



Mid-Long Term R&D Master Plan of Korea's Wireless Telecommunications Using Analytic Hierarchy Process

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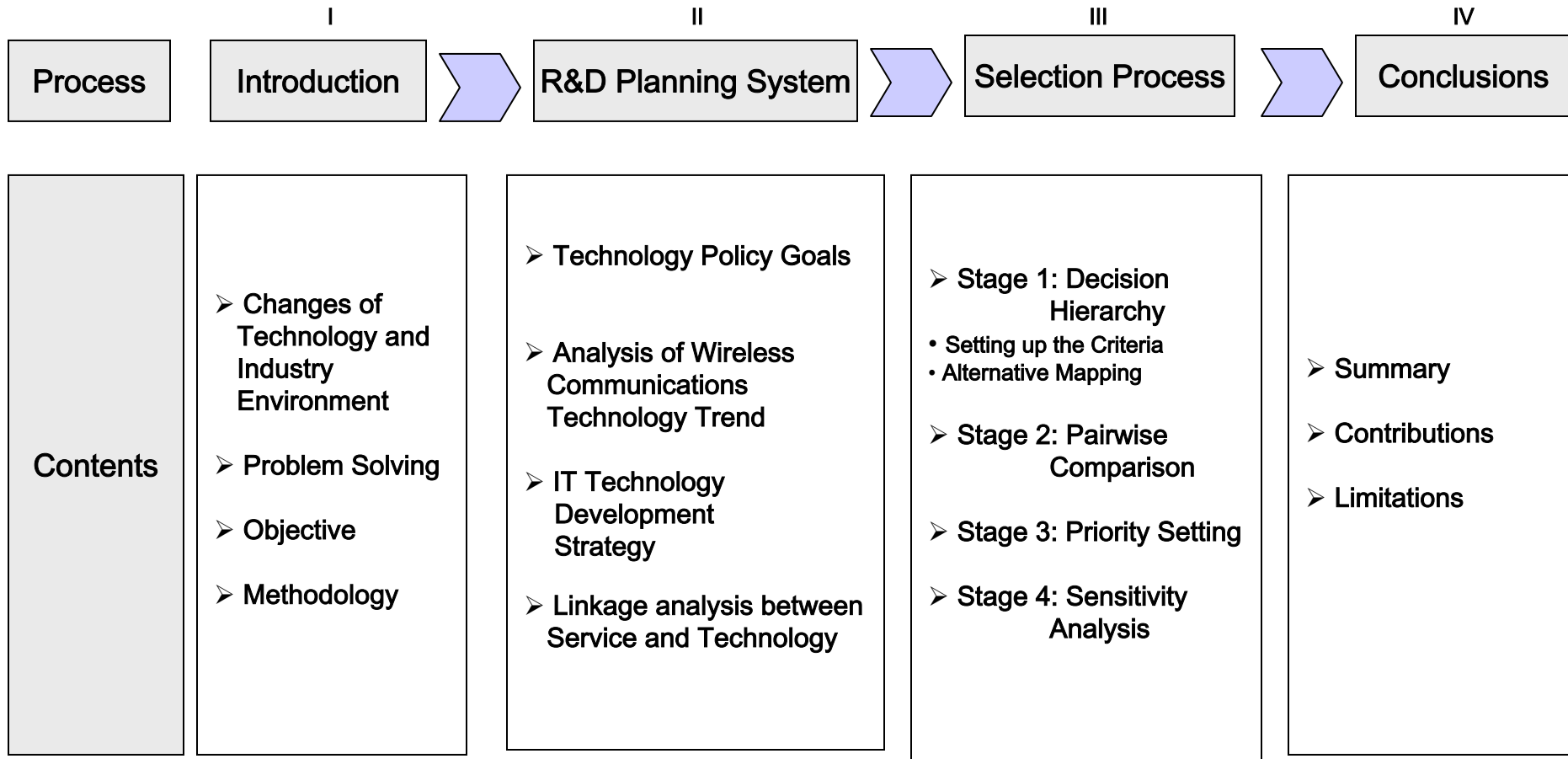
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➤ Changes of Technology and Industry Environment

- **Recently, information technology(IT) industry is getting better from its bubble collapse. As a result of success from investing in IT, it is becoming driving force of national productivity improvement. Major reason of this recovery is IT diffusion to traditional industry and applied service sectors.**
- **Only technologies having the characteristics of a high degree of value potential for the customer can create and sustain a competitive advantage (Chiesa and Manzini, 1998).**
- **“IT everywhere and IT inside*” is expected to rapidly develop through IT diffusion.**

*** IT diffusion to other applied service sectors that affect social needs.**

➤ Problem Solving

- **Technology development in the public sector also needs to consider applied service-technology that affects social needs.**
- **In this respect, we need systematic R&D Planning to minimize the risk of technology development.**

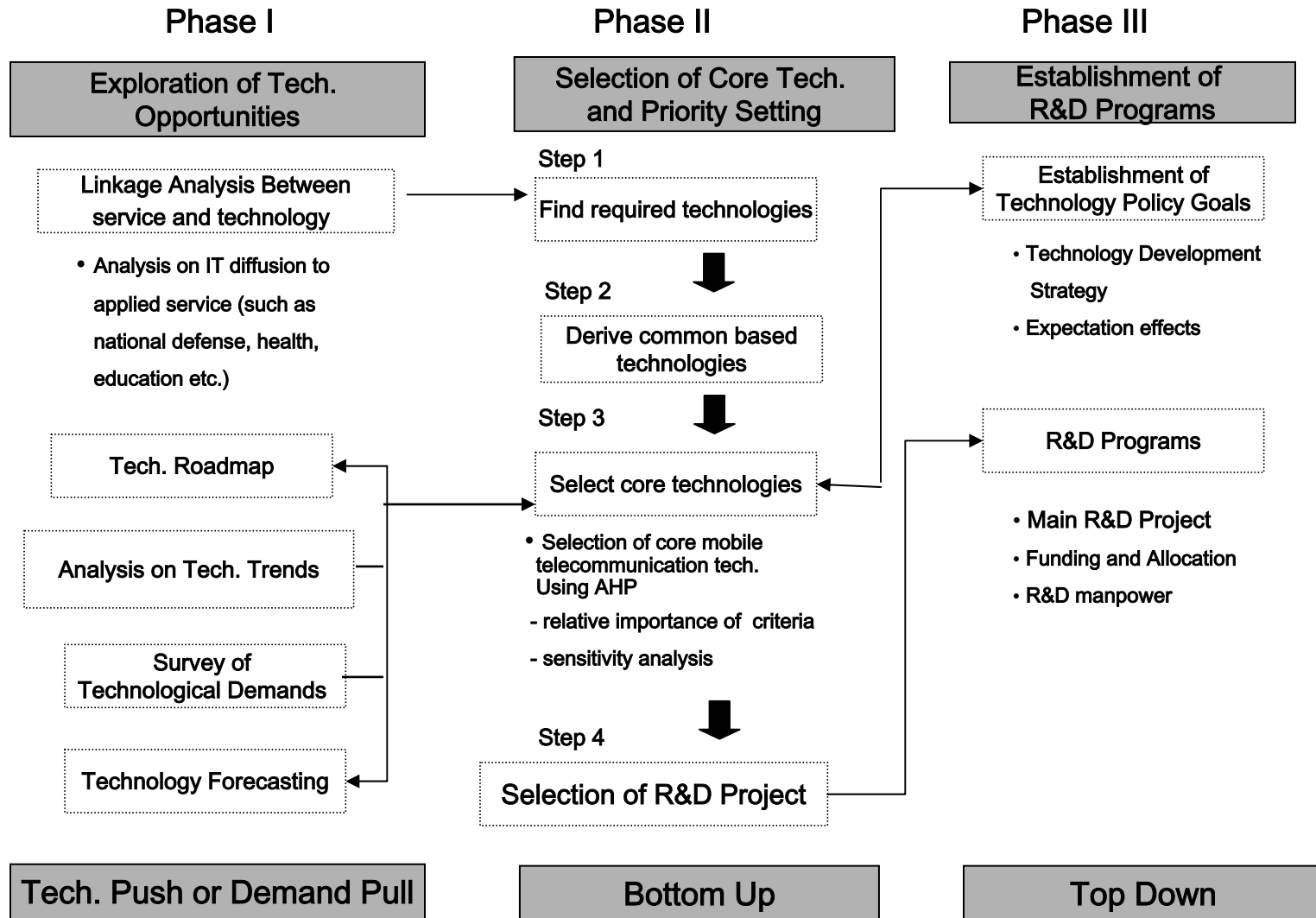
➤ Objective

- **In this paper, we focus on deriving core wireless communications technologies and priority setting to realize applied service under R&D planning system.**

➤ Methodology

- **Analytic Hierarchy Process**

2.1 R&D Planning System



[Phase I] Explore technology opportunities

- **This phase provides basic and important data for the analysis for the next phase.**
- **Technology forecasting and the analysis of technology trend are based on “technology push” while technology roadmap, the linkage analysis between service and technology and the survey of technology demands are based on “demand pull”.**
- **This above study should be interactive model to harmoniously include both technological seeds and needs so as to attain promising technologies.**

[Phase II] Select core technologies

- **Based on the results from phase I and technology policy goals from phase III, required technologies and common based technologies are derived through linkage analysis between service and technology to realize “IT everywhere IT inside”.**
- **Finally, we could get core technologies using analytic hierarchy process.**
- **At this phase, the results of selecting core technologies depend on criteria and professional abilities of technology consultants.**

[Phase III] Establish R&D Programs

- **In recognition of technology policy goals and resources (R&D man powers, equipments, and funds) main R&D projects using AHP are established by mid term technology planning. We could set up technology development strategies and expectation effects through solid action plans.**
- **As an approach to a technology planning system, it introduces mixed type because most of the decision-making related to the technology policy goals was carried by a superior and core technologies was selected by expert groups and technology committee members.**

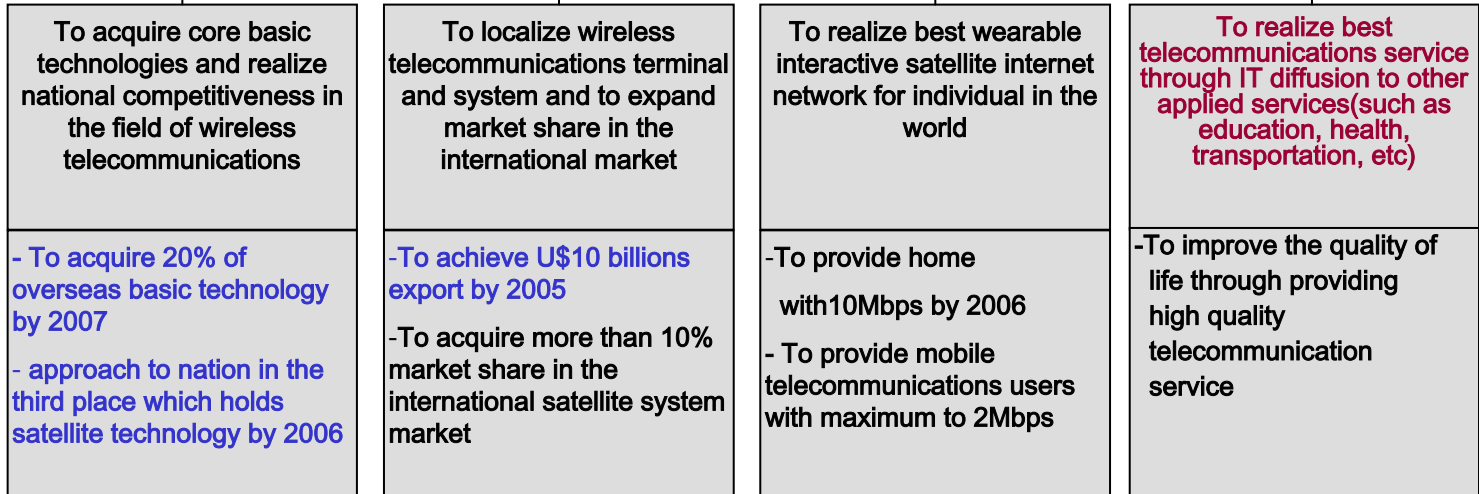
2.2 Vision and Goals

Vision

To Acquire Broadband Wireless
Multimedia Technology
and realize “4 Any”

Goals

(Qualitative)



Goals

(Quantitative)

* 4 Any (Any time, Anywhere, Anyone, Any kind service)

2.3 Analysis of Wireless Communications Technology Trend

➤SWOT Analysis

Strengths	Opportunities
<ul style="list-style-type: none"> ✓ hold system and operating technology through CDMA commercialization ✓ easy to approach international market through success in domestic market of mobile telecommunications ✓ High level of technology in the field of mobile telecommunications ✓ High quality of human resource 	<ul style="list-style-type: none"> ✓ opportunity to massive Chinese market ✓ possibility to utilize new electric wave resources such as IMT-2000, B-WLL, ITS, and wireless LAN ✓ easy to access IMT-2000 market by using the experience of CDMA commercialization IMT-2000 ✓ increase the market demand in high-speed internet service by using the wireless
Weaknesses	Threats
<ul style="list-style-type: none"> ✓ High dependency on overseas technology ✓ weak core parts technology in the field of mobile telecommunications ✓ weak core demagnetization technology ✓ weakness in the domestic standardization ✓ lack of specialist in the field of mobile protocol application 	<ul style="list-style-type: none"> ✓ lack of investment in based technology ✓ quick technology development of mobile telecommunications maker in Japan and Europe ✓ fast development of Chinese IT industry ✓ foreign company's threat to domestic market ✓ lack of domestic company's new technology development ✓ favorable to foreign products of telecommunications company

2.4 Transition of IT Technology Development Strategy

➤ In 80's, Korea concentrated on technology development to replace import equipments such as TDX, transmission equipments, and semi-conductors.

The aim of Korean information technology plan was to educate human resource through government funded research institute and to protect domestic market.

➤ During 90's, We invested in more challengeable large-scale project to acquire basic technology such as CDMA commercialization technology that was very successful in the market.

➤ After the IMF bailout, we are interested in small scale project that can be commercialized in the short term. High-speed internet and mobile telecommunication terminal, export main items, was very successful items developed by private sectors.

• What is Next?

➤ Future Strategy

To reduce risks and to increase profits of technology development, we need core technology portfolios affecting social needs.

- **Leading Strategy: leading technology development that is important to future growth and has a great spill**

over effect(high risk, high return)

- **Catch-up Strategy: applied technology development that affects social needs and sustains export competitive**

advantages(low risk, low return)

- **IT diffusion to other service-technology sectors (such as national defense, health, environment, and etc.) creates social needs and gives a national competitiveness.**

2.5 Linkage Analysis Between Service and Technology

Areas	Applied Service Contents	Required Tech.	Common based Tech.
National Defense	<ul style="list-style-type: none"> - War Modeling, Simulation, Automatic Sensing - Early Warning Satellite, Protection for Cyber Terror 	Next Generation Wireless Transmission Tech./ Satellite Realtime Simulator Tech./ Mobile packet data service technology / IP based wireless internet network system technology	High Speed packet wireless transmission Tech(4 G) Wireless LAN/MAN Mobile Network System Tech Wireless Home Link Tech Satellite Communication Embedded Tech Broadband Core Based Tech HSDA Modem Tech HDFS Tech Satellite Network Design Tech. Electric Wave Detection System Tech. Intelligent Transport System(ITS) Intelligent Satellite Control Tech. Ka band interactive high-speed satellite internet tech. Electromagnetic Environment Plan and Standardization Tech. Mobile Ka band interactive high-speed satellite internet tech.
Health	<ul style="list-style-type: none"> - Electronic Prescription, Medical Information Sharing - Telemedicine, Usage of Gene 	Broadband Mobile Network/ Next Generation Wireless Transmission Tech./ performance and capacity enhancement technology/ Mobile Network and System Tech./ Electromagnetic Bio Signal Tech	
Environment	<ul style="list-style-type: none"> - Remote Surveillance for Environment - Environment Measurement - Remote Management 	Electric Wave Measurement and Modeling Tech./ Electric Wave Detection System Tech./ Wireless Communications Controller/ mobile packet data service technology/ GIS/ Electromagnetic Environment Plan and Standardization Tech.	
Public Admin.	<ul style="list-style-type: none"> -On-line Public Petition - Providing Public Information - Electronic Office Management 	performance and capacity enhancement technology/ Wireless LAN/MAN / mobile packet data service technology / IP based wireless internet network system technology /4G	
Education	<ul style="list-style-type: none"> -e-learning - Electronic Library 	IPv6 based multimedia wireless applied protocol / performance and capacity enhancement technology/ High-speed Wireless Modem Tech./ high quality barcode video processing technology/ Wireless Home Link Tech./ Mobile Network and System Tech.	
Culture	<ul style="list-style-type: none"> -Digital Contents - e-entertainment 	Wireless Multimedia contents Providing Tech./ API Tech. / IPv6 based multimedia wireless applied protocol/ high quality barcode video processing technology/ Satellite Network Design Tech./ Multimedia QoS Support Tech.	
Industry	<ul style="list-style-type: none"> -EC, ERP, CRM - Remote Manipulation - Robotics - Cyber-Home 	CDMA Modem Tech./ High-speed Wireless Internet Terminal Tech/ IPv6 based multimedia wireless applied protocol/ performance and capacity enhancement technology/ IPv6 based mobile IP / IP based wireless internet network system technology/ 4G/ Wireless 1394 and Home Network Tech.	
Social Infrastructure	<ul style="list-style-type: none"> - GPS Service - GIS service - Logistics - ITS 	GIS/ ITS/ GPS/CDMA Modem Tech./ Next Generation Wireless Transmission Tech./4G / IPv6 based mobile IP/ IP based wireless internet network system technology	

➤ Process to select required and common based tech.

- **Required Technology**

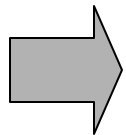
- **Technology committee members derived required technologies by embedding IT to 8 applied service areas** such as traditional industry, health, social infrastructure, etc.

- **Common based technology**

- **They also made consensus to select 15 common based technologies. The criteria to choose common based technologies are leading technology, core technology to realize applied service, and competitive technology to sustain export main items.**

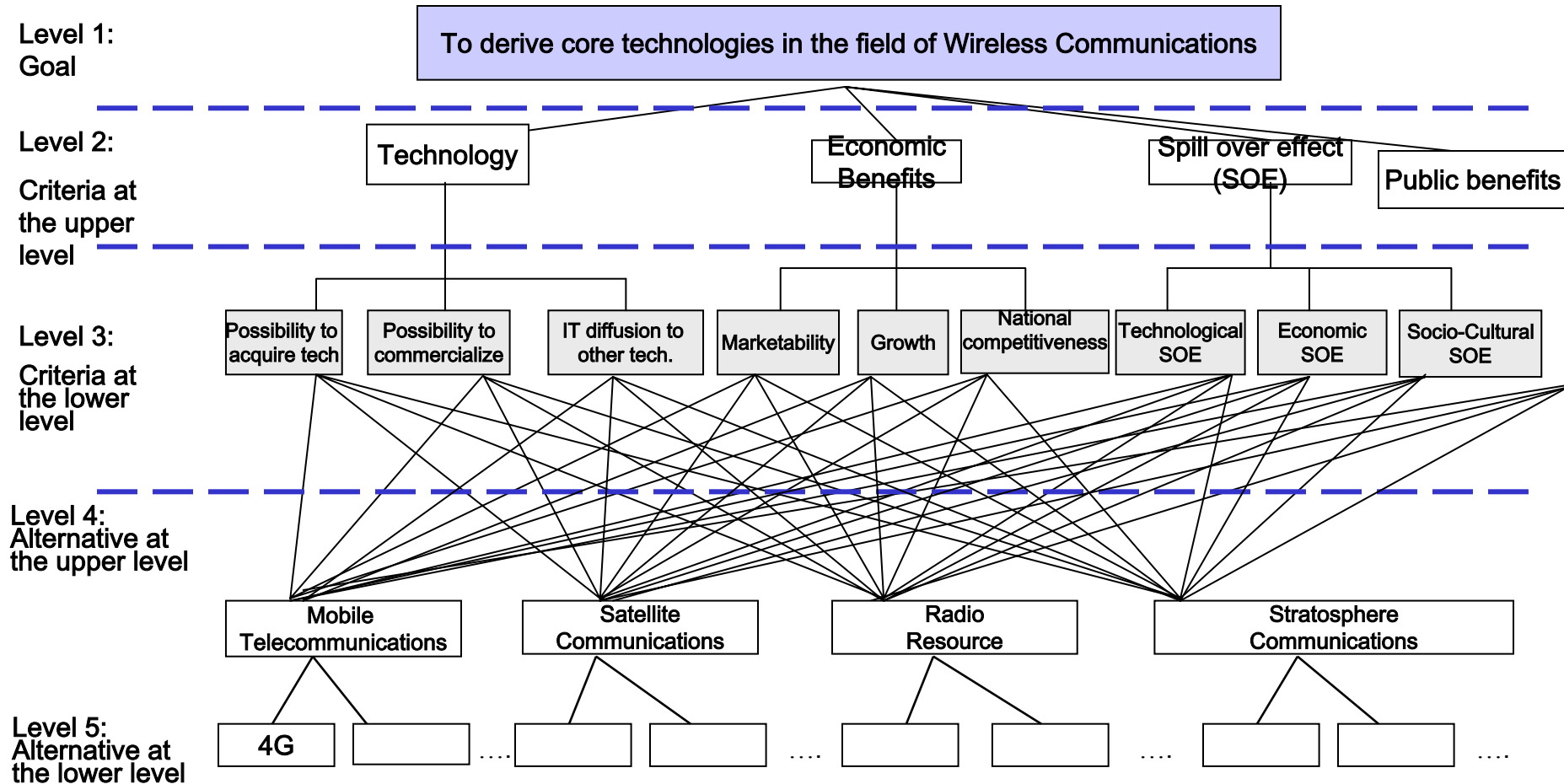
Why do we use AHP Methodology?

- **The Analytic Hierarchy Process is a technique for multiple criteria decision-making (Satty 1990, 1994). It allows decision-makers to determine the relative importance of the criteria and alternative solutions for decision-making.**
- **In the field of wireless communications, it is not easy to select core technology and priority setting because the selection process has various criteria to consider and many interest groups are involved in the process of decision-making. Moreover, it is very difficult to be quantitative.**



- AHP considers both qualitative and quantitative factors simultaneously.**
- AHP helps complex problems to simplify by decomposition and hierarchical form.**

[Stage 1] Decision Hierarchy



➤ Alternative Mapping

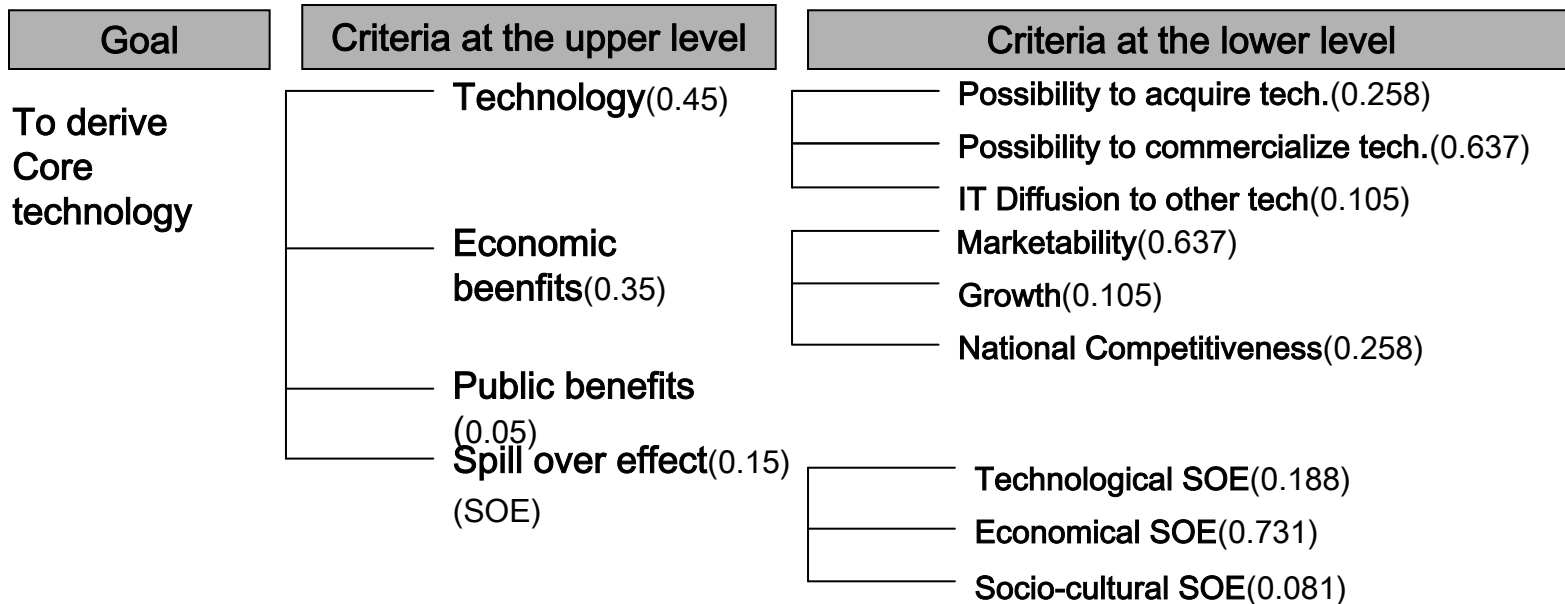


Mobile Telecommunications	Satellite Communications	Radio Resource	Stratosphere Communications
<ul style="list-style-type: none"> - High Speed Packet Wireless Transmission Tech.(4G) - Mobile Network System Tech. - HSDPA Modem Tech. 	<ul style="list-style-type: none"> -Satellite Communications Embedded Tech. - Satellite Network Design Tech. - Intelligent Satellite Control Tech. - Ka band interactive high-speed satellite internet tech. - Mobile Ka band interactive high-speed satellite internet tech. 	<ul style="list-style-type: none"> - Broadband Core Based Tech. - Electromagnetic Environment Plan and Standardization Tech. - Electric Wave Detection System Tech. 	<ul style="list-style-type: none"> -Wireless LAN/MAN Tech. - Wireless Home Network Tech. - HDFS Tech. - ITS

[Stage 2] Pairwise Comparison

- **For evaluation, we performed the survey of ten inside experts(ETRI) and ten outside experts [industries(5), universities(3),research institutes(2)] in the field of wireless communications.**
- **The value of relative importance is selected from a nine-point scale that is widely used for the AHP technique.**
- **The consistency ratio of questionnaire to pairwise comparison was accepted because the ratio was below 10%.**

<Relative Importance of Criteria at each level>



- Expert group considered **the most important criteria at the upper level as technology (0.45)**
 - Actually we expected economic benefits to be considered the most important factor. But, this result suggests that technology factor should be considered to get economic benefits and spill over effect because the most important thing is to commercialize promising technologies.
- **The reason why the value of economic spill over effect is higher is that wireless communications area has an important effect upon other industry's production, value added, and employment.**

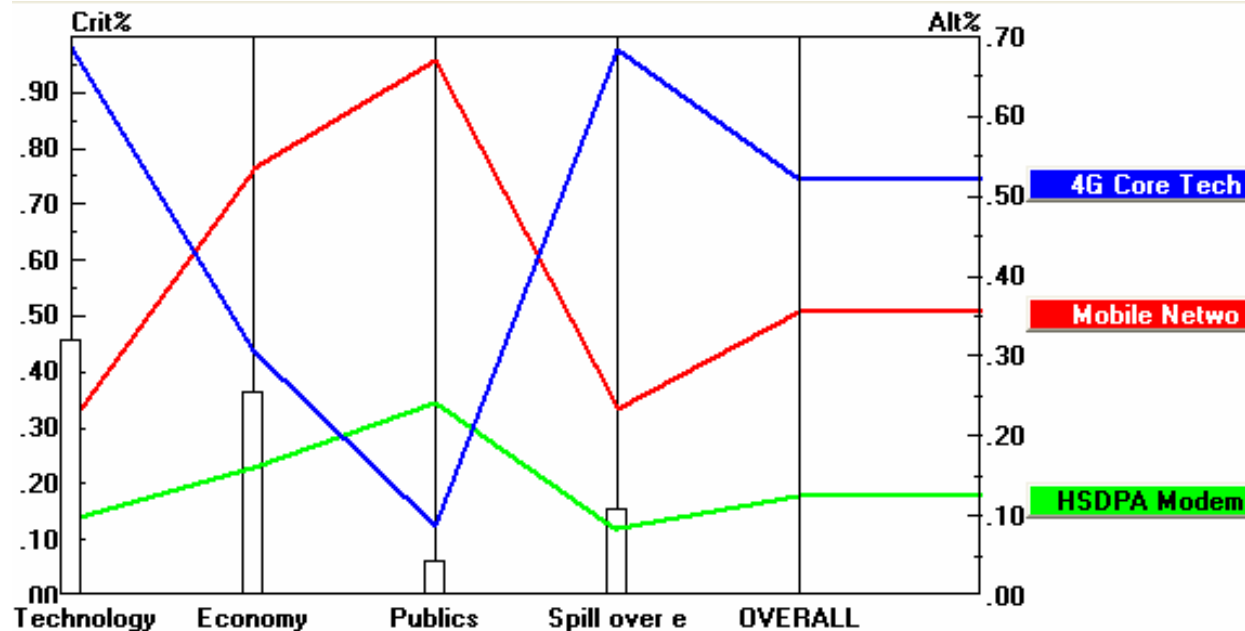
[Stage 3] Priority Setting

Tech Area	Importance	Core Technology Candidate	Importance	Ranking
Mobile Telecommunications	0.569	High Speed packet wireless transmission Tech(4 G)	0.416	1
		Wireless LAN/MAN	0.114	2
Satellite Communications Tech	0.106	Mobile Network System Tech	0.107	3
		Wireless Home Link Tech	0.092	4
		Satellite Communication Embedded Tech	0.049	5
		Broadband Core Based Tech	0.049	5
Radio Resource Tech	0.075	HSDA Modem Tech	0.046	7
		HDFS Tech	0.028	8
		Satellite Network Design Tech.	0.024	9
Stratosphere Communications Technology	0.250	Electric Wave Detection System Tech.	0.019	10
		Intelligent Transport System(ITS)	0.016	11
		Intelligent Satellite Control Tech.	0.015	12
		Ka band interactive high-speed satellite internet tech.	0.011	13
		Electromagnetic Environment Plan and Standardization Tech.	0.007	14
		Mobile Ka band interactive high-speed satellite internet tech.	0.007	14

- Interestingly, most people recognized that mobile telecommunications area was more important than any other fields because it is crucial technology for export and applied service to realize “IT everywhere, IT inside”.
- Given 15 alternative technologies to be evaluated, we obtained top 6. The result shows that 4G is the first priority because 4G was considered as next generation promising technology in terms of high performance and is in the process of technology development in Korea.
- Next priority selection was made in the order of wireless LAN/MAN, mobile network system tech., wireless home link tech.
 - Wireless LAN/MAN and wireless home link tech. was also considered as necessary technologies to realize “IT everywhere, IT inside”.

[stage 4] Sensitivity Analysis:

The sensitivity of the alternatives with respect to all the factors below the goal



- The left y-axis also explains each factor's priority. Technology is about 0.45 while economic and public benefits, and spill over effects are 0.35, 0.05, 0.15 respectively.
- The right y-axis explains the overall priority for each alternative. 4G is the first priority.
 - The value of 4G is higher than other technology areas in terms of technology and spill over effect.
 - But, the economic value of 4G is lower than that of mobile network tech. Because 4G's marketability is very low due to high investment cost in the technology development.

➤ Summary

- Expert groups such as private companies, universities and research institutions selected 4 strategic areas and 15 core technologies. Given 15 alternative technologies to be evaluated, we obtained top 6 using AHP.

➤ Contributions

- **This paper made some contributions as follows: First, we introduced the concept of “IT everywhere, IT inside” by analyzing linkage between service and technology. Second, core technologies were derived in the framework of R&D planning system. By utilizing technology policy goals and linkage analysis we derived core technologies to affect social needs, using AHP.**

➤ Limitations

- The limitations of this study are that the result to priority setting can depend on members' subjective notion of expert group and that it is not easy for evaluators to be consistent if they have a lot of alternatives to make decision.
- To complement these weaknesses of AHP, we could use other empirical method such as data envelopment analysis. Moreover, various tools such as technology portfolio and technology roadmap can be used to derive core technology for further study.

**Thank you for
your attention.**