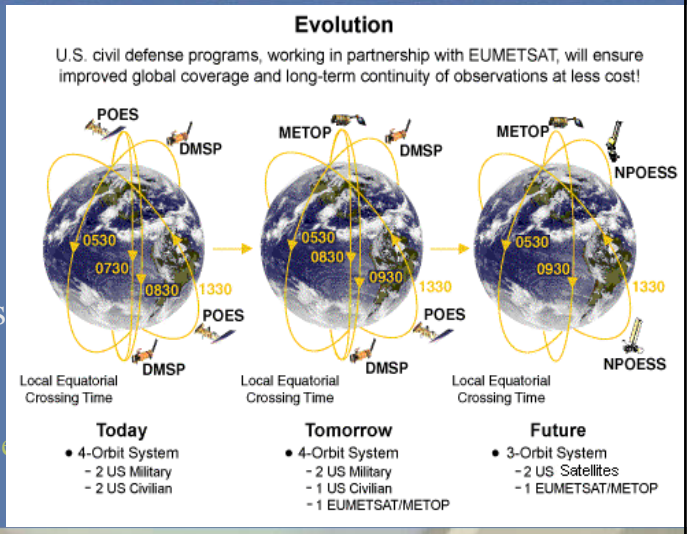
- NPOESS: National Polar Orbiting Operational Environmental Satellite System-Merges
  - DOC NOAA AVHRR
  - DOD Air Force
  - EUMETSAT



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- **Disaster Monitoring Constellation (DMC):**
  - The DMC will comprise seven Earth observation microsatellites launched into low Earth orbit to provide daily imaging revisit anywhere in the world.
  - The DMC Consortium:
    - Algeria
    - China
    - Nigeria
    - Thailand
    - Turkey, Vietnam and the United Kingdom. Each organisation is building an advanced yet low-cost Earth observation microsatellite to form the first ever constellation specifically designed and dedicated to monitoring natural and man-made disasters. The first DMC microsatellite is scheduled to be launched for Algeria in September 2002 and subsequent microsatellites into the same orbit in 2003 & 2004.
- The objective of the Consortium is to derive the maximum mutual benefit from the constellation through collaboration and cooperation between the DMC Partners. The partners in the DMC Consortium agreed to exchange their DMC satellite resources and data to achieve a daily Earth observation imaging capability for disaster monitoring and other dynamic phenomena.

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- Next Generation Remote Sensing:
  - Implementation with High Performance Computing – Supercomputers & Clusters for Research & Time-Critical Operations
  - Implementation on Laptops & Handhelds for Field Personnel, Local Communities & K-16 Education
  - Data Fusion with *In Situ* Sensors
  - Visualization Technology Integration
  - Decision Support: Virtual Hindsight & Virtual Foresight

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- Remote Sensing & Sustainability
  - Monitoring Eco-Systems Integrity
  - Ensuring Knowledge Transfer
  - Guaranteeing Inter-generational Resource Continuity
  - Disseminating to Underserved Communities
  - Best Practice Identification
  - Data Quality Integrity
  - Data Affordability – Legislated and Enforced
  - Development of Recognized Sustainability Indices
  - Accumulation and Updating Spectral Signature Libraries for both natural and man-made phenomena

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- The Sustainability of Remote Sensing
  - Competing Economic Pressures
  - Public Policy Perturbations
  - Systems Resilience
  - Biogenic Factors
  - Inadvertent Anthropogenic Impact
  - Deliberate Anthropogenic Impact

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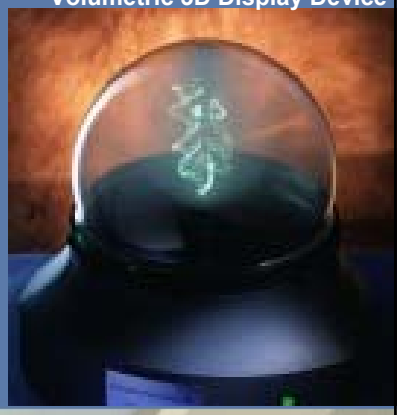
- Fusing Remote Sensing with Other Technologies

Virtual Reality Theatre

Volumetric 3D Display Device



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- Remote Sensing Data Fusion:

Haptic Devices

Sensing Devices

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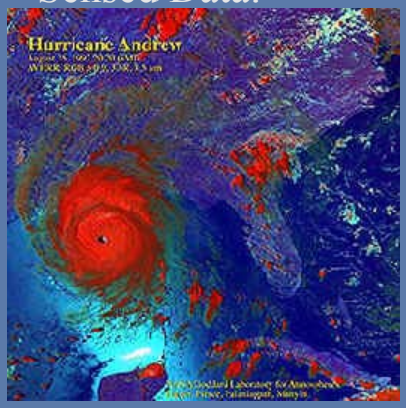
- Displaying Remotely Sensed Data:



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- **Remote Sensing Policy Issues:**
- Federal Support for Local Government, Academia and the Private Sector
- Privatization
- Access: the Digital Divide
- Remote Sensing as an Equal Opportunity Technology
- Potential for Regional Empowerment
- Distributional Justice
- Privacy & Security
- Inculcation of Intergenerational and Inter-regional Ethics
- Sustainable Development
- Sustainable Deployment

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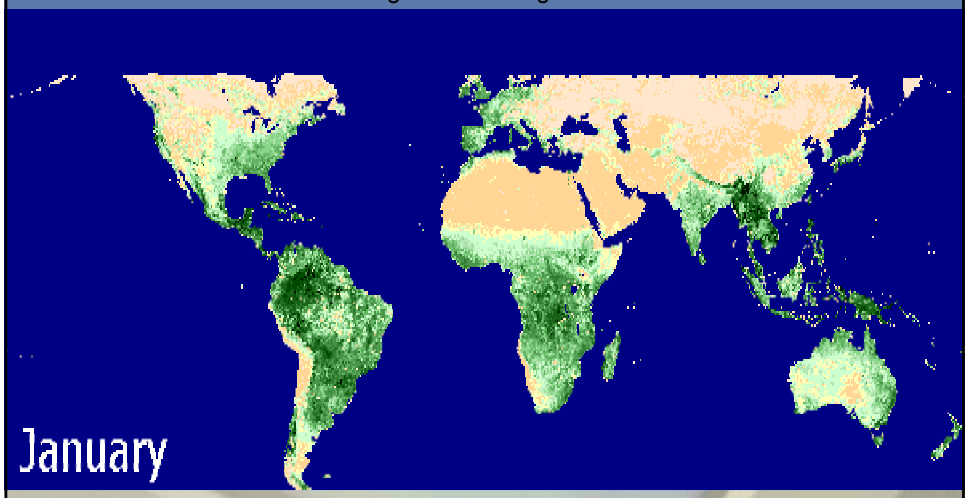
Vegetation Change Detection



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Mexico/US Border

Chicago

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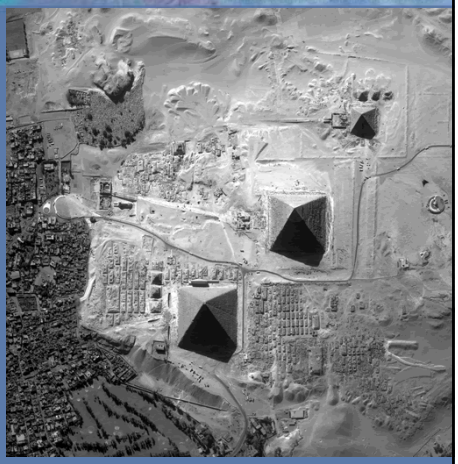
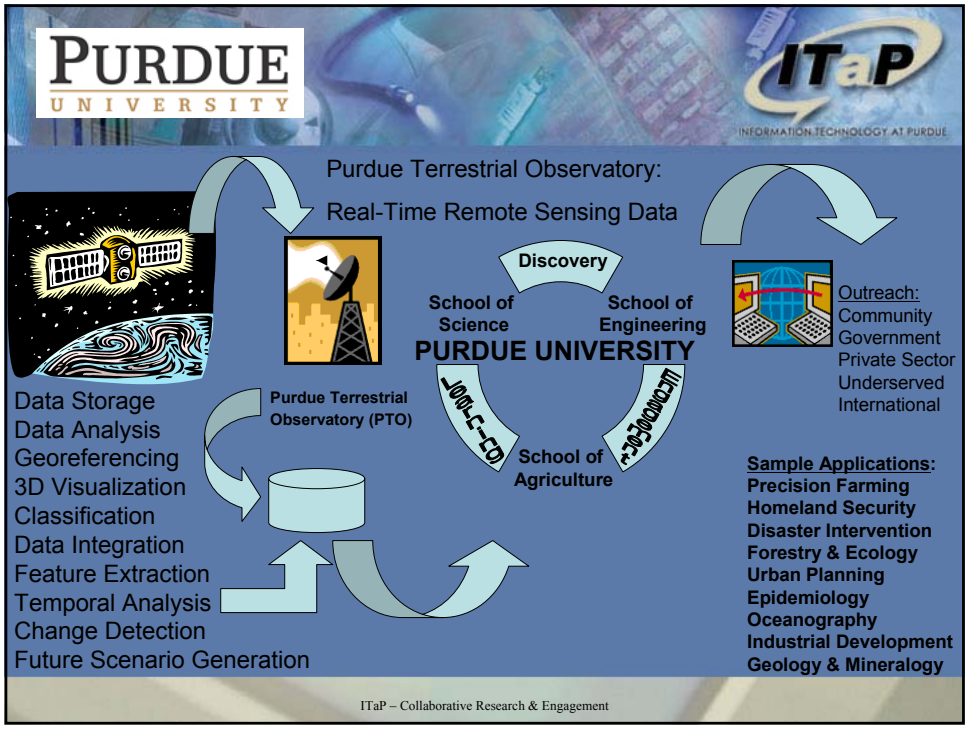
Digital Globe's QuickBird: Sapporo, Japan



Space Imaging's IKONOS:
Pyramids at Gisa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INFORMATION TECHNOLOGY AT PURDUE
Purdue Terrestrial Observatory:
Real-Time Remote Sensing Data
Discovery
School of Science
School of Engineering
PURDUE UNIVERSITY
School of Agriculture
Purdue Terrestrial Observatory (PTO)
Outreach:
Community
Government
Private Sector
Underserved
International
Data Storage
Data Analysis
Georeferencing
3D Visualization
Classification
Data Integration
Feature Extraction
Temporal Analysis
Change Detection
Future Scenario Generation
Sample Applications:
Precision Farming
Homeland Security
Disaster Intervention
Forestry & Ecology
Urban Planning
Epidemiology
Oceanography
Industrial Development
Geology & Mineralogy
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8. 캐나다의 GIS 산업기반 및 차세대 기술 개발현황

(Stefan Palko, Geomatics)

Natural Resources Canada | Ressources naturelles Canada

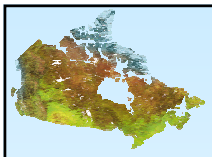
GIS Market and Technology in Canada

Stefan Palko
CCRS
Geomatics Canada

International GIS Research Conference 2002, Seoul, Korea

November 8, 2002.

Canada



Presentation Outline

- GIS and Geomatics in Canada
- Market Profile of Geomatics Industry
- Canadian Geospatial Data Infrastructure (CGDI)
- Partnership Programs
- Different Technologies for Different Needs
- Examples of CGDI Applications

Definition of Geomatics

Geomatics is defined as the science of geographic information management.

[Canadian Council on Geomatics]

Geomatics

Activities to acquire, integrate and manage spatial data for scientific, administrative, legal and technical operations.

[Canadian Institute of Geomatics]

Sectors

of the Canadian Department of Natural Resources

- **Canadian Forestry Sector**
- **Earth Sciences Sector**
- **Energy Sector**
- **Corporate Services Sector**

Earth Sciences Sector

created in 1995

Geomatics Canada | Geological Survey of Canada | Polar Continental Shelf Project

Provides knowledge and expertise to:

1. **Understand Canada's land mass**
2. **Manage country's rich natural resources**

Canada Centre for Remote Sensing

Canada
Government of Canada
Natural Resources Canada
Earth Sciences Sector
Geomatics Canada
CCRS

- **Director General's Office**
- **Applications Division**
- **Data Acquisition Division**
- **GeoAccess Division**
- **Technology Assessment Division**

Geomatics Industry Association of Canada

National business association dedicated to serving geomatics industry.

Members include app. 100 of Canada's leading geomatics service and technology firms, and approximately 80% of the active exports.

The association is:

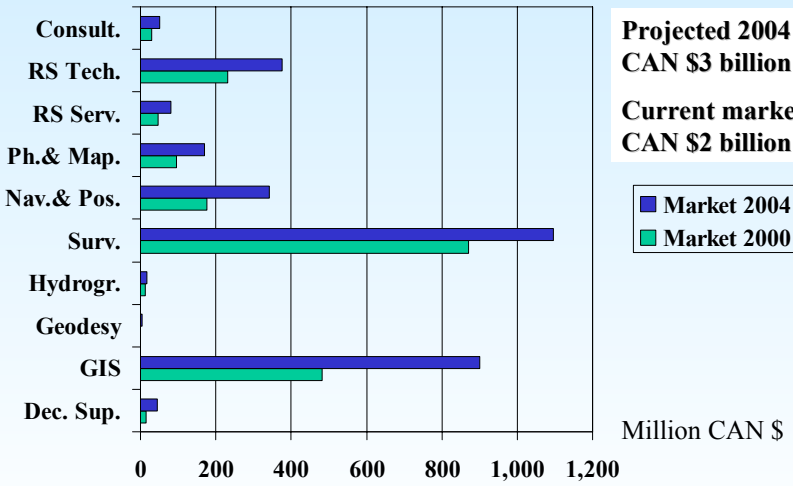
Private sector firms, government agencies and educational institutions.

World Wide Geomatics Industry: Market Value

Year	US$
2000-2001	24 billion
2001-2002	26.5 billion
2003-2004	30 – 40 billion

Based on Geomatics Sector Human Resources Study

Canadian Geomatics Industry: Market Value

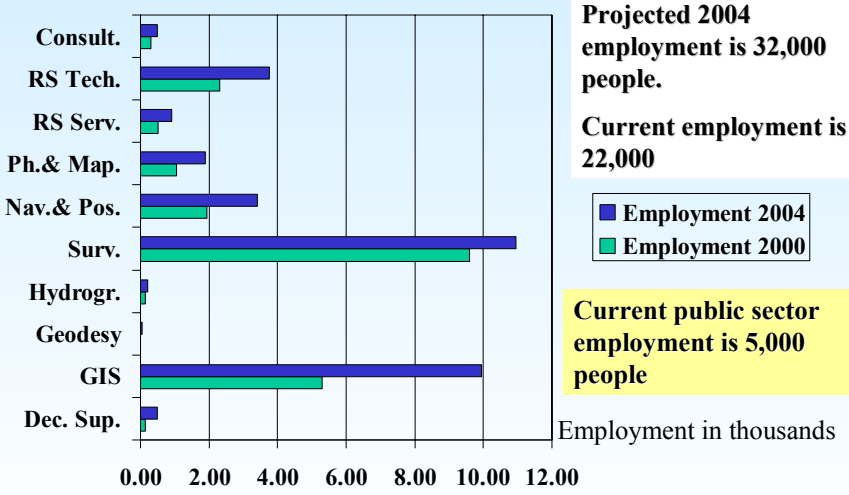


Projected 2004 market is CAN $3 billion

Current market is over CAN $2 billion

- Market 2004
- Market 2000

Canadian Geomatics Industry: Employment in Private Sector

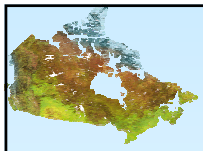


Projected 2004 employment is 32,000 people.

Current employment is 22,000

- Employment 2004
- Employment 2000

Current public sector employment is 5,000 people



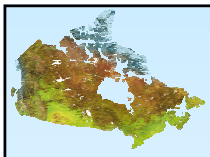
Market Profile of Geomatics Industry: Firm Size in Canada

Company Name	Number of Employees	An. Sales Mil. Can $	Canadian Projects	International Projects
Company A	900	$121.0	66%	34%
Company B	200	$30.0	99%	1%
Company C	30	$3.0	100%	0%
Company D	20	$1.5	60%	40%
Company E	20	$1.0	50%	50%
Company F	18	$2.0	80%	20%
Company G	7	$0.5	85%	15%
Company H	7	$0.5	50%	50%

98% are smaller than 100 people

75% are smaller than 10 people

Sample profile of 9 Canadian companies



Canadian Geospatial Data Infrastructure (CGDI)

Definition:

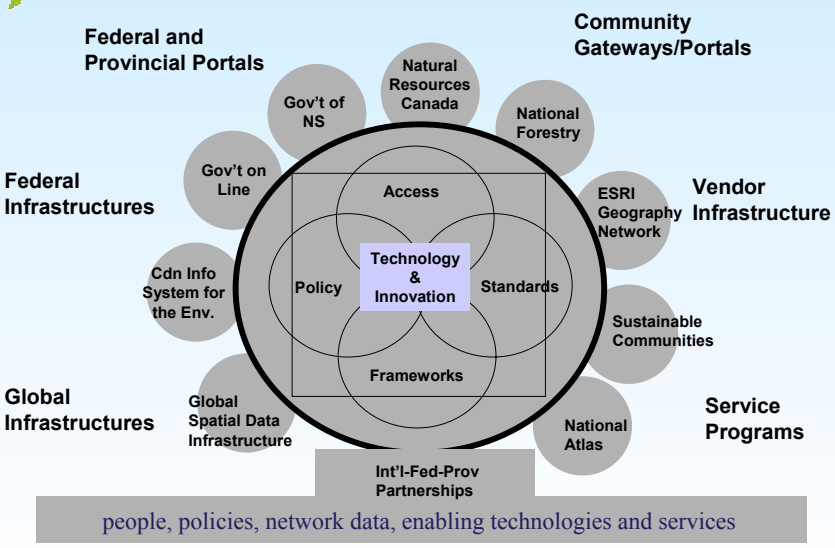
integrated, on-line system delivering geospatial data and services for:

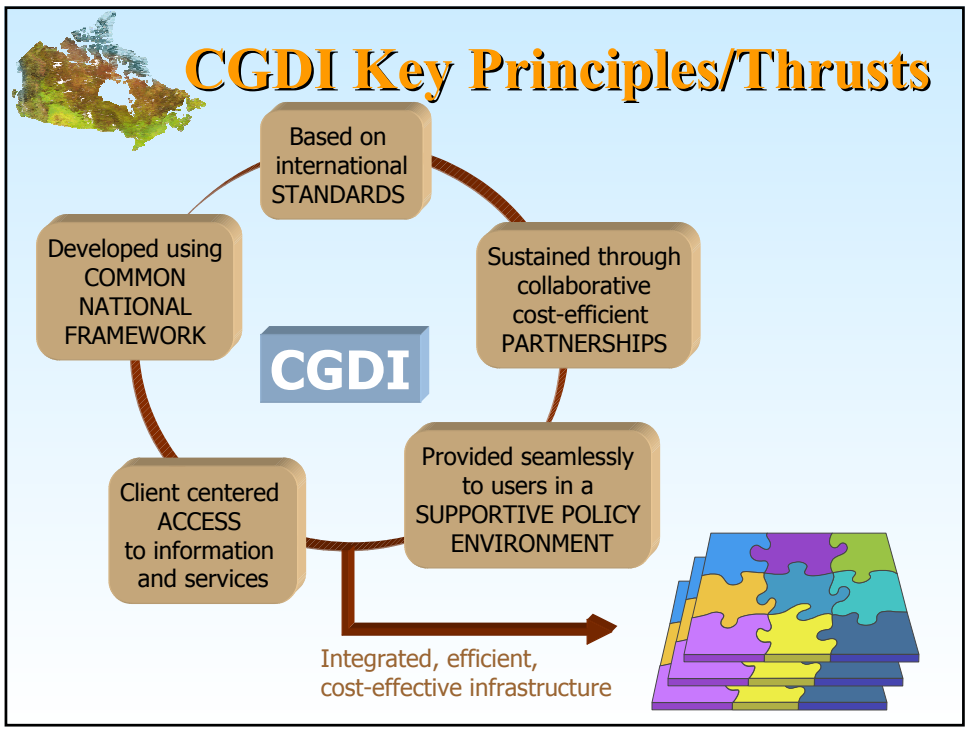
- applications for environment, health, sustainable development, transportation, business development…
- business and policy decision-making
- value-added commercial activities

CGDI Objectives

1. Increase amount of geospatial data, information and services available on-line;
2. Ease data integration issues and data standardization;
3. Expand use and application of geospatial data;
4. Promote development of innovative technology;
5. Simplify conditions for geospatial data use and resale.

CGDI Components





CGDI: Access

- Internet-based data clearinghouse:
  - locate geospatial datasets
  - obtain metadata
  - on-line delivery of geospatial data
  - integrated delivery and services and/or similar information
- examples: Discovery Portal - http://cgdi.gc.ca/
  GeoGratis - http://geogratis.gc.ca/
  Atlas of Canada - http://atlas.gc.ca/

CGDI: Common National Framework

- Geographic Framework for Canada
  - simplify data integration
  - basis for application development and value-added products and services
  - framework on which other datasets can be built
- Will be developed through Federal-Provincial cooperation

CGDI: Standards

- International Participation:
  - **GeoData Discovery, Catalog Service (OGC spec. based on Z39.50 profile)**
  - **ISO Metadata standard (TC 211 DIS 19115)**
  - **WMS (OGC web map service spec.)**
  - **WFS (OGC web feature service spec.)**
  - **GML v2 (OGC spec. based on XML)**
- Objectives:
  - participate in evolving world standards
  - help Canadians anticipate, adopt, and use standards

CGDI: Partnerships

Way of operating

- Open consultations
- Data sharing and collaboration
- Federal-provincial-territorial agencies have adopted a Statement of Principles on partnerships
  - gather data in partnerships
  - only once, closest to source
  - share and use many times

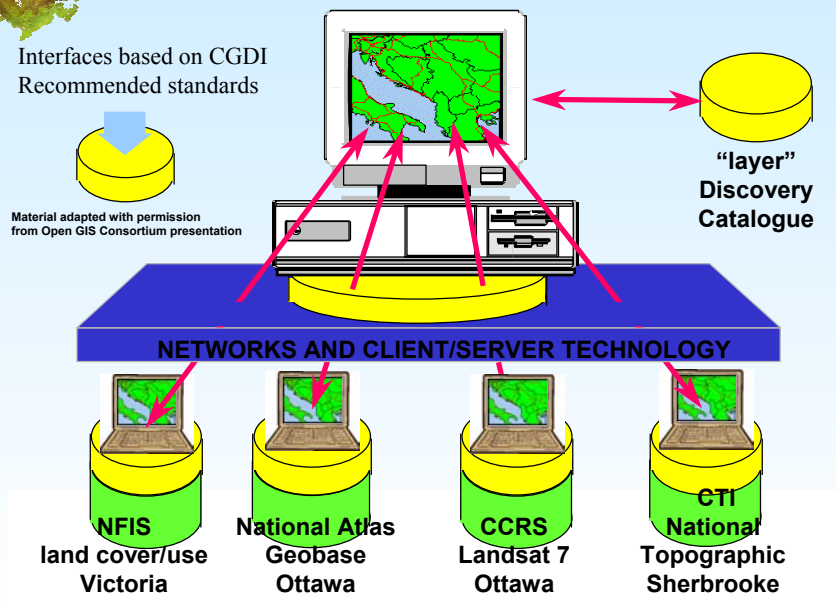
CGDI: Supportive Policy Environment

- Seamless distribution and use of government geographic information
- Easing policy issues
- Government taking client view to developing access:
  - from any department
  - from any level of government
  - with simpler, common sales and licensing agreements

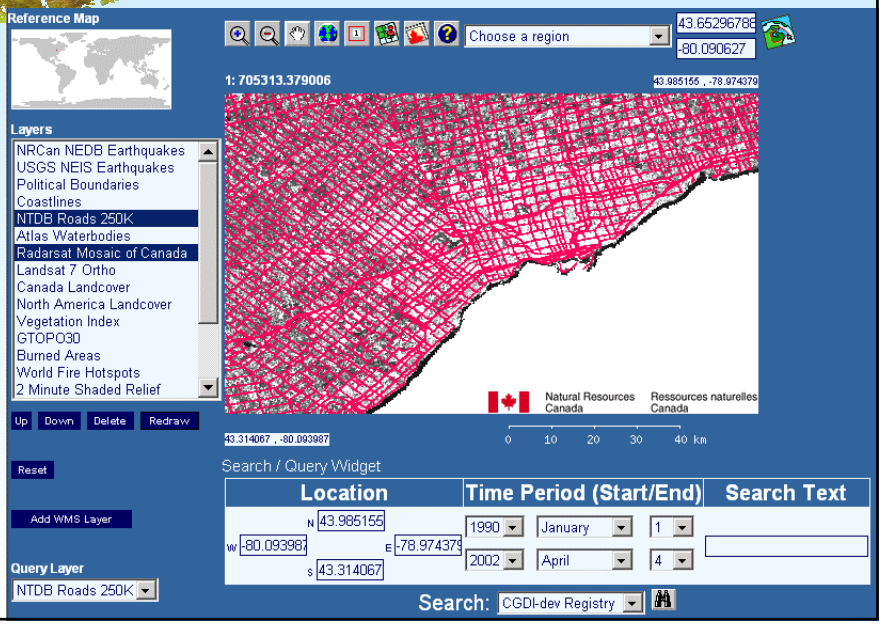
CGDI: Shared Leadership

- Broad and varied participation
- Open and consultative approach to decision making
  - federal, provincial, territorial government agencies
  - private sector and academia
- Collective leadership among the participants
- Need for matching investments and integration
- Recognizes multi-participants and activities across different user communities

CGDI: Web Mapping Service



CGDI: WMS Output Example



CGDI: GeoConnections

GeoConnections is a national partnership initiative led by Natural Resources Canada.

Through GeoConnections, governments are working with industry to build the Canadian Geospatial Data Infrastructure (CGDI), which will make Canada's geospatial databases, tools and services readily accessible on-line.

CGDI: GeoConnections Funded Partnership Programs

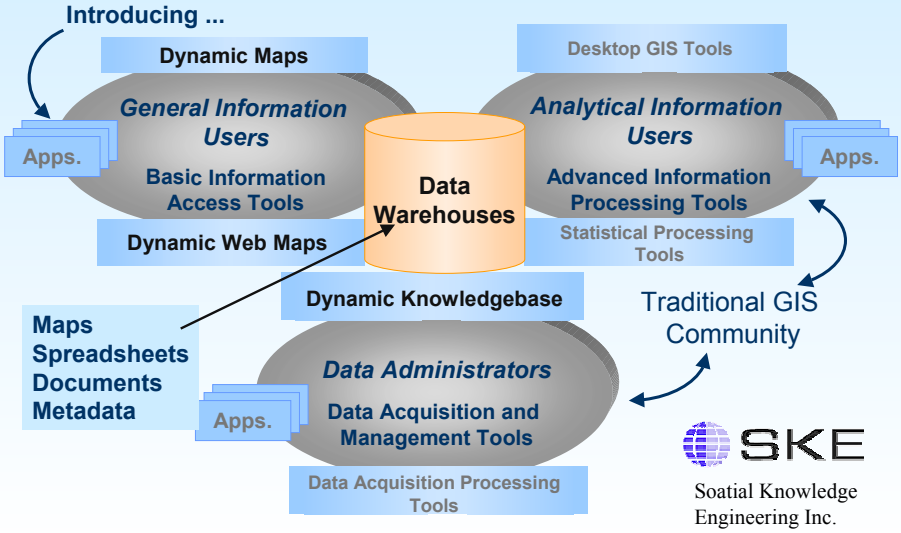
1. National Access
2. National Framework
3. GeoPartners
4. GeoInnovations
5. National Atlas
6. Sustainable Communities
7. Skills Network

GeoConnections Funding for Partnerships

Financing over 6 years (CAN$60 million)

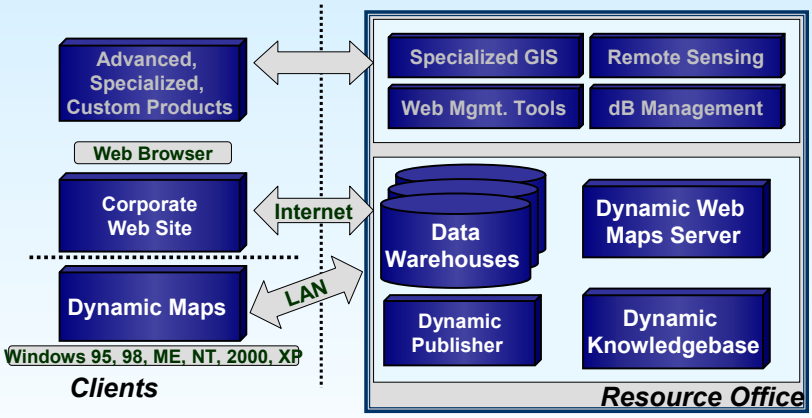
- –1st year -- ramp-up (Aug. 1999 – April, 2000) $ 4 million
- –2nd year -- $ 8.5 million (2000 – 2001)
- –3rd year -- $ 12 million (2001 – 2002)
- –4th year -- $ 12 million (2002 – 2003)
- –5th year -- $ 15.5 million (2003 – 2004)
- –6th year -- $ 8 million (2004 – 2005) close-out

Example of Approaches:
Different Technologies Support Different Users and Needs…



SKE
Soatial Knowledge Engineering Inc.

Example of Approaches:
Organization and Technology Component Model



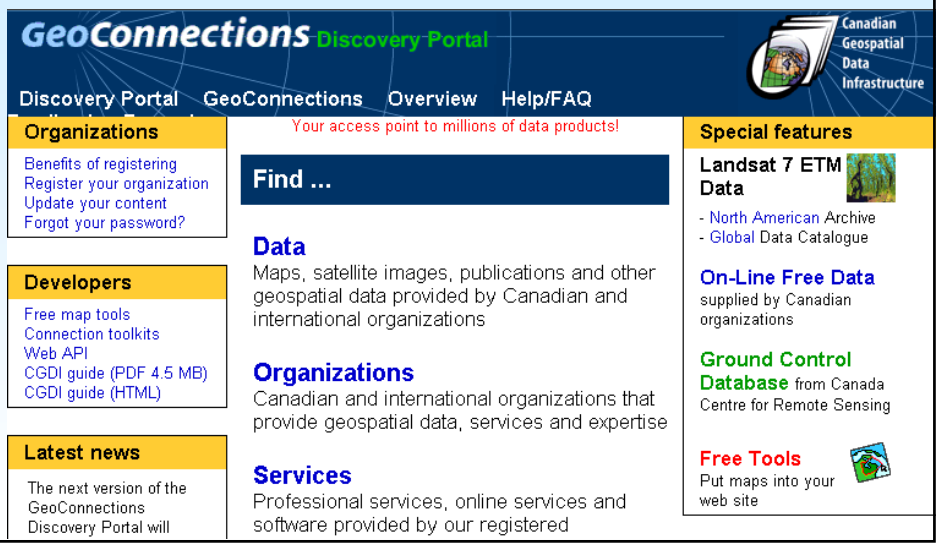
Puts database set up and management "behind the scenes" in Resource Office, therefore easy access to the data is given to end users through Dynamic Maps and/or through their web browsers.

SKE

CGDI and GeoConnections Entry Page

http://cgdi.gc.ca or http://geoconnections.org

Examples of CGDI Applications: GeoConnections Discovery Portal



Examples of CGDI Applications: Organizations Search - Korea

GeoConnections Discovery Portal

Canadian Geospatial Data Infrastructure

Discovery Portal GeoConnections Overview Help/FAQ

Find organizations Tutorial

Search keywords

korea

Tips: +requires, -excludes, quote to "search for phrase"
Example: forest +canadian -"research centre"

Search

By alphabetical list of organization names

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z Other

By region

Canada	Newfoundland and Labrador	Prince Edward Island
Alberta	Northwest Territories	Quebec

Examples of CGDI Applications: Organization Search Results - Korea

GeoConnections Discovery Portal

Canadian Geospatial Data Infrastructure

Discovery Portal GeoConnections Overview Help/FAQ

Organization search results: 2 items found Refine Search

Canadian

1. Korea Ocean Reasearch and Development Institute Description
2. Korean Oceanographic Data Center Description

Refine Search

Examples of CGDI Applications: Organization Search Results - KORDI

GeoConnections Discovery Portal

Canadian Geospatial Data Infrastructure

Discovery Portal GeoConnections Overview Help/FAQ

Data provided by Korea Ocean Reasearch and Development Institute

Access options Contact the distributor to obtain this data

Further information See the full description

Abstract

The Korea Ocean Research and Development Institute offers wind stress,
wave, and sea surface temperature data for the Yellow Sea and East Sea.
Data are collected at in situ buoys and data collection stations.
There are approximately 8-10 stations in operation.
Wave data has hourly resolution. Wind and temperature data has variable resolution.
Data format information is available from the Data Center contact.

Data coverage

Time period: 1990-01-01 to Present

Blue line indicates geographic extent of data.

Examples of CGDI Applications: Organization Search Results - KODC

GeoConnections Discovery Portal

Canadian Geospatial Data Infrastructure

Discovery Portal GeoConnections Overview Help/FAQ

Korean Oceanographic Data Center

Data products available

- Coastal Oceanographic Data from KODC
- Sea Surface Temperature Data from KODC
- Serial Oceanographic Data from KODC

Central Contact Point

Phone number: (82)-51-720-2223
Fax number: (82)-51-720-2225
Email address: kodc@haema.nfrda.re.kr

Address

408-1 Shirang-Ri, Kijang-Up Kijang-Gun, Pusan
619-900 Republic of KOREA

Additional online information

Visit the organization's web site

Examples of CGDI Applications:
Services Search Results

Services search results using Mobile GIS as keywords (129 returns)

1. Mobile Technical Office (MTO), *HGI Wireless Inc.*
2. GIS Software and Training, *McElhanney Consulting Services Ltd.*
3. RoadNet, *Infrastructure Systems Limited (ISL)*
4. GIS Consulting, *Infrastructure Systems Limited (ISL)*
5. PMOffice, *Systemcorp A.L.G. Limited*
6. AIS and Communications Engineering, *International Communications and Navigation Ltd.*
7. GeoTrak-AVL (Auto Vehicle Location), *HGI Wireless Inc.*
8. GPS/GIS Software Customization, *ELIRIS Inc.*
9. Geographic Information Systems (GIS Applications Specialist), *Sault College*
10. Hunter GIS Solutions for Autodesk MapGuide, *Hunter and Associates / Hunter GIS*

Examples of CGDI Applications:
Services Search Results

Services search results using Virtual GIS as keywords (9 returns)

1. Virtual Toronto Electronic Atlas, *Ryerson Polytechnic University, Faculty of Arts - School of Applied Geography*
2. GEOREX Virtual offices *LBGI, Le Bureau Géo Info Inc.*
3. Planimetry, *Triathlon Limited*
4. GIS Consulting, *Triathlon Limited*
5. Training, *Sani-International Technology Advisors Inc.*
6. Natural Resources Information Network, *Southern Interior Forest Extension and Research Partnership*
7. The Environmental Data Manager (EDM) Program, *Waterweb Groundwater Database Inc.*
8. Intelligent Library System (ILS) *Lockheed Martin*
9. Dynamic Knowledgebase - Integrate and Publish Your Data, *Spatial Knowledge Engineering Inc.*

Examples of CGDI Applications: Additional Examples

Examples of data search results will be shown during the presentation, including satellite images of Korea.

Selected URLs

Canadian Geospatial Data Infrastructure and GeoConnections http://cgdi.gc.ca/

Geomatics Industry Association of Canada http://www.giac.ca/

Virtual GIS and Dynamic Maps http://www.skeinc.com/

Real-time Mapping and Mobile GIS http://www.caris.com/

9. 일본의 GIS 산업기반 및 차세대 기술 개발현황
(별 지)

(Shibasaki, 동경대)

10. 중국의 GIS 산업기반 및 차세대 기술 개발현황

(Jun Chen, CAGIS)

Latest GIS Research and Development in China

Prof. CHEN Jun
President, National Geomatics Center of China
President, China Association of GIS
President, ISPRS Technical Commission II
Seoul, Nov.8, 2002

Contents

1. 1980-2002: Milestones & significant events
2. Applications: From 'pilot' to operational
3. Data sets: Multi-scale databases
4. Technical Systems: Home-grown GISs
5. Scientific research: Intensive activities
6. Education: Degree program & training
7. Coordination: Institutional & policy issues
8. Conclusion

1980: the Beginning of GIS Development in (Mainland) China

The first GIS laboratory in China was established at the Institute of Remote Sensing Applications on 19th January 1980 by Prof. Chen Shupeng, an academician of the Chinese Academy of Sciences （He and Jiang, 1996).

Milestones & significant events （2）

- 1985：Establishment of the State Key Laboratory for Resources and Environmental Information Systems
- 1986: NNSFC was formed and it has since funded a total of 80 GIS and related projects.
- 1988：the first undergraduate program in GIS was initiated at WTUSM) This marked the recognition of GIS as a discipline in academic community
- 1990：another State Key Laboratory in GIS LIESMARS was established at WTUSM

Milestones & significant events （3）

- 1994: China Association for GIS (CAGIS) was founded. This marked the recognition of GIS as a profession.
- 1995: National Geomatics Centre of China (NGCC) was founded by SBSM, serving as major provider of national fundamental spatial data
- 1997: National Technical Commission on Geographic Information Standards was formed.
- 1999: National Coordination Commission on Geospatial Information was also set up to coordinate the sharing of geospatial data.

GIS in China: 22ed Anniversary

- 22 is the marriage age in Chinese laws (22 for men and 20 for women). Similarly, in the Western culture, the age of 21 is particularly meaningful because it marks the full right as an adult.
- After 22 year of development in China, GIS as a technology has become very matured like an adult and found a large variety of applications.

Early applications in the 80s

- Rather 'technology-pushed' or 'system-driven'.
  - Used mainly for the automation of the existing manual map-based operations, such as computer-assisted mapping, land suitability evaluation, environmental assessment, map data storage and retrieval
- Largely research-oriented pilot studies.
  - Some systems remained on a continual cycle of pilot projects, and many GIS projects failed to deliver their originally anticipated benefits within the predefined time frame.
  - End users could not make effective use of the systems, partly because the organizations involved had not trained sufficient experts

Operational use of GIS since 1990s

More specialized & purposeful GIS applications & long-term and productivity-enhancing GIS application programs since the beginning of 90s

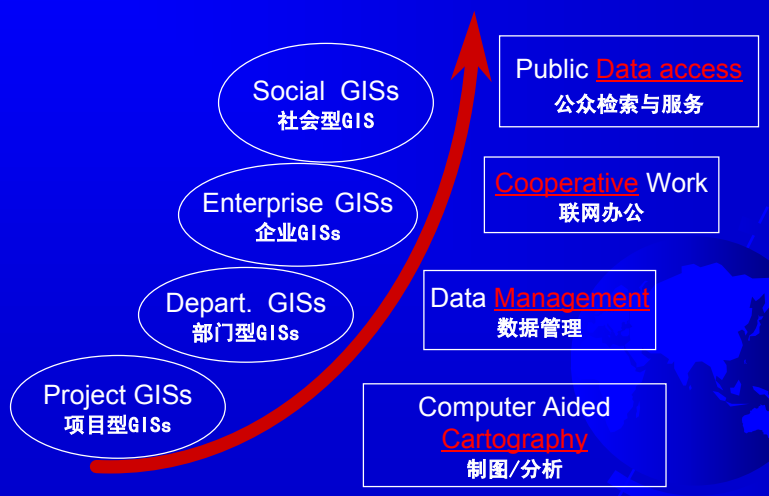
- A huge demand in the field of urban planning, land management, resource survey and environmental analysis
- The radical technical advances also make GIS easier to use and more affordable.
- Numerous GISs have been set up by both government and private sectors for their daily work and strategic planning, and for public use

Three Categories of Operational Use

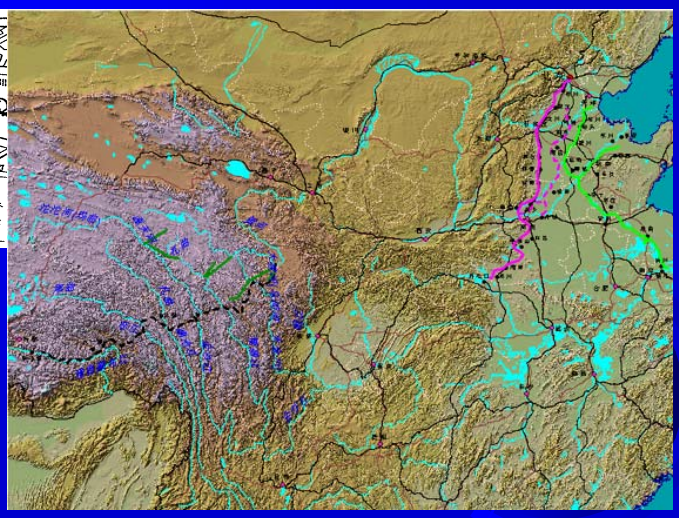
Classified according to the nature of their utilization

- Used for day-to-day routine work, such as many urban GIS applications.
- Characterized by the strategic or senior management operation of government departments or major businesses, such as those used by local and central governments.
- Use by the general public

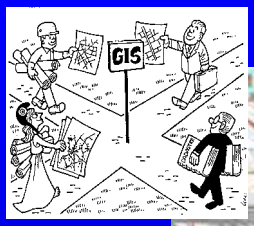
Four Development Stages



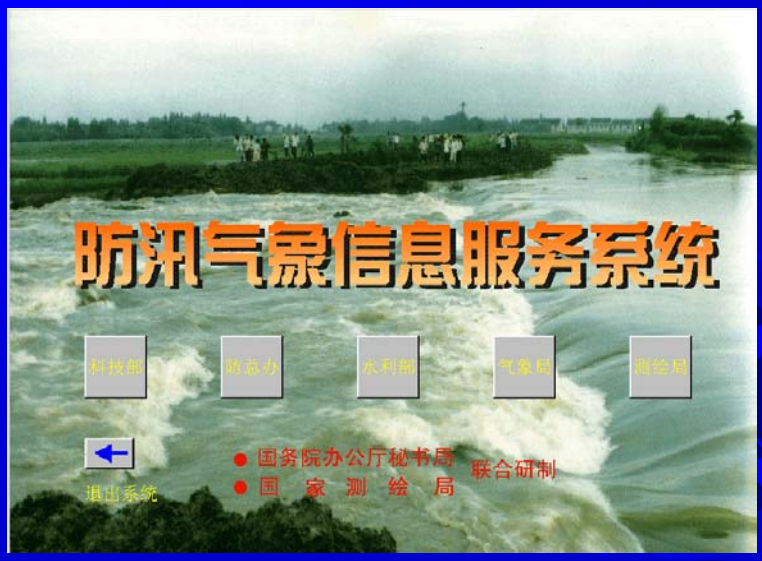
Transferring Water from South to North



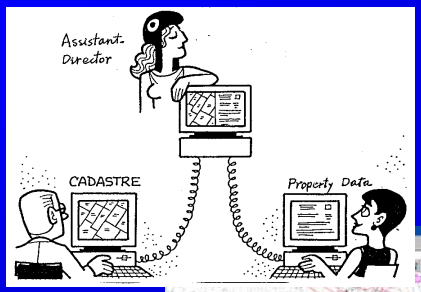
State Boundary Negotiation

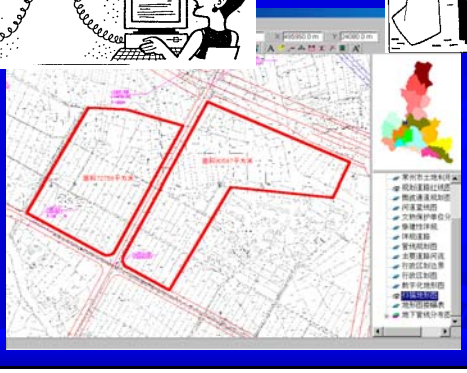


Senior Management Applications



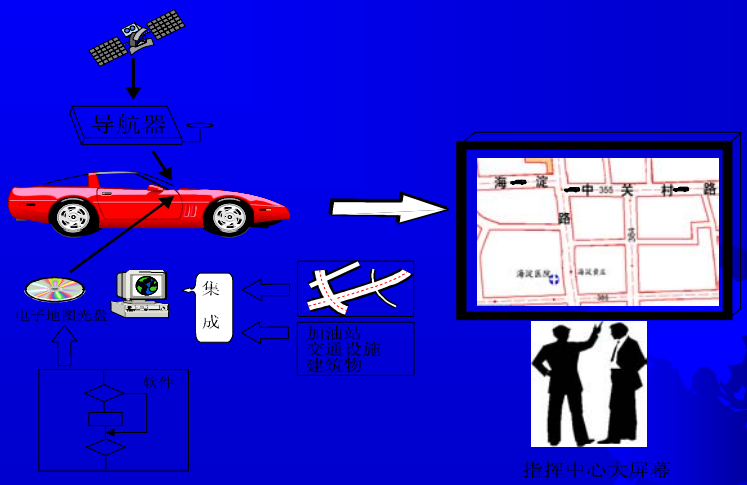
Collaborative Working Systems





General Public Applications

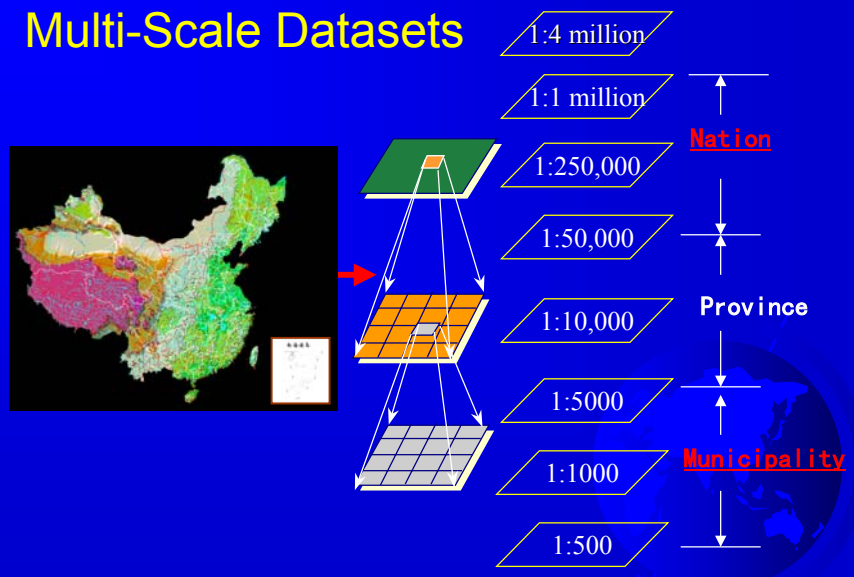
ITS Application



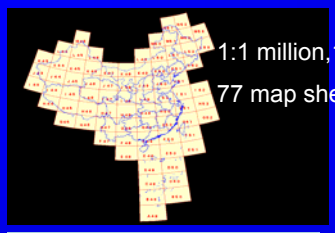
Top Priority since the late 80s

- Development of multi-scale core (fundamental) geo-spatial databases became the top priority of the central government since the late 80s.
- The state, provincial and municipal governments continue to be the biggest providers of geo-spatial data for GIS applications

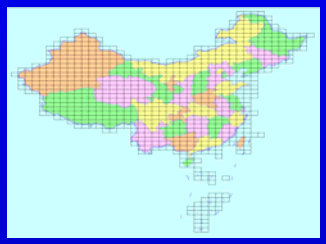
Multi-Scale Datasets



Geo-spatial Data Sets at National Level

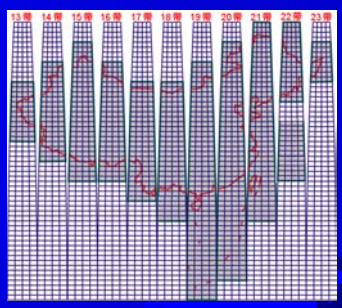


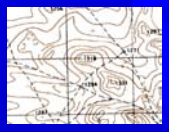
1:1 million,1994
77 map sheets



1: 250,000, 1998
816 map sheets

1:50,000 *24,000 sheets*





DRG

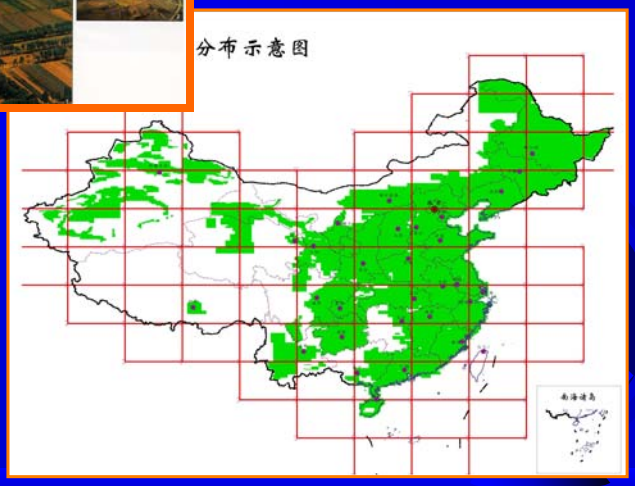
DEM

Data Volume of 1:50,000 Dbs

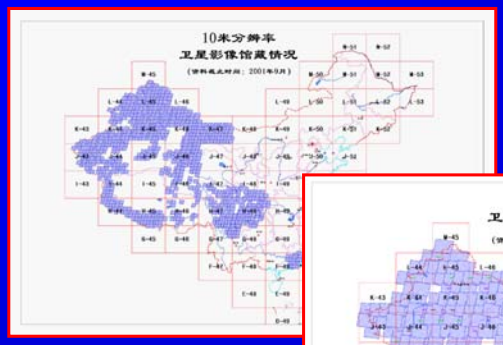
products	Data format	Storage volume	Online volume	notes
DRG	raster	186 GB	162 GB	4m resolution
DEM	Vector,raster	1700 GB	78 GB	25m grid (ArcInfo format)
DOM-AP	raster	6250 GB	218 GB	1m resolution, airphoto
DOM-TM	raster	[illegible]	[illegible]	30m resolution, TM image
DOM-SPOT	raster	[illegible]	[illegible]	0m resolution SPOT pan mage
DLG	vector	[illegible]	[illegible]	eo-element, with no ontour
PN	text	4 GB	4 GB	More than 3 million items
LC	Vector, raster	30GB	10 GB	30m resolution
CP	Text, raster	127 GB	50 GB	0.15 million points
MD	text	10 GB	10 GB	
others		524 GB	16 GB	
total		10009 GB	671 GB	11TB

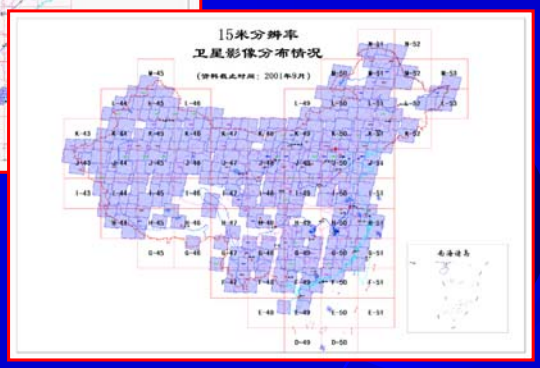
11TB

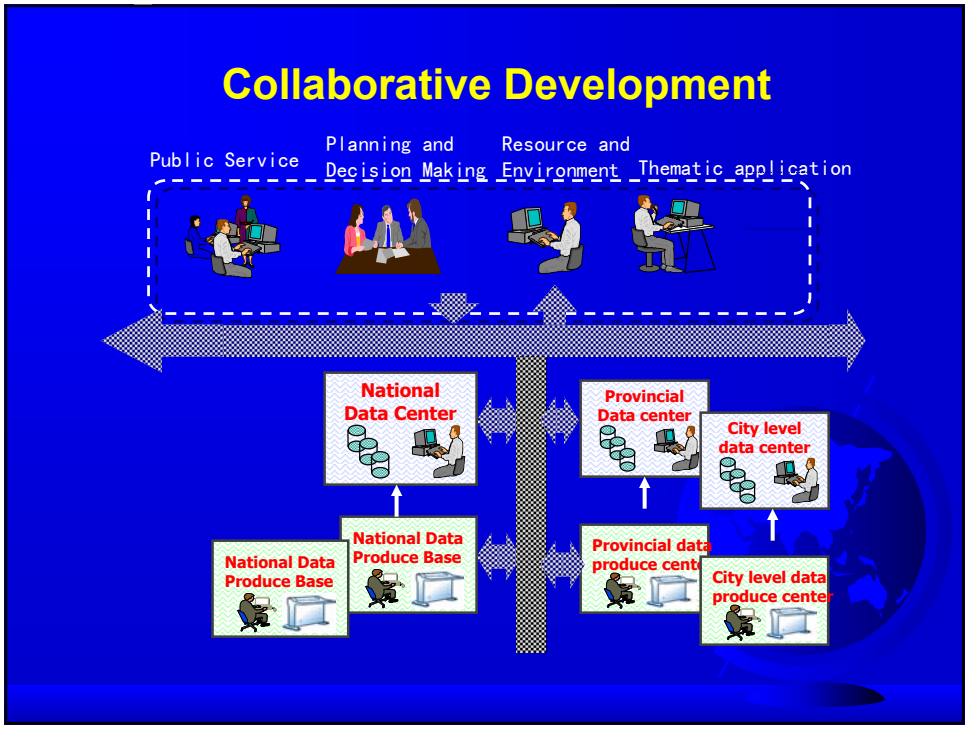
National Photography

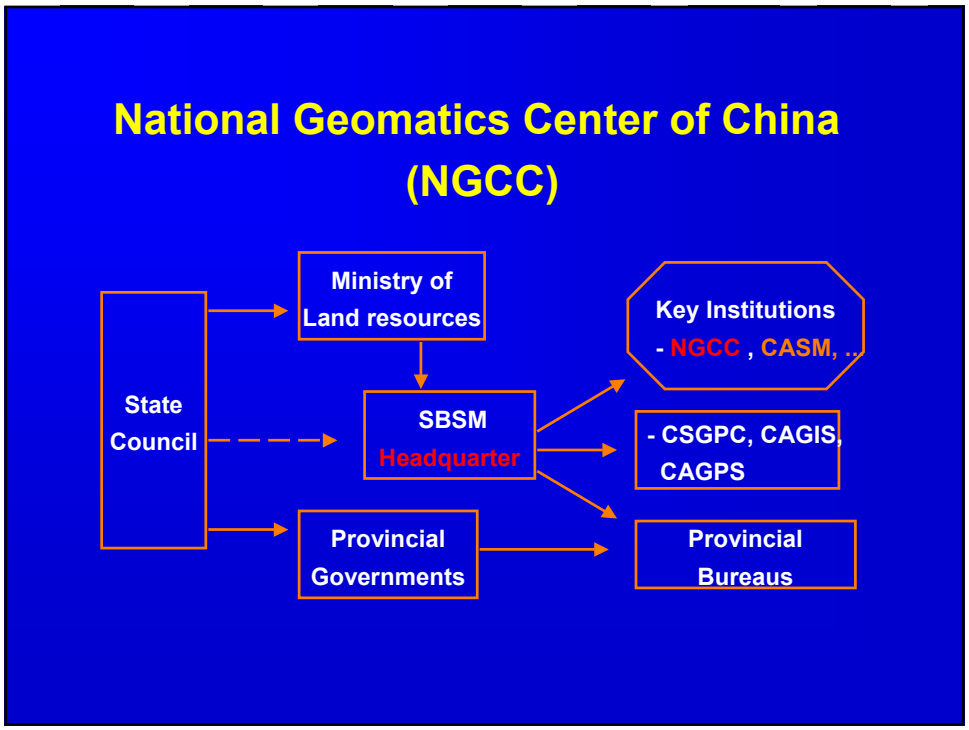


Satellite Imagery Coverage



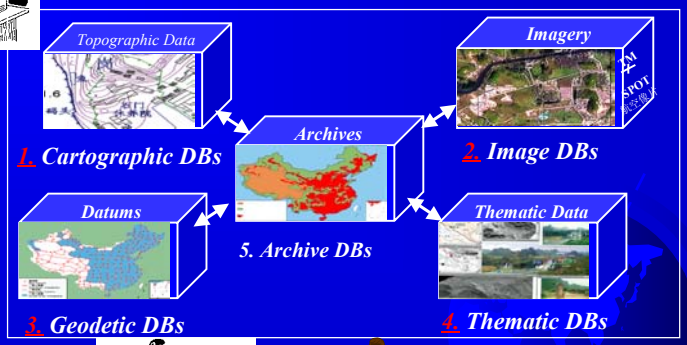



Collaborative Development
Public Service
Planning and Decision Making
Resource and Environment
Thematic application
National Data Center
Provincial Data center
City level data center
National Data Produce Base
National Data Produce Base
Provincial data produce cent
City level data produce center


National Geomatics Center of China (NGCC)
State Council
Ministry of Land resources
SBSM Headquarter
Provincial Governments
Key Institutions - NGCC , CASM, ..
- CSGPC, CAGIS, CAGPS
Provincial Bureaus

Fundamental Data Sets

6. Information Service System



1. Cartographic DBs

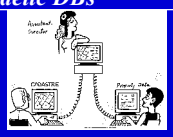
2. Image DBs

5. Archive DBs

3. Geodetic DBs

4. Thematic DBs

7. Intranet systems



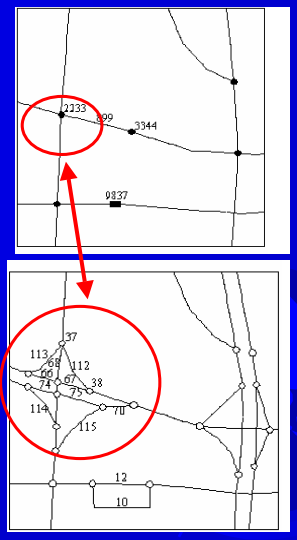
8. Technical Support Systems

Updated Traffic Data

Urban Large Scale Data Sets (Shanghai Case)

		Coverage	Map Sheets	Updating Cycle (year)
1:10,000	DLG	Whole city	322	5
1: 2,000	DLG	Whole city	7511	4
1: 1,000	DLG	Fringe area	5069	3
1: 500	DLG	Down town	7758	2
1: 2,000	DOM	Whole city	2463	

Multi-scale Data Modeling

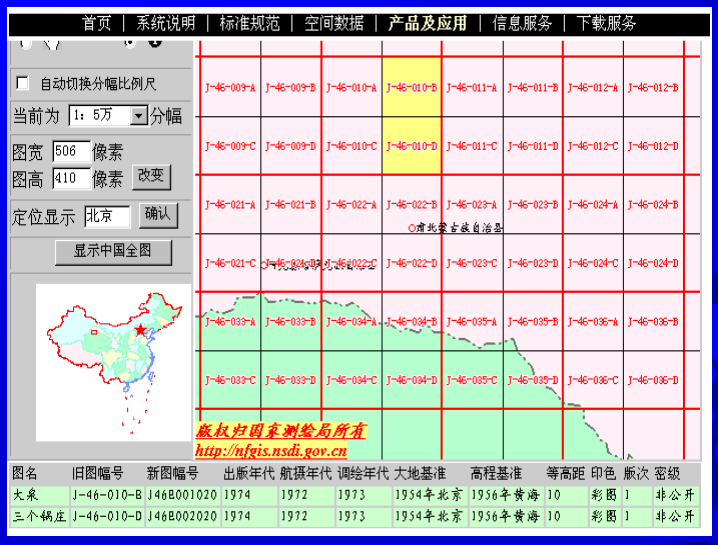


NFGIS Website: http://nfgis.nsdi.gov.cn

Data sets being documented by categories and scales using traditional free text file(HTML file), not metadata

- Information being published about NFGIS individual data sets, specification and standards used, application demonstrations
- Some data can be browsed or downloaded

Catalogue of Maps



Catalogue of Aerial Photos

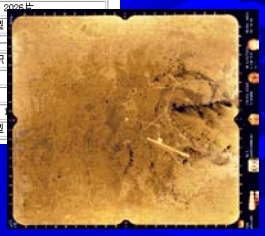
航空影像

测区名称：**丽江**		摄区编号：9830	摄区面积：16579km2
包含图幅：G-47-43-B，G-47-43-D，G-47-44			
北：26	西：115.75	南：24.66	东：117.25
资料提供单位：国家基础地理信息中心		介质类型：胶片	航片数：1358片
航摄比例尺：1:40000	航片焦距：152cm	航片尺寸：23 X 23cm	航片类型：黑白

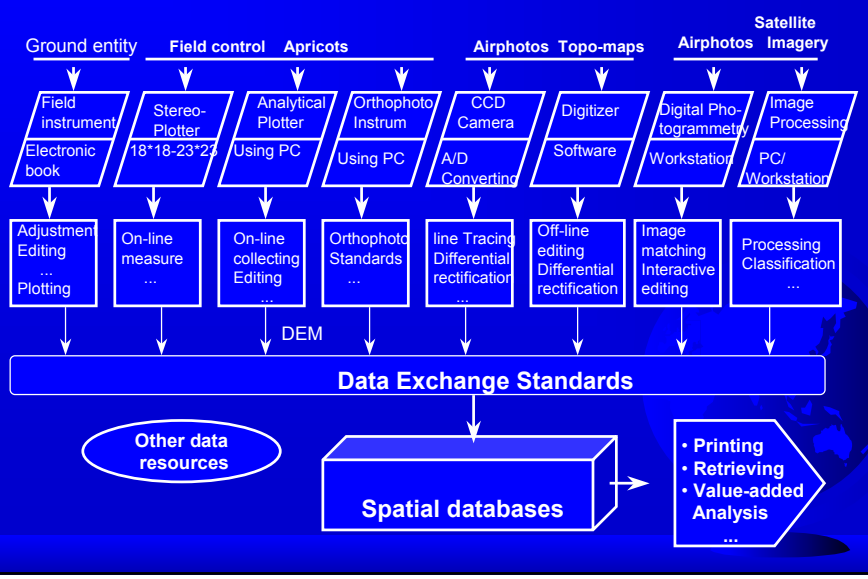
测区名称：**云南大理**		摄区编号：9992	摄区面积：24130km2
包含图幅：F-47-80，F-47-81，F-47-82，F-47-83，F-47-84			
北：26	西：101.66	南：24	东：103.66
资料提供单位：国家基础地理信息中心		介质类型：胶片	航片数：2685片
航摄比例尺：1:35000	航片焦距：152cm	航片尺寸：23 X 23cm	航片类型：黑白

测区名称：**龙岩**		摄区编号：9612	摄区面积：21826.33km2
包含图幅：G-50-77-B，G-50-77-C、G-50-77-D，G-50-78，G-50-79，G-50-80，G-50-89，G-50-90，G-50-91，G-50-92			
北：27	西：99.25	南：26	东：100.75
资料提供单位：国家基础地理信息中心		介质类型：胶片	航片数：2026片
航摄比例尺：1:35000	航片焦距：154cm	航片尺寸：23 X 23cm	航片类型

测区名称：**福建德尤**		摄区编号：9605	摄区面积
包含图幅：G-50-69，G-50-70，G-50-80，G-50-81			
北：26.33	西：118.75	南：25.16	东：120
资料提供单位：国家基础地理信息中心		介质类型：胶片	航片数：
航摄比例尺：1:35000	航片焦距：153cm	航片尺寸：23 X 23cm	航片类型



Digital Surveying and Mapping Systems

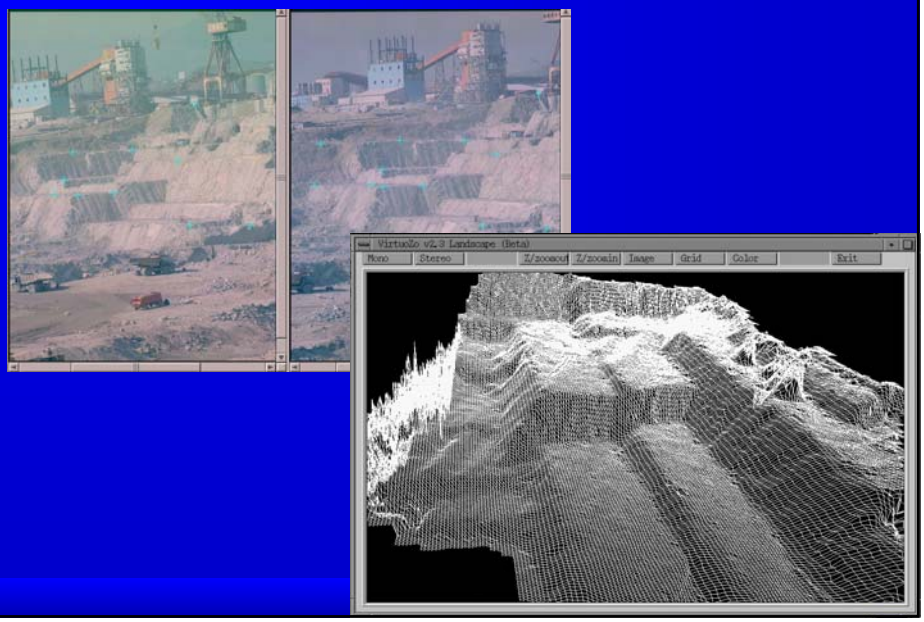


Digital Photogrammetry Systems

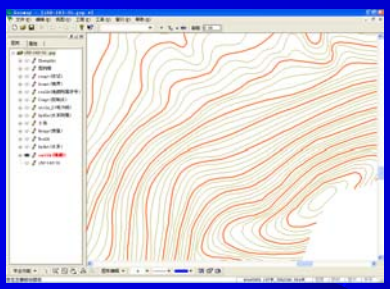
VirtuoZo NT **JX4C DPS**

- Two major digital photogrammetric workstations in use, not only acquired about 90% of the domestic market but also entered the international market for competition.

3gorge's Close-range Iimages

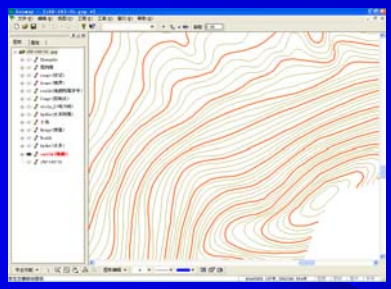


Generating DEM from Contour Maps



- GeoTIN (Wuhan Geo Co.Ltd)
- DEMIX (Wuhan Superfoft Inc)
- GeoWayDEM (BeijingGeoway Co.Ltd)

Raster-Vector Conversion



- **GeoWayDLG**
- **EPSCAN 2000 (Beijing Tsinghua Sunway Co. Ltd)**

Image Processing

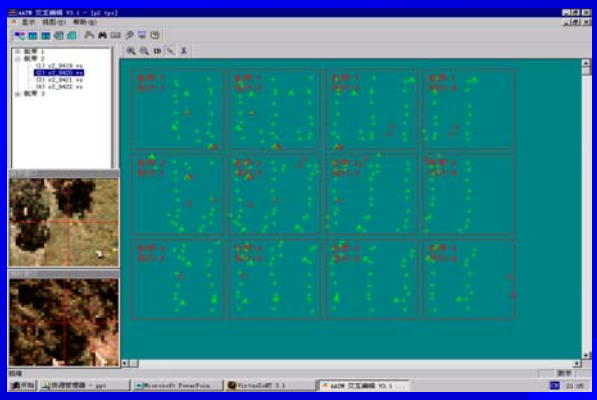
- CyberLand
- Geo Imager
- Photomapper
- LT VRMap
- GeowayDOM
- Imagesuite

Imagesuite

No Dodge

Dodge & Mosaic

Auto Digital Aerotriagulation Systems



- VirtuoZo-AAT (Supersoft, Co.Ltd)
- GXP-AAT (Beijing Siwei)

Scanners and Plotters

Imatzier 2304 – a professional photo scanner

JSH6080- Laser Raster Plotter

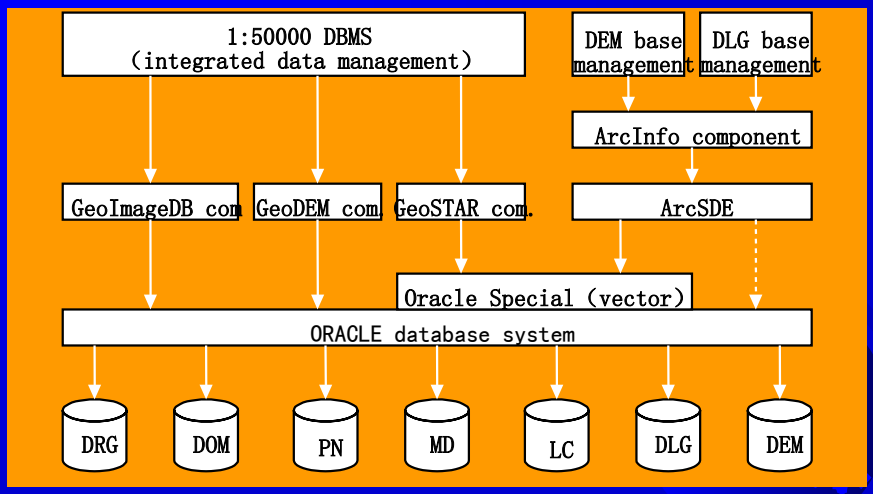
Systems for Spatial Data Custodian

- Early stage of development, most GIS software was imported.
- Since the late 1980s, efforts have been made to develop homegrown GIS software systems. The initial efforts came from university laboratories and research institutes. Several GIS software packages were developed as the result of research projects.
- Since the mid 1990s, attention has been paid to the commercialization of such software.

Homegrown commercial GIS platform software

- **GEOSTAR**
- **MAPGIS**
- **Supermap**
- **CITYSTAR**
- **MapEngine**
- **IMAGIS: 3D Visual GIS**
- **MirageGIS**
- **MapEngine**
- Based on statistical data in 2000, homegrown GIS software has occupied about 30% of the domestic market [National GIS Software Evaluation Committee, 2000].

Managing 1:50,000 scale Data on Oracle 8i

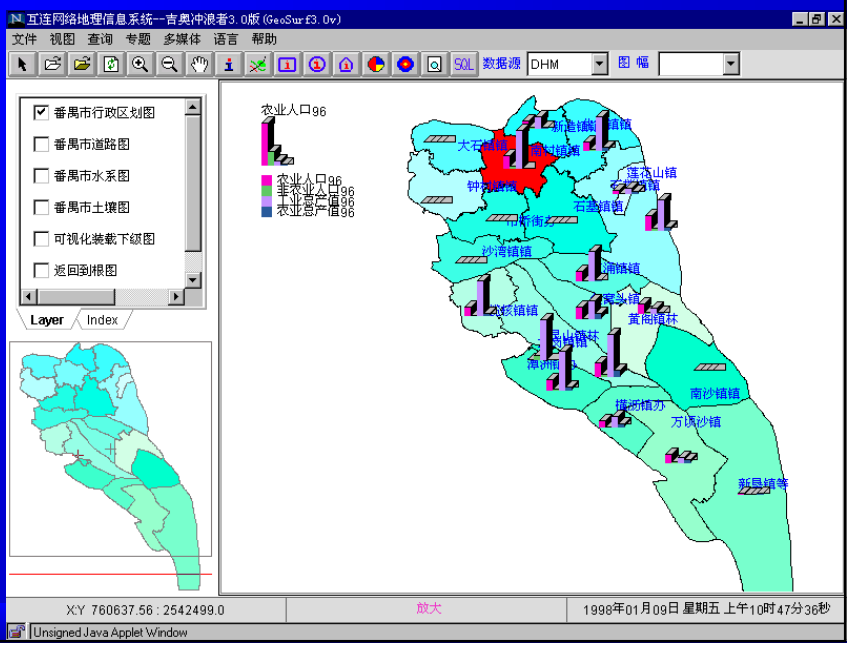


Com. = component

Internet GIS Products

- GeoSurf-
- GeoBeans- National Engineering Research Center for Geoinfomatics
- AFInternet GIS-
- CDWebGIS

GeoSurf Statistics analysis based on interoperability



Visualization Systems

- CyberCity (***SUPRESOFT)***
- SMVR- 3D Virtual reality system (*Beijing Siwei*)
- WebCybercity (Wuhan Geo)

3D Modeling and Visualization

虚拟建设（房屋、高压线、电杆...）

Evaluation of Homegrown Software

- The Ministry of Science and Technology of China (MOST), the China Association of GIS (CAGIS) and the Association of Chinese Professionals in GIS (Abroad) (CPGIS) established in 19996 the annual domestic software evaluation project
- Commercial domestic GIS software package are tested, evaluated, and criticized by an expert panel.
- The evaluations resulted in numerous studies published and distributed among GIS professionals in China, which serve as the important sources of information for understanding the development of GIS software industry in China.

Date	1997	1998	1999	2000
Num. evaluated products	9	34	40	31
Software praised and strongly recommended	GROW MapGIS	GeoScan GROW MapCAD MapGIS MirageGIS	GeoStar GROW MapGIS	EPSCAN2000 GeoStar GeoWay GROW MapGIS
Software praised and strongly recommended		CityStar EFGIS EPSW98 GeosStar GeoSurf IntAtlas MapEngine Shanghai Yellow pages	AFInternetGIS Beijing Guide V3.0 EFGIS EPSCAN2000 EPSW2000 GeoSan GeoSurf GeoTIN GeoGrid MirageGIS PhotoMapper	AFInternetGIS Beijing Guide V3.0 EFGIS EPSCAN2000 EPSW2000 GeoSan GeoSurf GeoTIN GeoGrid MirageGIS PhotoMapper

From Zhou and LI, 2002

Research groups-

- State key Laboratory LREIS (Beijing)

  - a background in geo-sciences, concentrating on the basic problems related to spatial analysis and geo-applications.
- State key Laboratory LIESMARS (Wuhan)

  - focuses on the development of the basic theories and key technologies of RS data processing, GIS spatial data modeling and GPS, and integrated systems
- More than 20 GIS research groups at other universities or research institutes

  - Dynamic and Multi-dimensional GIS lab at NGCC

Funding bodies

- National Nature Science Foundation of China (NNSFC)
  - 50 GIS-related research projects was granted to researchers by the Division of Geographical Science of the NSFC during the period of 1991-2000
  - 75% of the principal investigators come from universities.
- Other ministries
  - State ministry of Science and Technology
  - State ministry of Education
  - State Bureau of Surveying and Mapping
  …

Research Areas

- Hot topics in the past five years

- Spatial data modeling, such as
  - Voronoi spatial data model, spatial-temporal data modeling, 3D data modeling
- Spatial analysis models, spatial decision support systems, system integration
- Non-technical factors in implementing operational GIS, such as
  - Re-engineering the networked organization under the CSCW environment
  - Policies and regulations for assuring the operational use of the systems
  - Education and training strategies
  - Updating & budgeting mechanisms for NFGIS & data sharing.

Publications of Research Results

- Publication in domestic journals from 1994-2000

  - 2562 papers with GIS as a keyword

  - Top five Chinese journals: The ACTA GEODETICA ET CARTOGRAPHICA SINICA, Journal of WTUSM, Journal of Remote Sensing, Journal of Geography, and Journal of Image and Graphics

- Publication in International journals

  - Started to publish research results in IJGIS, GeoInformatica and PE&RS

- Publication in international conferences in GIS and related areas

  - Spatial Data Handling, ISPRS symposium,…

Scholarly activities on the international stages

- Chairing GIS-elated international organizations
  - President of PCGIAP
  - Vice-Chairman of ICA
  - President of Commission II of ISPRS
- Organized a number of international conferences
  - 1st International Conference on Digital Earth (1999)
  - 9th International Symposium on Spatial Data Handling (2000)
  - International Conference on Cartography (2001)
  - 1st and 2ed International Workshop on Dynamic and Multi-dimensional GIS (1997, 1999)
  - ISPRS Com. II mid-term symposium

GIS Education and on-the-job training

- The development of GIS applications and the GIS industry has had a tremendous impact on geo-spatial information education at universities and on-job training [Li and Hu, 1994; Li and Chen, 2000].
- There is a huge demand for GIS professionals (especially high level professionals) in the market.
- About 100 universities and/or colleges offer GIS-related seminars or lectures at various departments (include surveying and mapping, geography, geology, earth science, environmental science, forest, hydraulic engineering, agriculture, urban planning and so on).

Degree programs in GIS (1)

- 1988: 1st GIS program (geo-information engineering) at under-graduate level was set up at WTUSM (now Wuhan University).
- 2002: over 70 universities are now offering four-year GIS programs, with an intake of about 2,500 each year.
- Moreover, more and more universities are starting to offer taught courses in at MSc level
- Some universities have been granted the authority to offer Ph.D awards in GIS. About 100 M.Sc and/or Ph.D graduates per year have left universities for GIS enterprises or user communities since 1995.

Degree programs in GIS (2)

- Most undergraduate level GIS programs are developed by geography, geology or surveying departments, i.e. the spatially-oriented disciplines.
- It is now encouraged to combine courses on spatial sciences with basic computer science courses in programming and data structures, leading to more advanced course work on spatial data structures, database design and the development of various applications of interest to GIS trainees.
- Many current GIS programs are more technology-oriented. Efforts are needed to include business-relevant and other non-technical topics (legal, personnel and managerial) in these GIS programs, to facilitate the strategic use of GIS.

On-job training in GIS

- SBSM (1998)

  - 51.3% of professionals in GIS area have only one to two years' experience and 55.1% are under 30 years old.

  - A three-level training program has been proposed and implemented by the SBSM for its employees for on-job GIS training.
- Training courses are also run by GIS vendors, but only for training the use of their own GIS software.

National Coordination

- National Coordination Commission on Geospatial Information (1999)
- China Association of GIS (CAGIS, 1994)

  Main objectives:

  - to foster exchanges between users, manufactures and academics
  - to promote operational use of GIS, and
  - to disseminate new technology and experience
  - (www.cagis.org.cn).
- National Technical Commission on Geographic Information Standards (1997)

National Coordination Commission on Geospatial Information

- This inter-department (ministry) organization consists of representatives from more than ten government departments (ministries) that have GIS-related business or activities.
- It aims to promote the national cooperative framework on geospatial information and to develop strategies and policies at the national level.

Administrative License Regulations

- Formulated by SBSM in the end of 1999
- Three category users for geo-information utilization agreement
- Geo-data sharing in China being promoted

CAGIS (1994-)

- Ten commissions
  Commission I: Theory and Methodology;
  Commission II: Standardization and Quality Control;
  Commission III: Geo-spatial Data;
  Commission IV: Education and Popularization;
  Commission V: Resources and Environment Application;
  Commission VI: Urban Information Systems;
  Commission VII: Government GIS;
  Commission VIII: Engineering Applications;
  Commission IX: Software Industry and
  Commission X: Market Promotion.
- Members
  - About 3000 individual members
  - About 300 corporate members
- Professional journal - *Geomatics World* (in Chinese)
- Biennial GIS conferences

National Standards
Worked out and Published

- Geographic grid (GB 12409-90),
- Classification and codes for national fundamental geographic information (GB 13923-92),
- Classification and codes for forest resources,
- Coding system of river names of China,
- Classification and codes for features on topographic maps at the scale 1:500,1:1000 and 1:2000 (GB 14804-93);
- Guide to standardization for Urban GIS, Coding structure and rules for urban geographic features- city roads, road intersections, blocks and municipal piping systems (GB 14395-93)
- National standard for spatial data transfer (GB/T 17798-1999);

National Standards under Development

- Data quality control and estimation
- Symbol systems for digital mapping at scales from 1:500-1:1,000,000
- Metadata standards
- Standards for data products and distribution
- National Standard on navigation maps
- National Standard on Data Collection and Processing for navigation maps

What's happened in China

- PE&RS special issue (April, 2004)

  1. Jun CHEN, Jing LI, Jianbang HE and Zhilin LI, Development of GIS in China: overview, PE&RS, 68(4):325-332

  2. Qiming ZHOU and Bin LI, A tentative view on GIS software development in China, PE&RS, 68(4):333-340

Thanks for Your Attentions !

Having a successful Workshop!