Modern Agent Technologies

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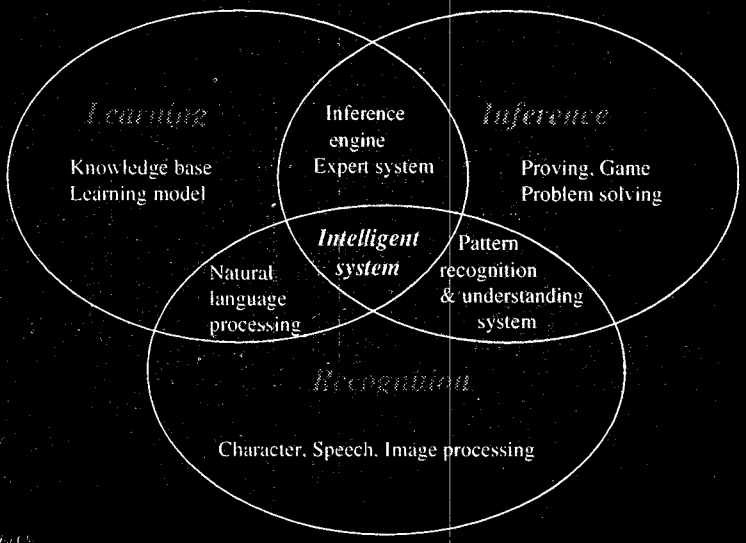
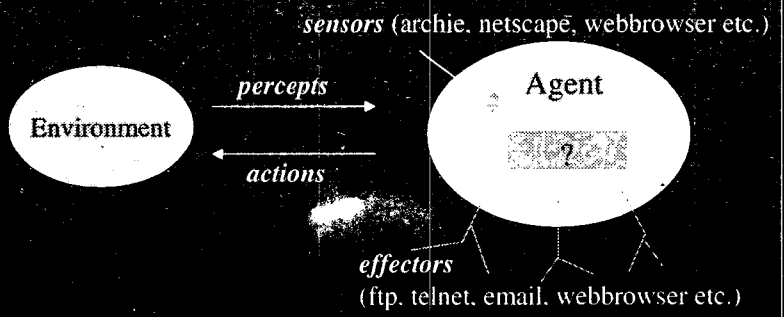
Intelligent Techniques



What is an Agent?

- An agent is anything that can be viewed as ***perceiving*** its environment through ***sensors*** and acting upon that environment through ***effectors*** (S.Russell, P.Norvig, 1995)



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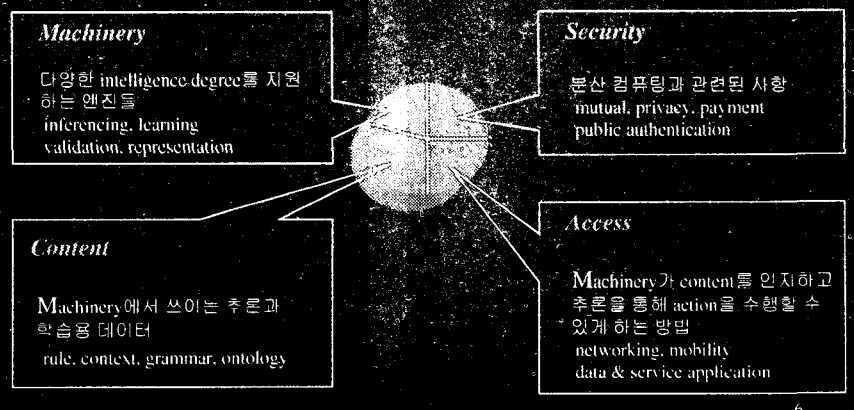
5. Conclusions

Factors of Intelligent Agent Technology



Intelligent Agents Measurement

Types by Agent's Environments

Desktop Agents (user assistance)	Operating System Agents Application Agents Application Suite Agents
Internet Agents (information agents)	Web Search Agents Web Server Agents Information Filtering Agents Information Retrieval Agents Information Extraction Agents Notification Agents Service Agents Mobile Agents Middle Agents
Intranet Agents (workflow, customization)	Collaborative Customization Agents Process Automation Agents Database Agents Resource Brokering Agents

Drawback in Conventional Researches

- Lack of Theoretical Model and Development Methodology
- Lack of Ability to deal with
  - Complexity of User's Requirements (Time/Quality/Cost etc.)
  - Heterogeneous as well as Huge Information in Internet
  - Acquired rather than Retrieved
  - Distributed Processing
  - Large Scale Network (Multiple Wide Area Network)

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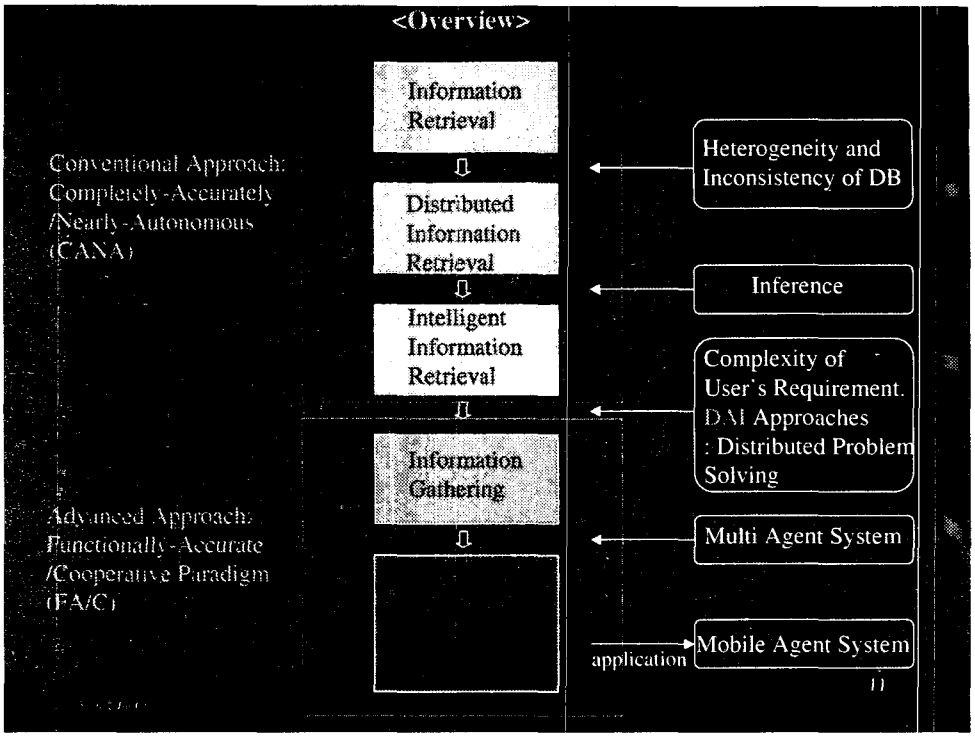


Completely-Accurate/ Nearly-Autonomous Approach

- Definition (1980)
  - Assumption: Each decomposed agent has sufficient data to solve its assigned sub-problems completely and accurately with little or no interaction with other agents
  - Little or no communicate with other agents
  - Simply information retrieval
- Limitations
  - Communication bandwidth
  - Delay of synchronization tip
  - Reliability
  - Speed etc.

New Trends

- Distributed AI Approach to Agent System
  - FA/C Paradigm (1991)
  - Mobile Multi Agent System (1998~)
  - Cooperative Information Gathering (1999~)
- Development of Agent Frameworks
  - JAF (Java Agent Framework) (1995)
  - DECAF(Distributed Environment Centered Agent Framework) (1996)
  - Advanced DECAF(2004~)

Distributed Artificial Intelligence(DAI)

- Modern Approach to Agent System
- Generalization of AI

  DAI is the study, construction, and application of multiagent systems, that is, systems in which several interacting, intelligent agents pursue some set of goals or perform some set of tasks.

  - Gerhard Weiss, Multiagent System
- Types
  - MAS(Multi Agent System)
    - Focus on agents coordination
  - DPS(Distributed Problem Solving)
    - Focus on task decomposition and solution synthesis
  - Hybrid: MAS + DPS ➡ FA/C Paradigm

    FA/C Paradigm + Mobility ➡ Mobile Agent

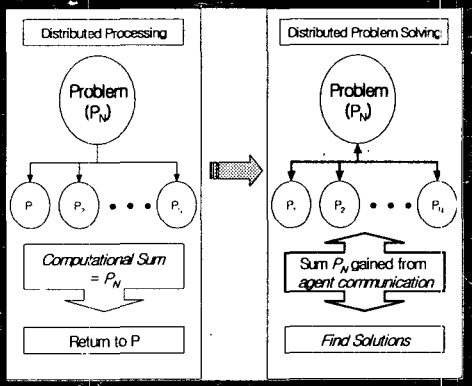
Attributes vs. Potential Range in MAS

	Attributes	Potential Range
Agents	number uniformity goals architecture abilities (sensors, effectors, cognition)	from two upward homogeneous ... heterogeneous contradicting ... complementary reactive ... deliberative simple ... advanced
Interaction	frequency persistence level pattern(flow of data and control) variability purpose	low ... high short-term ... long-term single-passing ... knowledge-intensive decentralized ... hierarchical fixed ... changeable competitive ... cooperative
Environment	predictability dynamics diversity availability of resources	foreseeable ... unforeseeable fixed ... variable poor .. Rich restricted ... ample

Distributed Problem Solving(DPS)

- Appropriate when subproblems are *independent*
- Given a computational problem P
  $P \longrightarrow P_i (1 \le i \le n) \longrightarrow \sum P_i$
  $\longrightarrow$ Return to P

- Appropriate when subproblems have *interdependencies* and where there is some benefit to be gained both logically and in terms of the global solution from *agent communication*
- $P \longleftrightarrow P_i (1 \le i \le n) \longleftrightarrow \sum P_i$
  $\longleftrightarrow$ Find Solution
- Partial results can be exchanged among agents

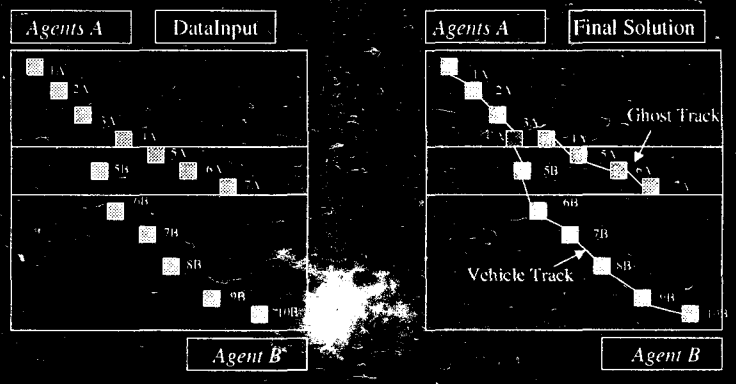


Functionally-Accurate/Cooperative Paradigm (FA/C)

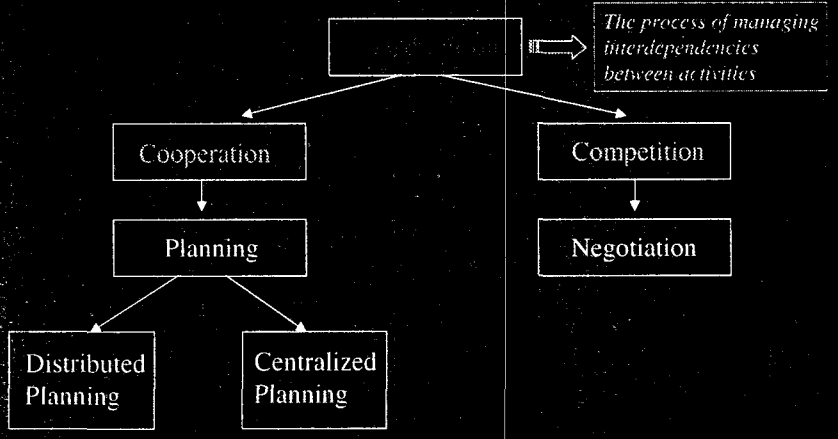
- Approaches to Multi-Agent System by DPS
- Proposed by Victor R.Lesser (Univ. of Mass; 1991)
  - Agents are solving ***interdependent, large-grained*** subproblems
  - Agents can generate ***partial and tentative high-level solutions*** in spite of incomplete and uncertain information
  - Agents can ***partially resolve inconsistencies and uncertainties*** based on constraints derived from partial solutions to interdependent subproblems received from other agents
- Advantages
  - Lower message traffic
  - More system reliability in face of processor, communication and sensor failure
  - Less agent idle time and more parallelism

Example of FA/C

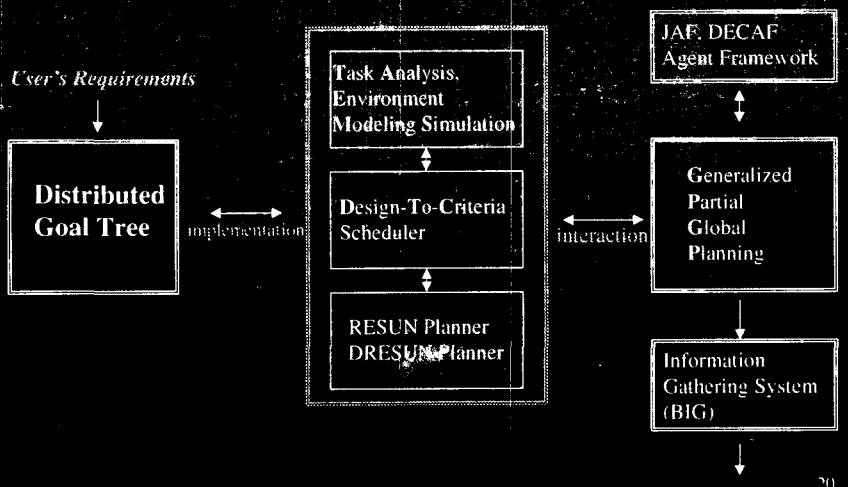
- Two-Agent Distributed Aircraft Monitoring Scenario



Taxonomy of Coordination

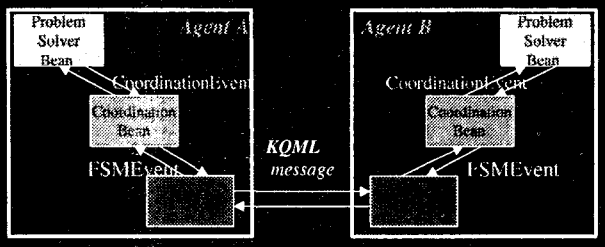


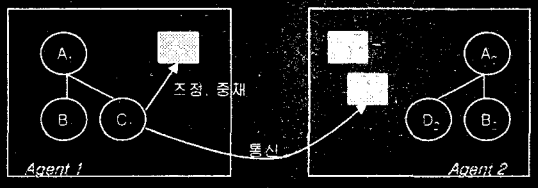
Research Components of FA/C



Agent Negotiation Algorithm

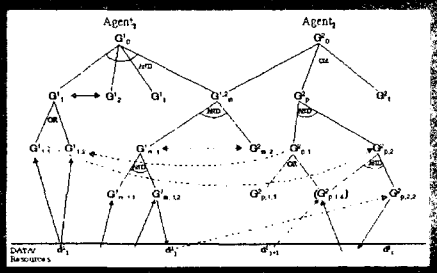
- 여러 에이전트들이 있을 때 상호 조정함으로써 하나의 큰 문제를 해결할 수 있도록 제안한 플래닝 알고리즘으로 일반화된 조정 과정에 사용되는 협상 알고리즘
- Facilitator에 의해 중재



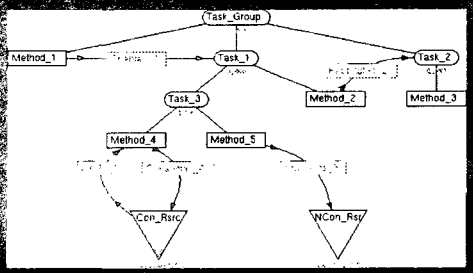


TAEMS

- 태스크 구조를 형성함으로써 전체 시스템 목표를 수행해 나가기 위한 중요한 분산 목표 트리 구조를 생성하는 시스템 개발도구
- 분산목표트리: 에이전트 목표(goal)과 메소드간의 상호의존성을 나타낸 것



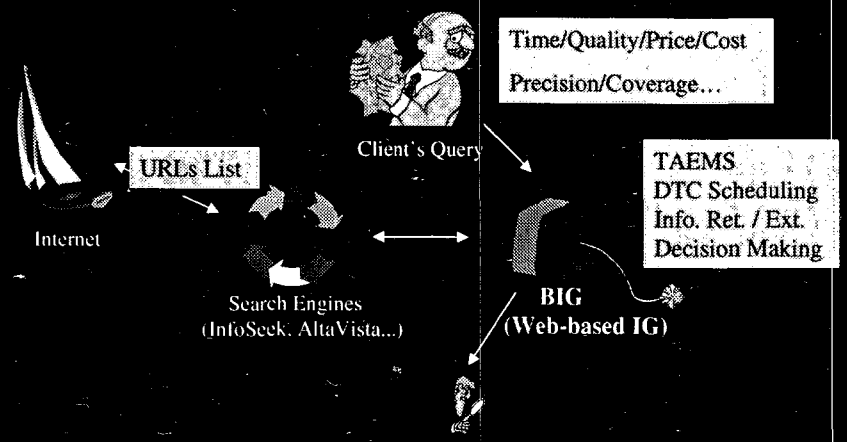
<Distributed Goal Tree>



<TAEMS Task Structure>

Case Study:BIG

(Resource-*B*ounded *I*nformation *G*athering, 1999)

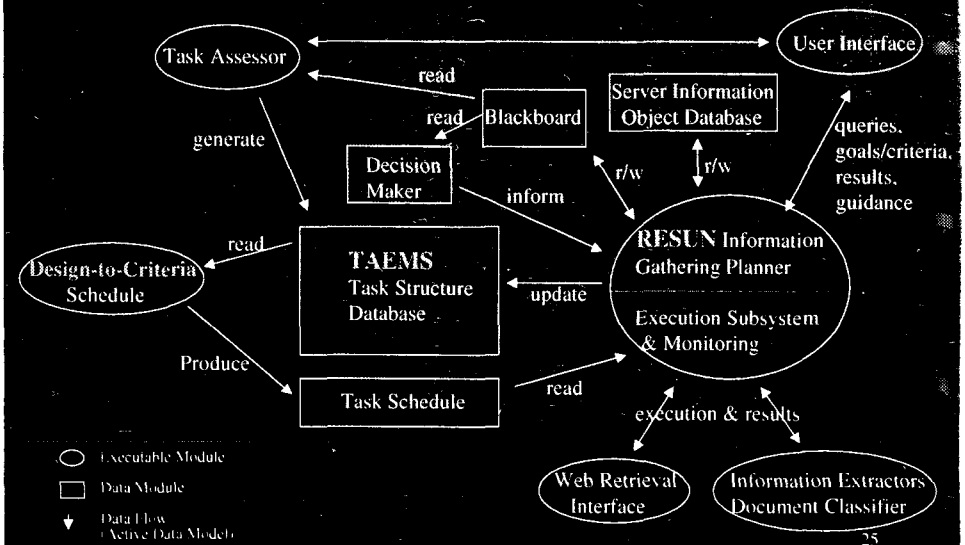


Selection Among Results

BIG vs. Web-based Information System

	Meta Search Engine	Personal Information Agent	Shopping Agent
Similarity	- Using multiple different web search tools	- Gathering documents by actively web searching	- Gathering documents with price information
Difference	- Learning products over time - Reasoning time/quality trade off of different web search options	- Performing information extraction on retrieved data	- Difference in complexity of decision process and information processing facilities
Character Sites	- Supplementation IR technology of search engines - Clustering documents - Too much data	- Search from one or more specific points on web - Selectively pursing links for relevant information - Concept-driven	- Search from built-in library - Development of shopping sites and interaction of relevant information
Types	- SavvySearch - MetaCrawler	- Not as fast as Meta Search Engine - Spider	- BargainFinder - Shopboat - Jango

BIG Agent Architecture

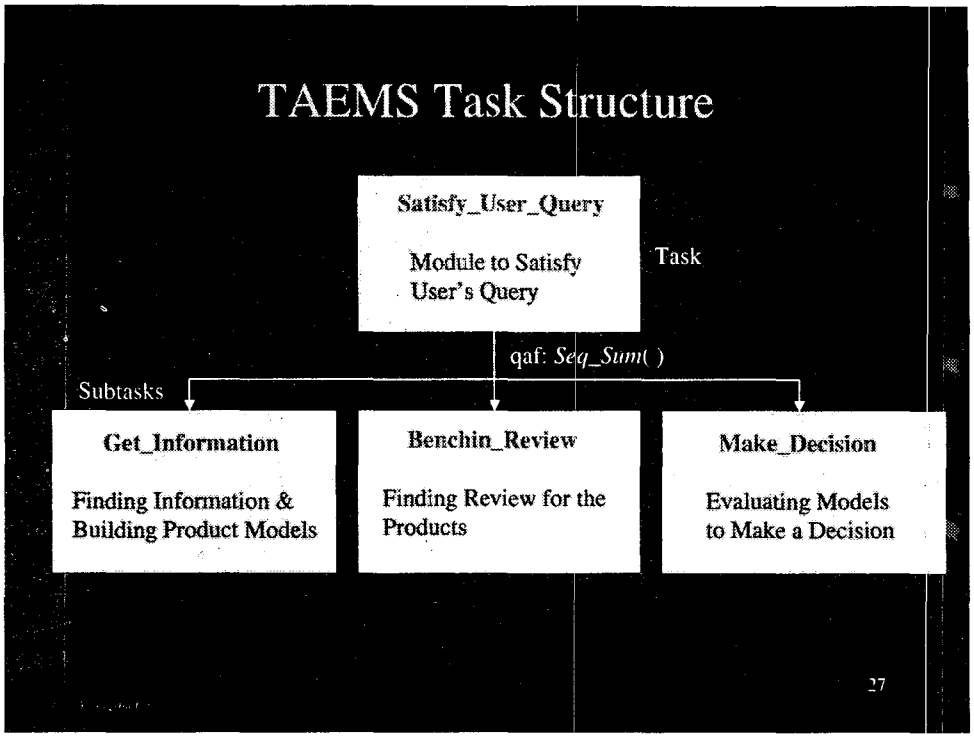


Execution Trace

< Client >

A student who uses the system to find a ***Word Processing Package*** which will most closely satisfy a set of requirements and constraints

- Query Formulation : User Interface
- Plan Construction : TAEMS
- Schedule Generation : DTC Scheduling
- Information Retrieval and Extraction : RESUN Planner
- Decision Making : Score Calculation


TAEMS Task Structure
Satisfy_User_Query
Module to Satisfy User's Query
Task
qaf: Seq_Sum( )
Subtasks
Get_Information
Finding Information & Building Product Models
Benchin_Review
Finding Review for the Products
Make_Decision
Evaluating Models to Make a Decision
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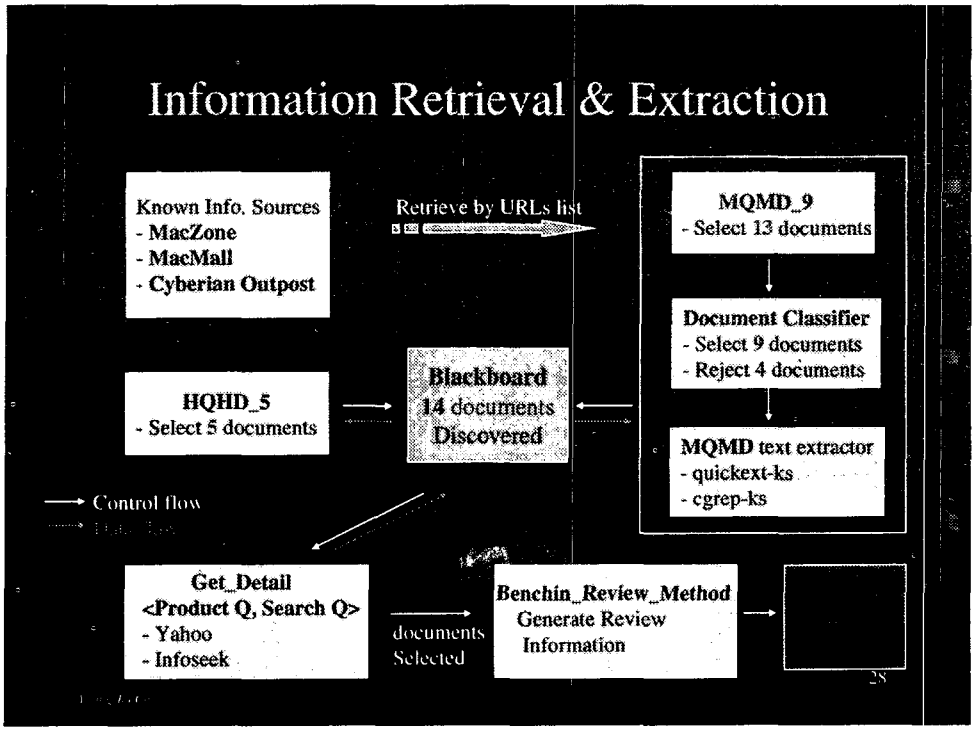
Information Retrieval & Extraction
Known Info. Sources
- MacZone
- MacMall
- Cyberian Outpost
Retrieve by URLs list
MQMD_9
- Select 13 documents
Document Classifier
- Select 9 documents
- Reject 4 documents
MQMD text extractor
- quickext-ks
- cgrep-ks
HQHD_5
- Select 5 documents
Blackboard
14 documents Discovered
Control flow
Get_Detail
<Product Q, Search Q>
- Yahoo
- Infoseek
documents Selected
Benchin_Review_Method
Generate Review Information
28

Example: Evolution of Dramatica Product Object

Product name : DRAMATICA PRO 2.0 3.5IN DSK
Company name : Screenplay
Price : 289.99
Processing Accuracy : (Genres 0) (PRODUCTID 0) (COMPANY 1.0)
(PRICE 2.2) (PRODUCTDESC 0) (PROCESSOR 0)
(RAMREQ 0) (DISKSPACE 0) (PLATFORM 0)
(MISCREQ 0) (OVERALLQUAL 0)

Product name : DRAMATICA PRO 2.0 3.5IN DSK
Company name : Screenplay
Price : 289.99

Product name : DRAMATICA PRO 2.0 3.5IN DSK
Company name : Screenplay
Price : 289.99
Processor:
Platform : macintosh-system_7.0_or_higher windows_95
misc requirement : (mb ram)
overall quality :
Usefulness :
Future Usefulness :
Ease of Use :
Power :
Stability :
Enjoy ability :
Value :
Processing Accuracy : (Genres 0) (PRODUCTID 0) (COMPANY 1.0)
(PRICE 2.2) (PRODUCTDESC 0) (PROCESSOR 0)
(RAMREQ 0) (DISKSPACE 0) (PLATFORM 0)
(MISCREQ 0) (OVERALLQUAL 0)
Review Consistence :

(PQUALITY 0.5714286) (SQUALITY 1.0)

Processing Accuracy : (Genres 0) (PRODUCTID 0) (COMPANY 1.0)
(PRICE 2.2) (PRODUCTDESC 0) (PROCESSOR 0)
(RAMREQ 0) (DISKSPACE 0) (PLATFORM 0)
(MISCREQ 0) (OVERALLQUAL 0)

: Found or updated data

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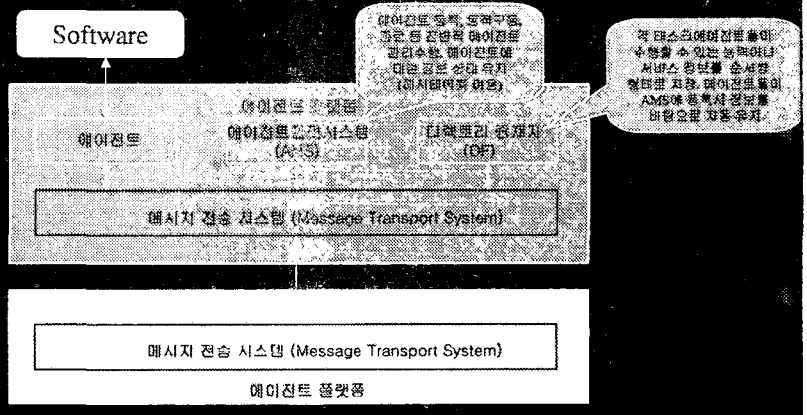
Agent Platform

• FIPA (Foundation for Intelligent Physical Agents): 에이전트 기술 국제표준화 기구



<FIPA Management Reference Model>

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DECAF Agent Platform

- Proposed by Keith Decker (Univ. of Delaware, 1996)
- DECAF (Distributed Environment Centered Agent Framework
- Agent OS 역할
- Functions
  - 분산 환경에 적합
  - 에이전트 구조 즉, 에이전트 통신, planning, 스케쥴링, 실행 모니터링, coordination, 진단, 학습 등을 평가하고 생성하기 위한 모듈화된 플랫폼 제공
  - 스스로 소켓 프로그램을 생성하고 메시지를 포맷하고 에이전트 통신을 수행하는 building block을 제공
  - API에 대한 지식이 없어도 프로그래밍 가능
- 구성
  - 에이전트 이름서버(Agent Name Server)
  - 플랜편집기(Plan Editor)
  - DECAF 프레임워크

Agent Name Server

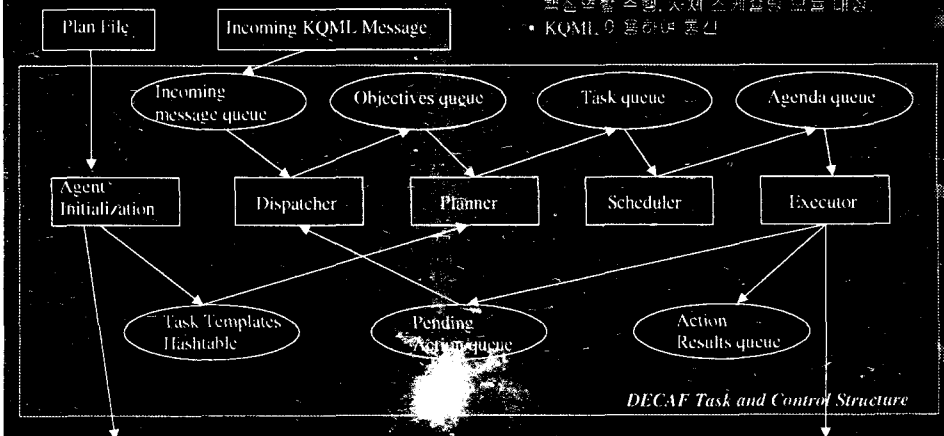
- DNS(Domain Name Server)와 유사한 개념으로 멀티에이전트 시스템내 미들웨어 역할을 담당
- 작업 도메인 내의 에이전트를 식별하는 역할 담당
- 에이전트 등록

Plan Editor

- 도메인에 속한 전체 작업을 세부작업과 최하위 에소드로 분할할 때 제공되는 GUI 형태의 트리구조 형태의 편집기

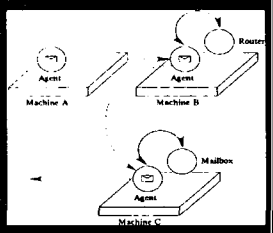
DECAF Structure

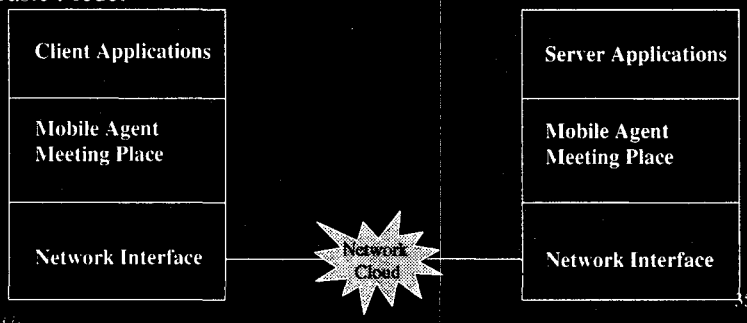
- 에이전트 생성, 저장, 오류 상호작용하는 핵심역할 수행, 자체 스케줄링 교통 내장.
- KQML 이용하여 통신



Mobile Agent System

- Program, typically written in a *script language*, which may be dispatched from a client computer and transported to a remote server computer for execution
- Basic Model





Example of Mobile Code Paradigm

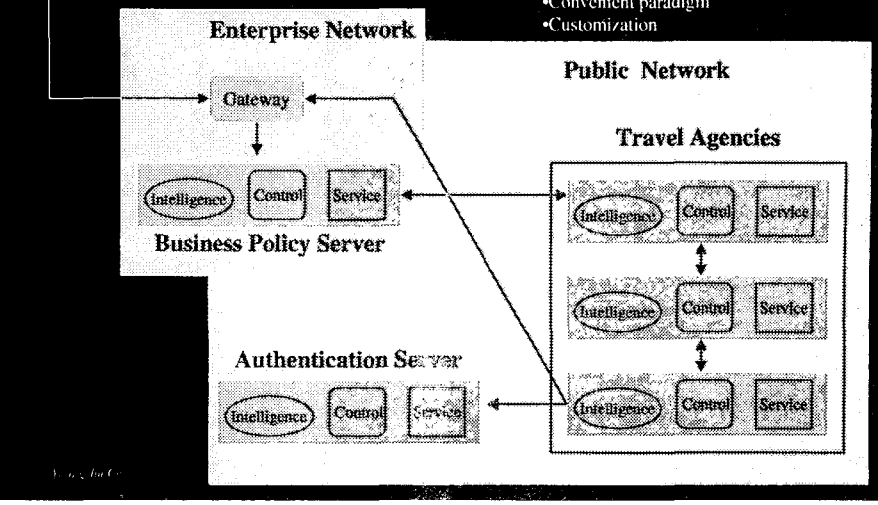
- Two friends (A, B)
- Make the cake (the result of a service)
- A recipe is needed (know-how about the service)
- Ingredients (movable resources)
- An oven to bake the cake (a resource that can hardly be moved)
- A person to mix the ingredients following the recipe (a computational component responsible for the execution of the code)
- To prepare cake (to execute the service)
- All these elements must be chocolated in the same home (site)

Paradigm \ B/A	Before		After	
	Client	Server	Client	Server
RPC	A	Know-how Resources B	A	Know-how Resources B
RP	Know-how A	Resources B	A	Resources B
Mobile Agent	Know-how A	Resources		Resources

- A, B: agents
- Know-how: code or procedure
- Resource: database, system resources

Mobile Agent Scenario

Advantages
- Efficiency
- Fault Tolerance
- Convenient paradigm
- Customization



Mobile Multi Agent System

- 기본 개념

- 장점
  - 네트워트개발과 개별화를 위한 오픈 형태의 일반화된 전역적 프레임워크를 지원한다.
  - 각 개별 에이전트의 기능적 지원을 한다.
  - 기존의 서비스는 물론 새로운 서비스와 새로운 비즈니스를 지원한다.
  - 인터넷 사회에 대단히 긍정적인 효과를 제공한다.
- 상용화된 종류
  - CAGIS DIAS
  - Voyager

Mobile Agent Survey

- Japan

  (Java-based autonomous software agent, IBM Japan, 1997)
  - Java applets에 의해 만든 네트워크 모빌 코드 모델의 확장 형태
  - 자신의 상태 정보 유지하면서 이동
- USA

Mobility Field	U. of Connecticut Distributed Collaborative Imaging System General magic.
	Dartmouth College D'agent 1.1 ( ): Working on Solaris 6.0. 1995 D'agent 2.0 : 1998
	U. of Kaiserslautern (Agent for Remote Action) : Mobile Agent Platform
Internal Functions & Platform	U. of Massachusetts : JAF(Java Agent Framework) U. of Delaware : DECAF U. of Michigan : Agent Coordination

Types of Mobile Agents by Languages

- Multiple-Language Systems
  - Ara: http://www.uni-kl.de/AG-Nehmer/Ara/
  - D'Agents(Agent Tcl): http://www.cs.dartmouth.edu/~agent/
  - Tacoma: http://www.tacoma.cs.uit.no:8080/TACOMA/
- Java-Based Systems
  - Aglets: http://www.trl.ibm.co.jp/aglets
  - Concordia: http://www.concordia.mea.com/
  - Jumping Beans: http://www.JumpingBeans.com/
- Other Systems
  - Messengers: http://www.ics.uci.edu/~bic/messengers/
  - Obliq:
    http://www.cc.gatech.edu/gvu/people/Phd/Krishna/VO/VOHome.html
  - Telescript: http://www/genmagic.com/technology/mobile_agent.html

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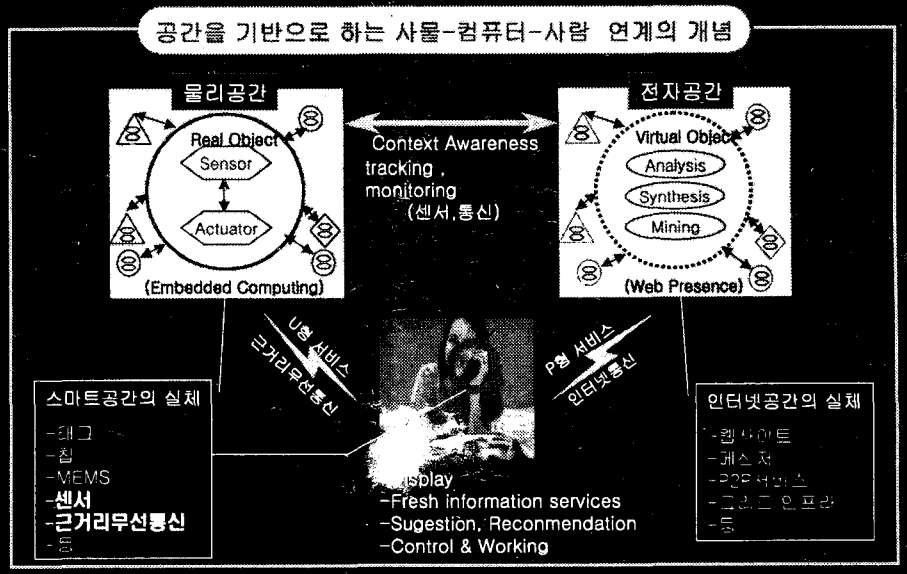
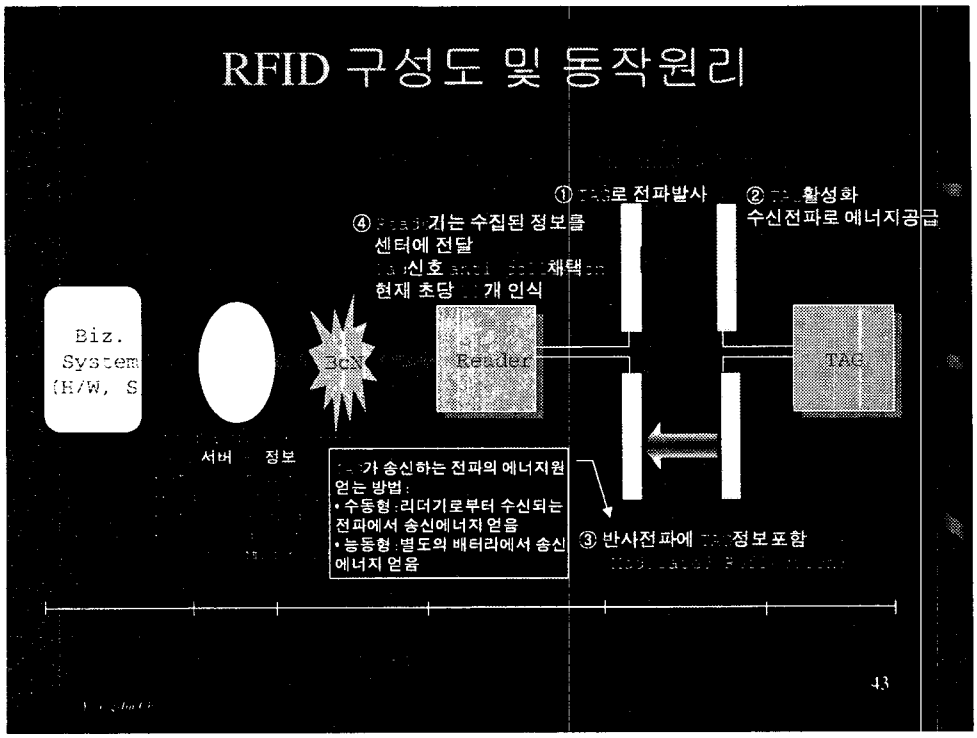
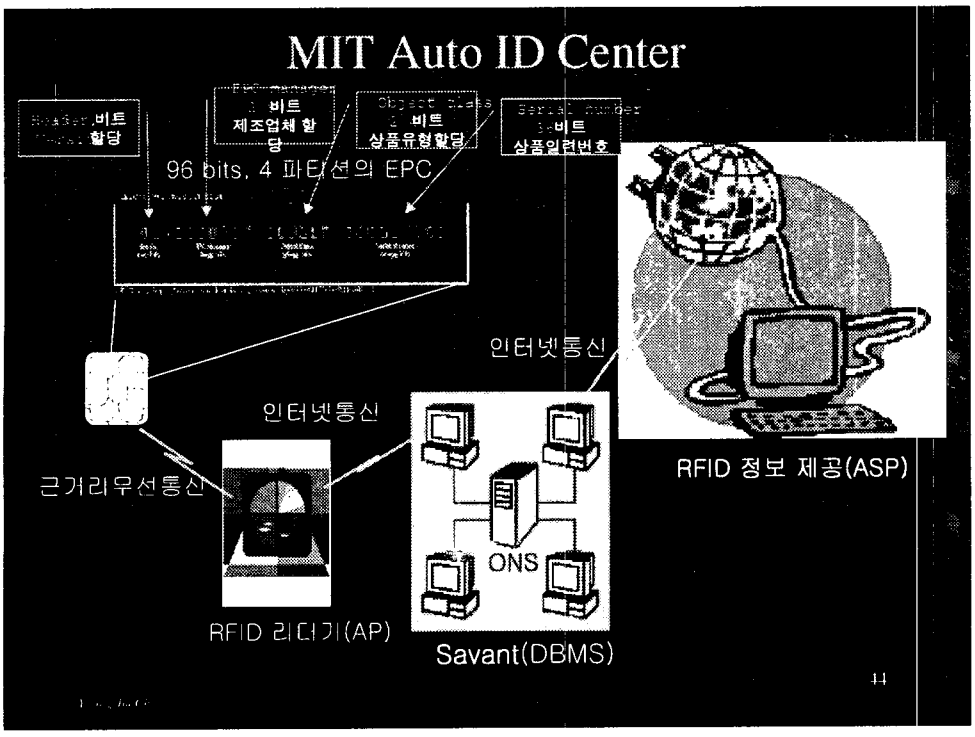
Ubiquitous Network Computing

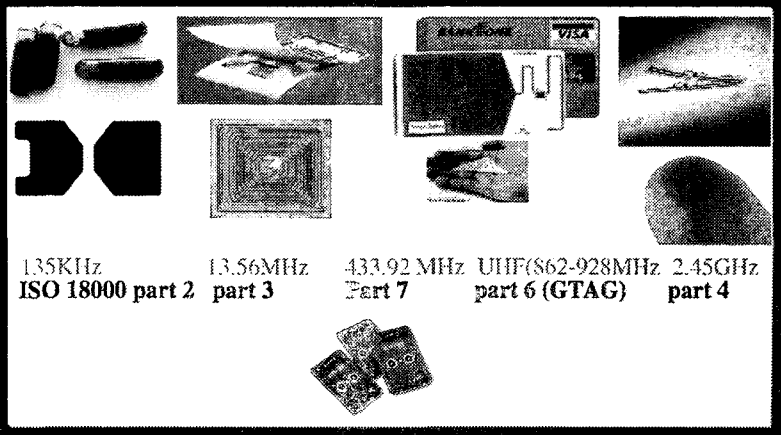



RFID 구성도 및 동작원리
① TAG로 전파발사
② TAG 활성화
수신전파로 에너지공급
④ Reader기는 수집된 정보를
센터에 전달
TAG신호 anti Collision
현재 초당 개 인식
Biz.
System
(H/W, S
Reader
TAG
서버
정보
TAG가 송신하는 전파의 에너지원
얻는 방법:
• 수동형 :리더기로부터 수신되는
전파에서 송신에너지 얻음
• 능동형 :별도의 배터리에서 송신
에너지 얻음
③ 반사전파에 TAG정보포함
43


MIT Auto ID Center
Header 8비트
Object class
Serial number
38비트
상품일련번호
96 bits, 4 파티션의 EPC
인터넷통신
인터넷통신
근거리무선통신
ONS
RFID 정보 제공(ASP)
RFID 리더기(AP)
Savant(DBMS)
44

RFID Types

Passive



Inductive

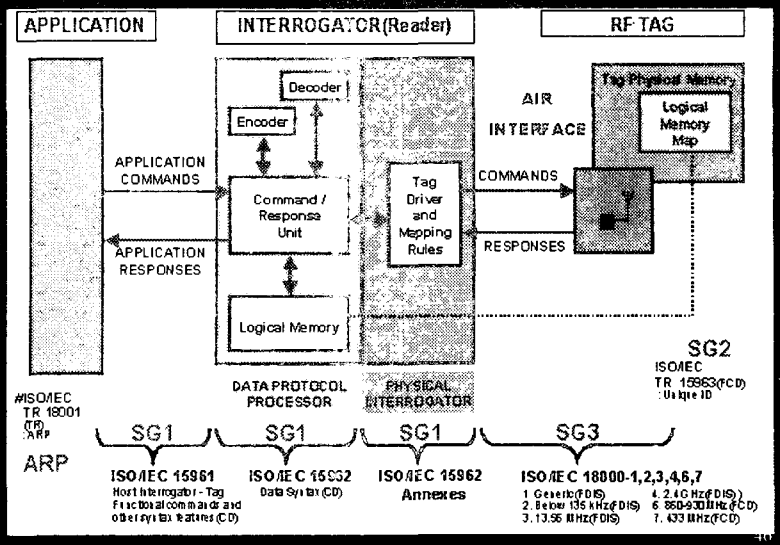
Electromagnetic

135KHz ISO 18000 part 2 | 13.56MHz part 3 | 433.92 MHz Part 7 | UHF(862-928MHz part 6 (GTAG) | 2.45GHz part 4

Active

RFID Standard (ISO/IEC)

- 년말 표준으로 완성될 예정



IPv6

❑ IPv6가 가지고 있는 주요한 특징은 주소의 개수가 많은 것 뿐만 아니라 기존 인터넷 보다 보안성(Security)이 뛰어나고, 이동성(Mobility)을 지원하며 품질(QoS)에 대한 고려가 가능하다는 것임.

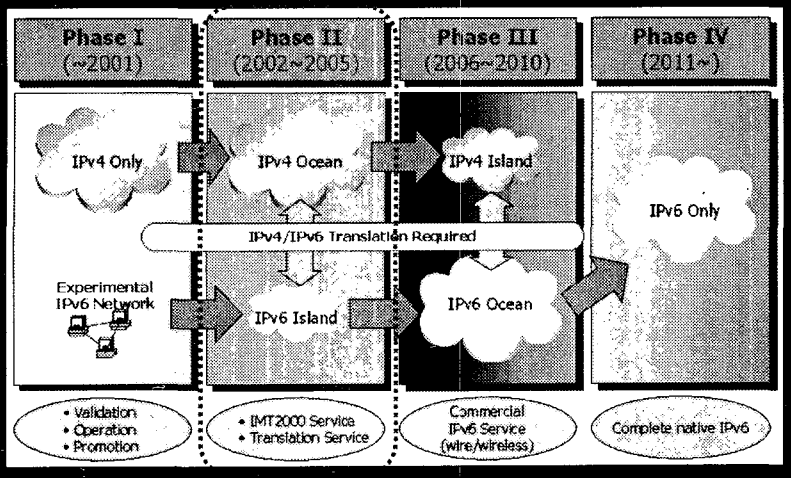
● IPv4와 IPv6의 비교

구분	IPv4	IPv6
주소길이	32비트	128비트
주소개수	약 43억 개	약 3.4×10^{38} 개 (거의 무한대)
품질제어	품질 보장이 곤란 (QoS 일부지원)	등급별, 서비스별로 패킷을 구분 할 수 있어 품질 보장이 용이
보안기능	IPsec 프로토콜 별도 설치	확장기능에서 기본으로 제공
자동네트워킹	곤란	있음(Auto configuration 기능)
이동성지원	곤란(비효율적)	용이(효율적)

→ PC 뿐 아니라 TV, 게임기, 휴대형 단말기, 카네비게이터, 센서 등 모든 정보 기기들이 하나의 네트워크로 연계, u-IT의 핵심기술

대형 ISP	기관별 주소	기관별서브넷	Interface ID

Steps of IPv6

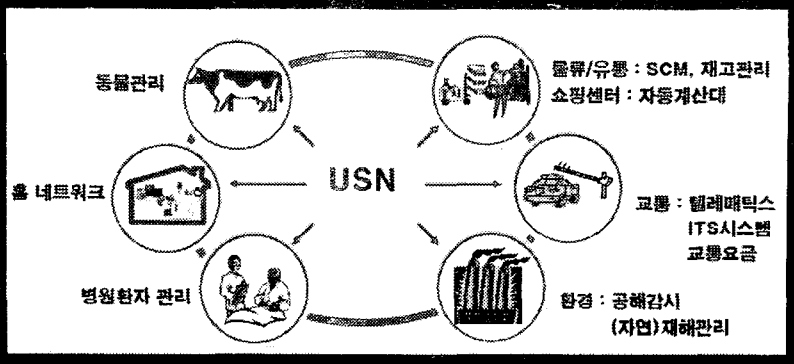


USN (Ubiquitous Sensor Network)

모든 사물에 전자 태그 부착 — Ubiquitous

사물 정보 및 환경 정보까지 감지 — Sensor

네트워크에 연결하여 실시간 관리 — Network



USN Vision

「전자 태그 보급 촉진을 통한 살기 좋은 u-life 구현」
정통부 2004.2 계획안 발표

2007년까지 세계 1위의 u-life 기술 확보
- 세계 전자 태그, u-센서 네트워크 시장의 5%(9.5억불) 점유
- 실생활에 u-life 본격 활용을 위한 기반 구축 완료

2010년까지 세계 1위의 u-life 실현
- 세계 RFID, u-센서 네트워크 시장의 7%(53.7억불) 점유

분야

반도체 산업을 기반으로
전자 태그, 센서 등 첨단
신산업 창출

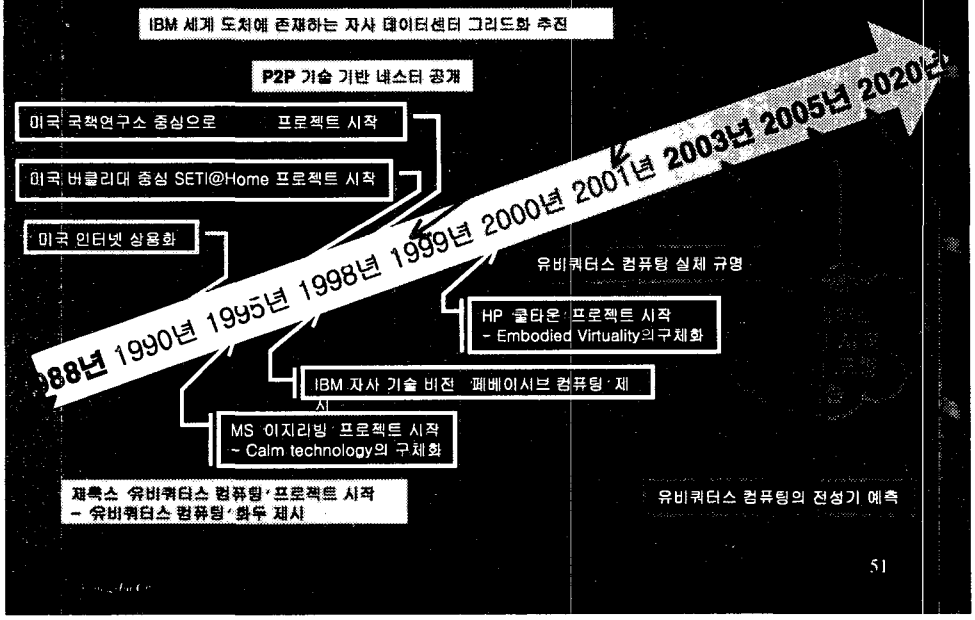
사[illegible]지 분야

상품 및 식품 관리, 교통, 환
의료 등 광범위한 실생활
적용으로 국민 복지 향상

산업 물류 분야

항만, 항공 등 물류 체계의
혁신으로 동북아 허브
구축에 기여

Ubiquitous Scenario



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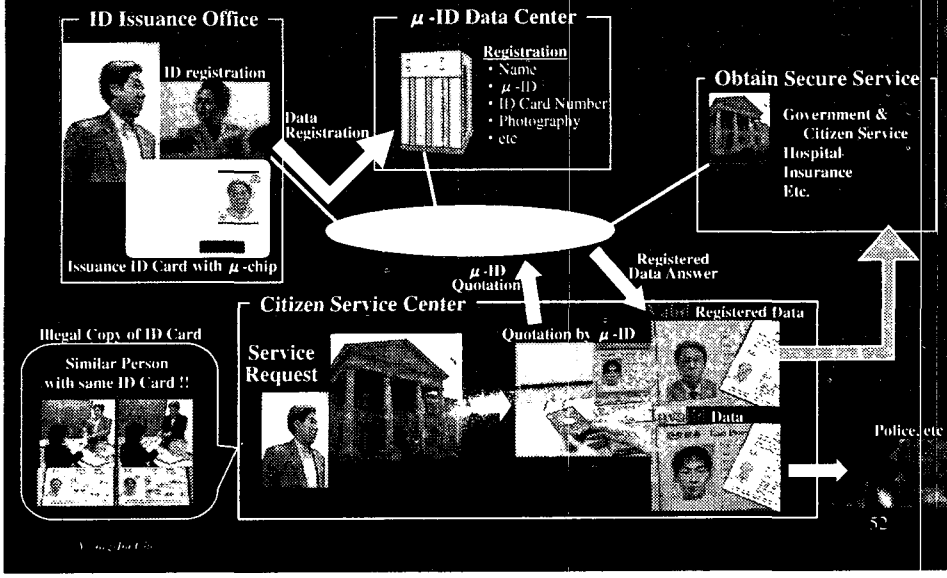
Security ID Solution



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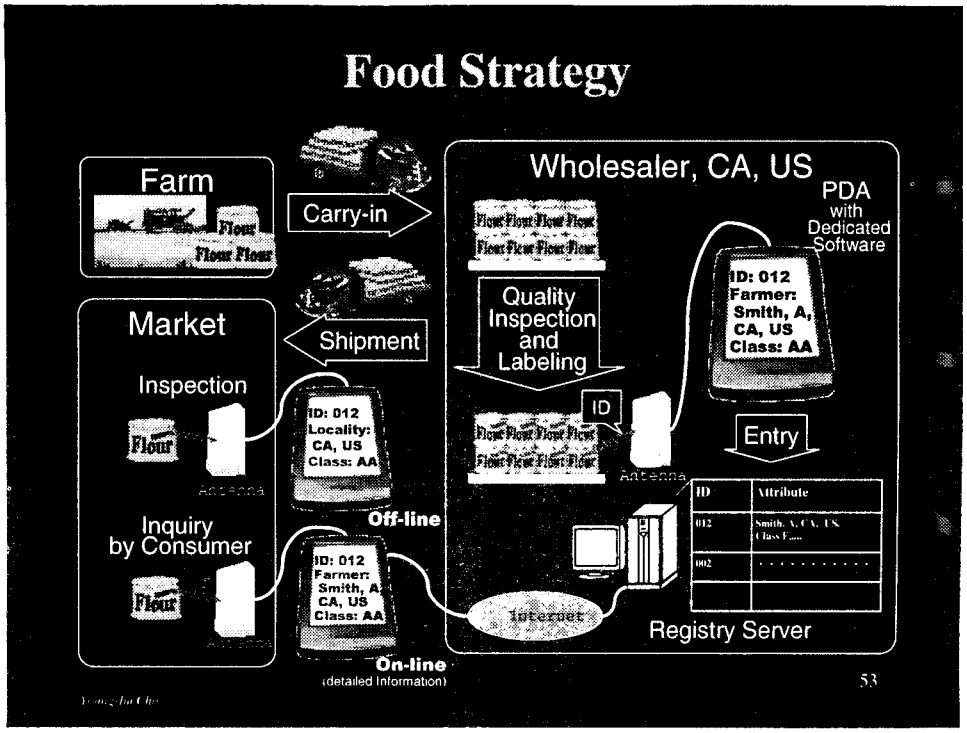
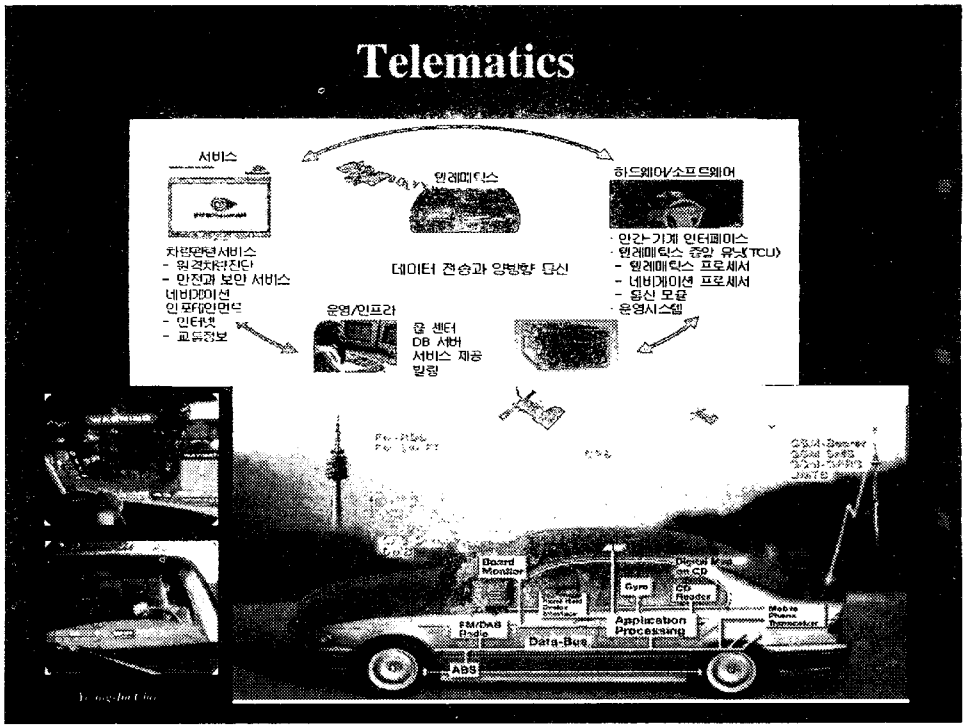

Food Strategy
Farm
Flour
Carry-in
Shipment
Market
Inspection
Antenna
Inquiry
by Consumer
ID: 012
Locality:
CA, US
Class: AA
Off-line
ID: 012
Farmer:
Smith, A
CA, US
Class: AA
On-line
(detailed Information)
Wholesaler, CA, US
PDA
with
Dedicated
Software
Quality
Inspection
and
Labeling
ID
Antenna
ID: 012
Farmer:
Smith, A,
CA, US
Class: AA
Entry
ID
Attribute
012
002
Internet
Registry Server
53


Telematics
서비스
텔레매틱스
하드웨어/소프트웨어
데이터 전송과 양방향 교신
운영/인프라
콜 센터
DB 서버
서비스 제공
일링
Board
Monitor
Gyro
Application
Processing
Data-Bus
ABS

Conclusions

- Comparison between Conventional Agent and Advanced Intelligent Agent Technologies
- Future Research
  - Mobile Multi Agent System
  - Theoretical Research about Agents
  - Intelligent Ubiquitous Computing with Agents