

The Performance of AtoN Design and Planning with AtoN Simulator

IALA 8th ARM Committee

October, 2018



Korea Institute of Aids to Navigation



Outline

Development Objective of AtoN Simulator(1)

- ◆ The larger and faster ships and the increases of traffic ships make the maritime traffic condition worse
- ◆ The maritime accidents have become bigger and more occurred
- ◆ To reduce the occurrence of maritime accident many kinds of AtoN have been used
- ◆ However, there is a limitation of the AtoN placement method, as it relies on the expert's experience
- ◆ So, it is necessary to develop the decision making system with the scientific technology for the quantified AtoN placement



Outline

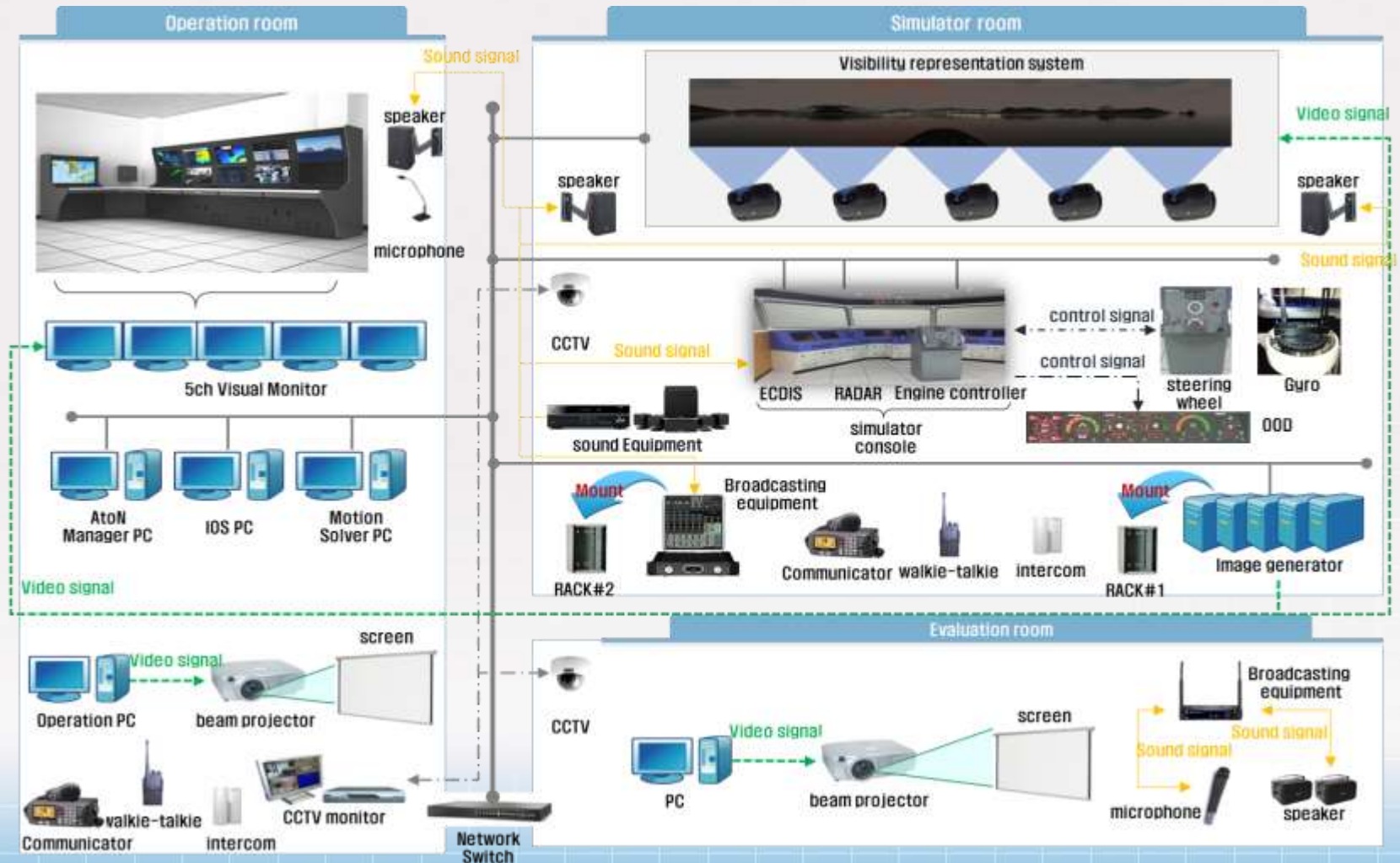
Development Objective of AtoN Simulator(2)

- ◆ To assist the decision making for AtoN design and placement plan in consideration of the effects of topographical, environmental and maritime traffic characteristic of target navigation area
- ◆ Based on ship handling simulation system
- ◆ Developed by Korea Institute of Aids to Navigation* and KRISO, funded by MOF
 - * Korea Association of Aids to Navigation(KAAN) changed to Korea Institute of Aids to Navigation(K-AtoN) on May 2018
- ◆ Installed on the Buoy Management Office in Yeosu, Korea
- ◆ A management S/W which can place AtoN and assign it properties such as shape, colour, light function, etc.



Configuration of AtoN Simulation System

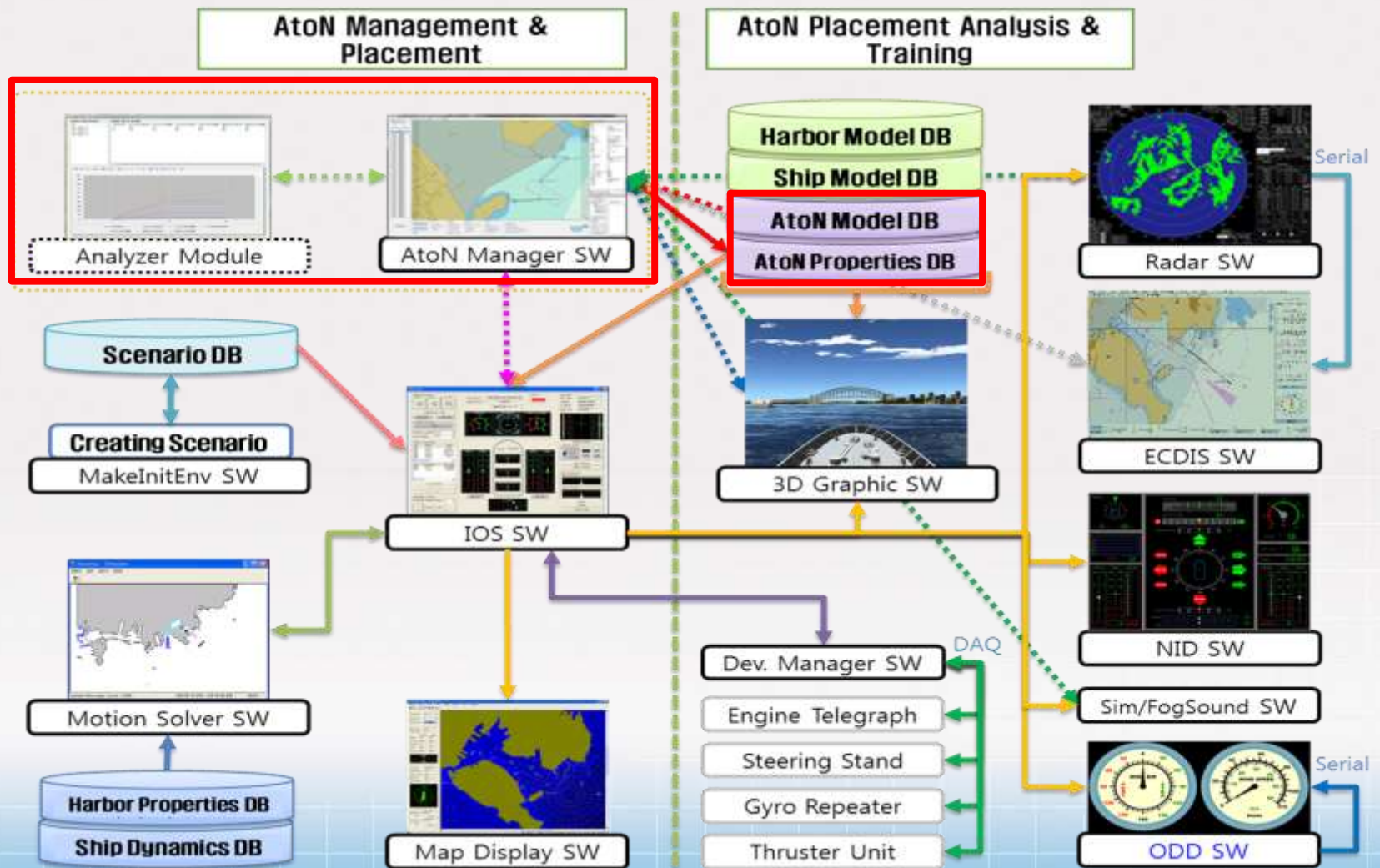
AtoN Simulation System(H/W)





Configuration of AtoN Simulation System

AtoN Simulation System(S/W)



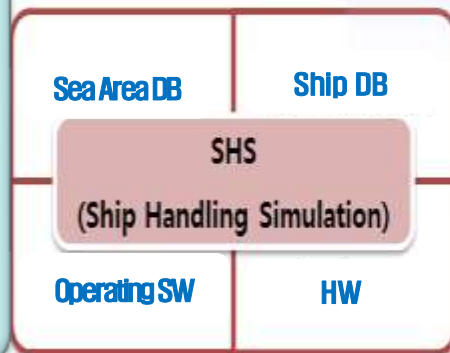


Configuration of AtoN Simulation System

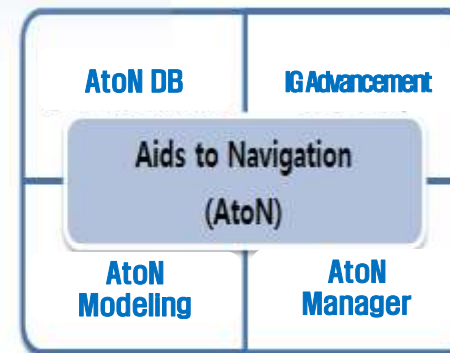
Configuration of Simulation System

Possess Ship Handling Simulation Technology

- Utilization of secured design and implement, management technology
- Utilization of Sea area & Ship DB
- Utilization of simulator system that is currently operating in developing Test Bed



AtoN Simulation System





Implementation of specific technologies for viewpoint of AtoN design

- Construction of AtoN 3D shape, Sea Area and properties DB
- Implementation of DB management S/W and high-performance video reproduction system considering
- Implementation of integrated management system for method to placement optimization






Configuration of AtoN Simulation System

Simulation System Type

Type	Feature	Picture
FMS (Full Mission Simulation)	<ul style="list-style-type: none">▪ More realistic than other simulation▪ Accurately evaluated various scenarios▪ Mainly used in 3D mode	
Desktop Simulation	<ul style="list-style-type: none">▪ Easy to using in simple scenarios▪ low cost▪ mainly used in 2D mode rather than 3D mode	



Configuration of AtoN Simulation System

Type	Function	Picture
Simulator Room	Verification and Training	
Operation Room	Design and Operation	
Evaluation Room	Analysis and Evaluation	



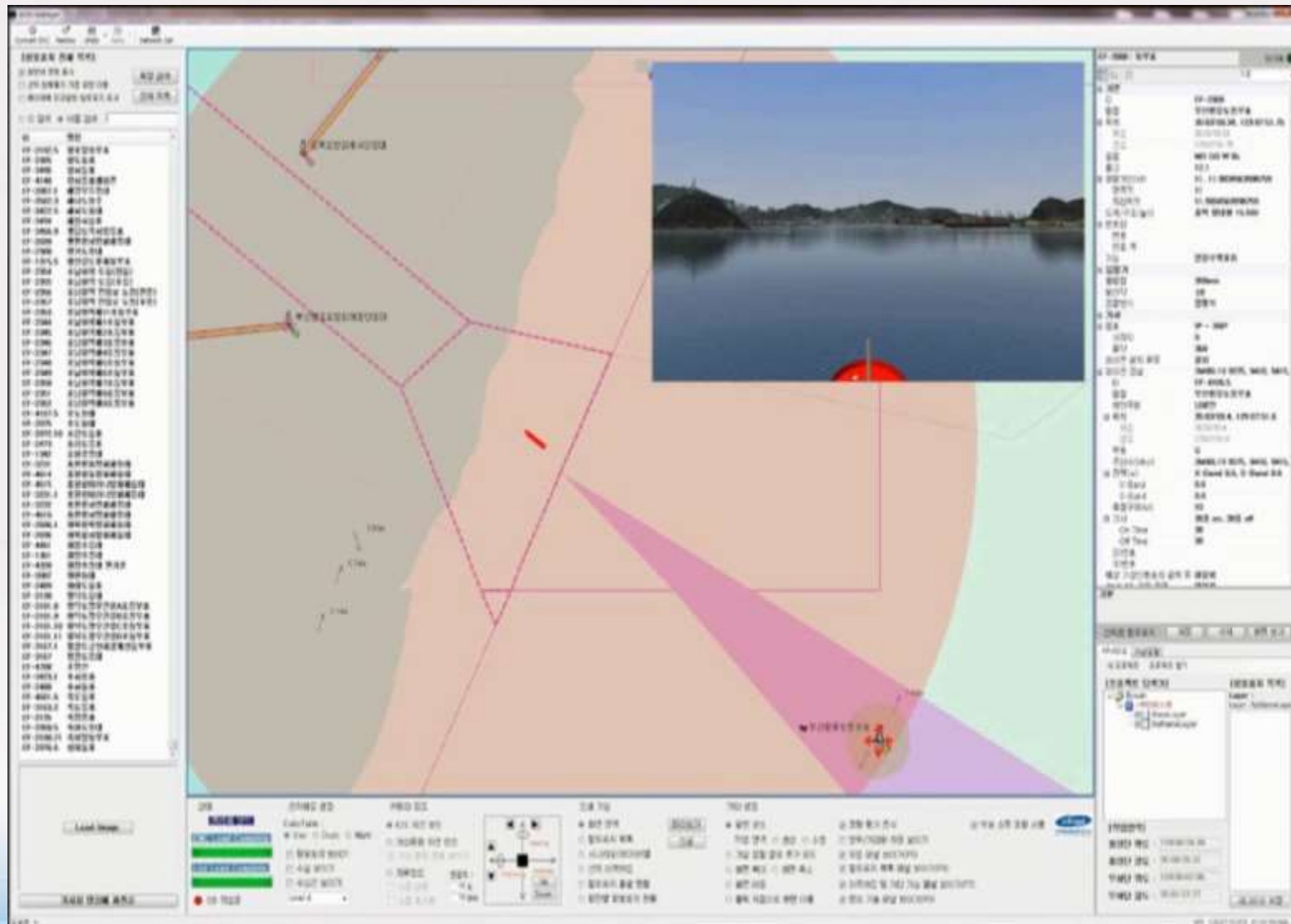
Characteristics of AtoN Simulator

- ◆ Support function of add/delete/move/edit/search for AtoN
 - Available to simply add for copy function
- ◆ Placement and Management for AtoN
 - Display the state of AtoN such as existing, relocation using the symbol
 - Management of level such as project > scenario > layer
- ◆ Control properties of AtoN
 - Control of AtoN properties for 19 kinds
 - Control of characteristics such as visibility distance(Nominal Range etc.)
- ◆ Support virtual navigation
 - Setting the waypoint and linear movement
- ◆ Provide printing and report for scenarios





Control of AtoN Properties using AtoN Manager



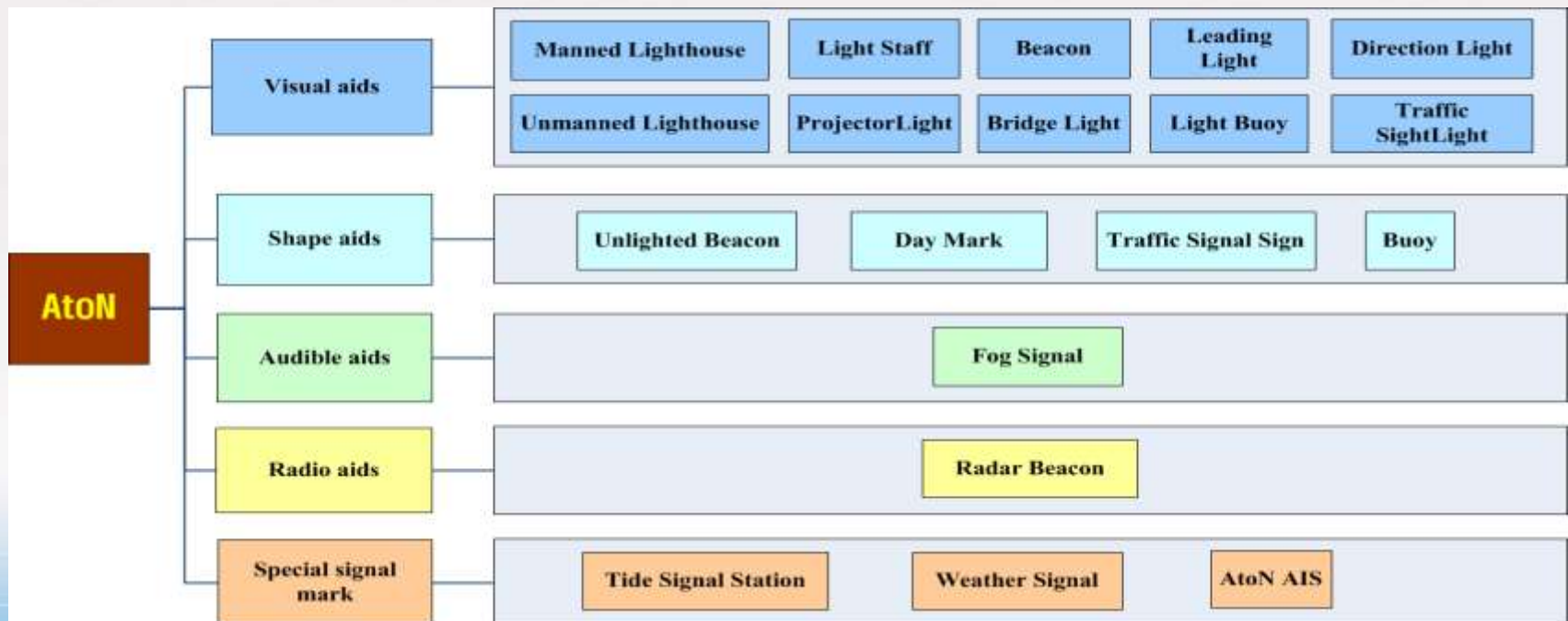
Difference of AtoN Simulator

◆ Support to various kind of AtoN

- Support 19 kinds of AtoN

◆ Precision Improvement for shape Database of AtoN

- Visualization Properties Modeling for various components(top mark, lantern)
- Support 3D Shape Database for a variety of AtoN





Difference of AtoN Simulator

- ◆ Introduction Database of systematic AtoN Properties and Placement
 - Formulation systematic structure for the AtoN properties and placement for easy management
 - Development of Characteristics table for AtoN Motion
- ◆ Improvement Accuracy for AtoN Motion

Unmanned Lighthouse											
AtoNID	AtoNName	Class	Type	Harbor	Office	Latitude	Longitude	LightRhythmCharIndex	LightColor	LightHeight	NRRange
EF-2039	두도등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0486666667	129.0150000000	91	W	54	8
EF-2027	부산남항동방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0848333333	129.0331666667	34	R	22	12
EF-2028	부산남항서방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0861666667	129.0311666667	34	G	22	12
EF-2006	부산항동삼동여항방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0715000000	129.0840000000	34	G	14	9
EF-2005	부산항조도방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0793333333	129.1051666667	130	G	20	12
EF-2007	부산항조도방파제서단등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0786666667	129.0976666667	34	Y	16	7
EF-2007.2	북빈물양장방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0895000000	129.0776666667	27	G	11	7
EF-2002	오륙도방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0911666667	129.1131666667	34	Y	18	8
EF-2003	오륙도방파제서단등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0845000000	129.1058333333	130	R	20	10
EF-2001.17	용호만남단등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.1311666667	129.1176666667	70	R	6.5	7
EF-2001.16	용호만북단등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.1321666667	129.1176666667	70	R	6.5	7
EF-2007.1	해경부두등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0848333333	129.0833333333	27	G	19	5
EF-2026.1	SK부산항등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.1025000000	129.0553333333	107	Y	5.8	6
EF-2003.6	부산항해군부두남방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0913333333	129.1095000000	91	R	9.4	5
EF-2003.5	부산항해군부두서방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0915000000	129.1058333333	91	G	9.4	6
EF-2028.63	송도여항방파제등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0715000000	129.0195000000	70	G	16	5
EF-2028.64	송도여항방파제서단등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.0711666667	129.0188333333	70	R	16	4
EF-2026.5	영도한진조선등대	광파표지	무인등대	부산북항	부산지방해양항만청	35.1008333333	129.0486666667	107	Y	12	7

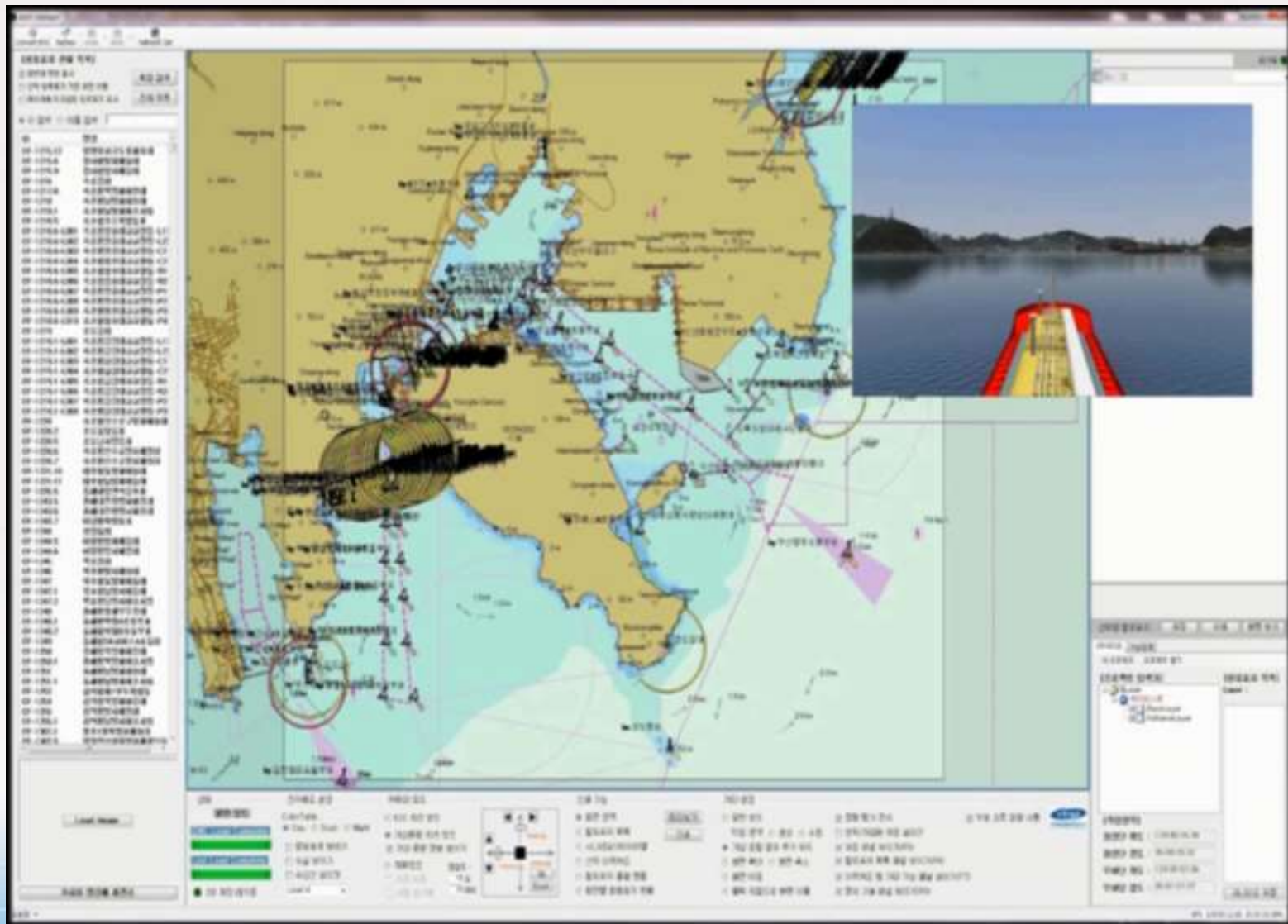


Difference of AtoN Simulator

- ◆ Improvement accuracy of Sea Shape Modeling
 - Modeling and Control of the Current for Sea Area
- ◆ Support Software for AtoN Placement
 - Writing and Management of Unique History Card for Type of AtoN
 - Placement and Management of AtoN based on ENC
 - Real-time Control of AtoN Properties
 - Display and Management for AtoN Status(Existing, Expansion, Relocation, Revocation, Virtual)
- ◆ Application AtoN Placing Quantification Algorithm
 - Feedback Placement Quantified Score for Location-based on Placement scenarios



Control of AtoN Properties using AtoN Manager



AtoN Modeling for AtoN Simulator

3D Modeling of AtoN



<Manned Lighthouse>



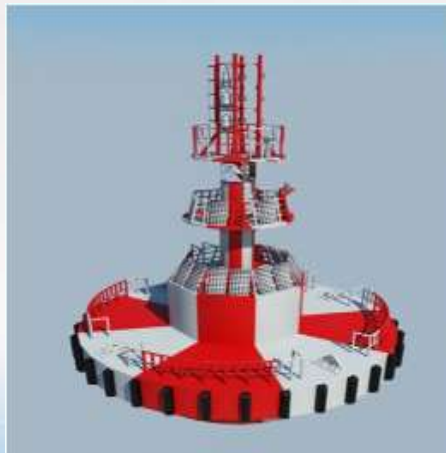
<Unmanned Lighthouse>



<Beacon>



<Light Pole>



<LANBY>

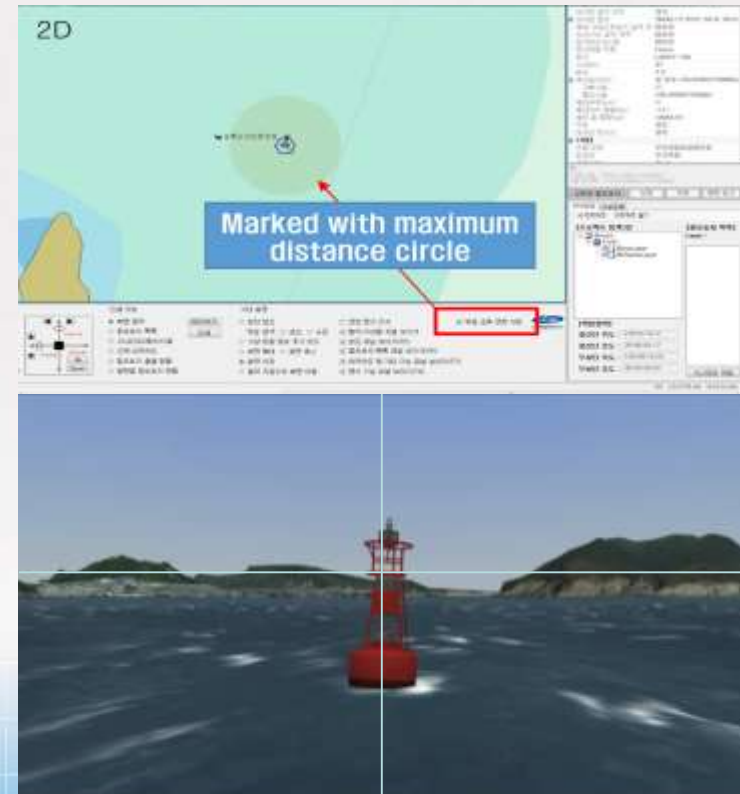
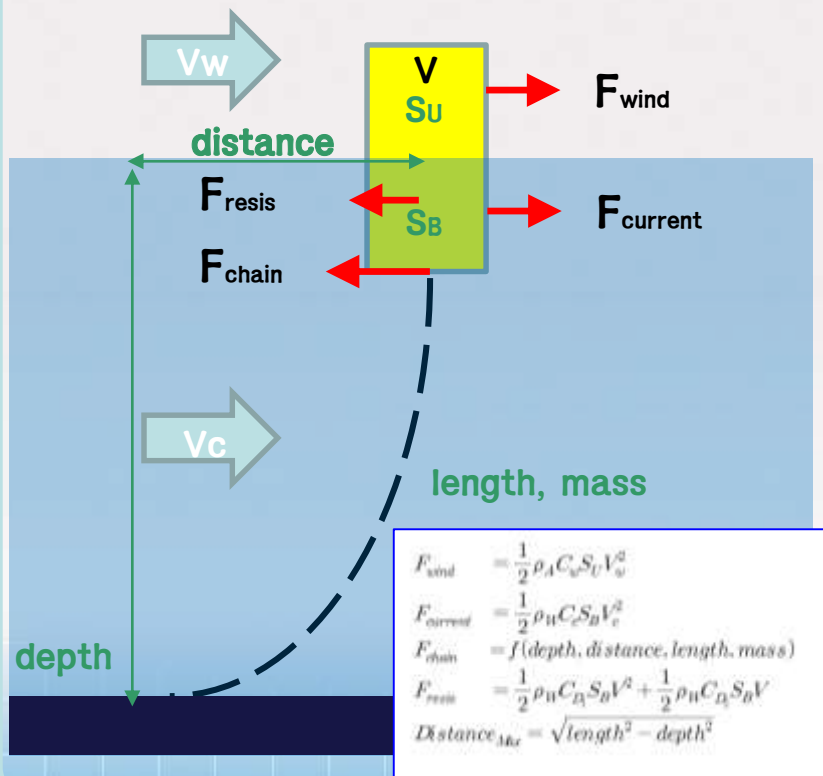


<Light Buoy>

AtoN Modeling for AtoN Simulator

Motion Characteristic of Buoys

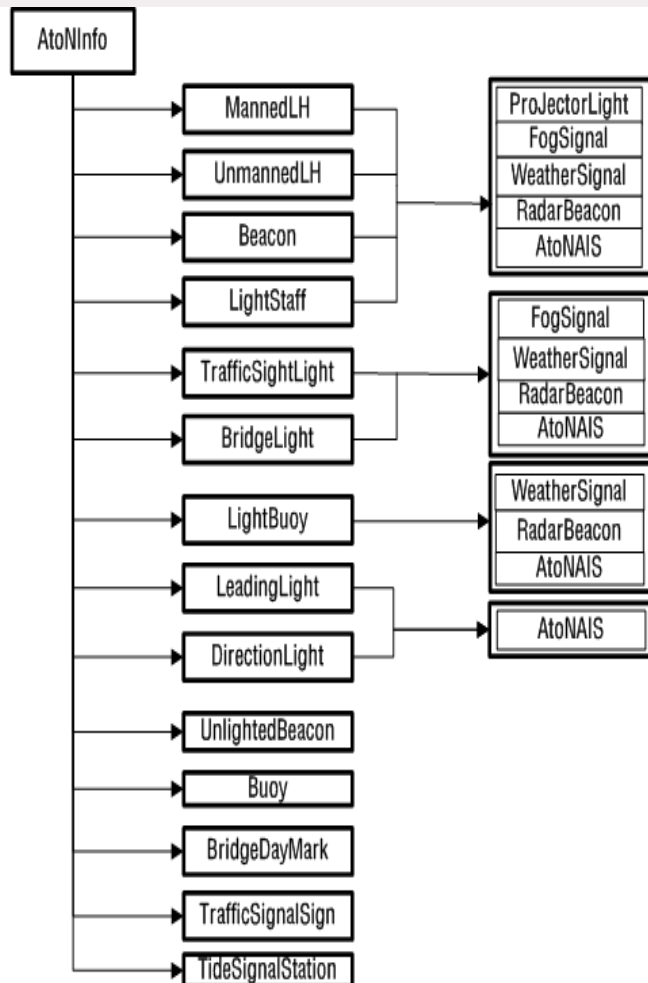
- ◆ Application of the surge and sway model
- ◆ Depending on the size of the current and wind, direction, AtoN specifications, chain weight, depth



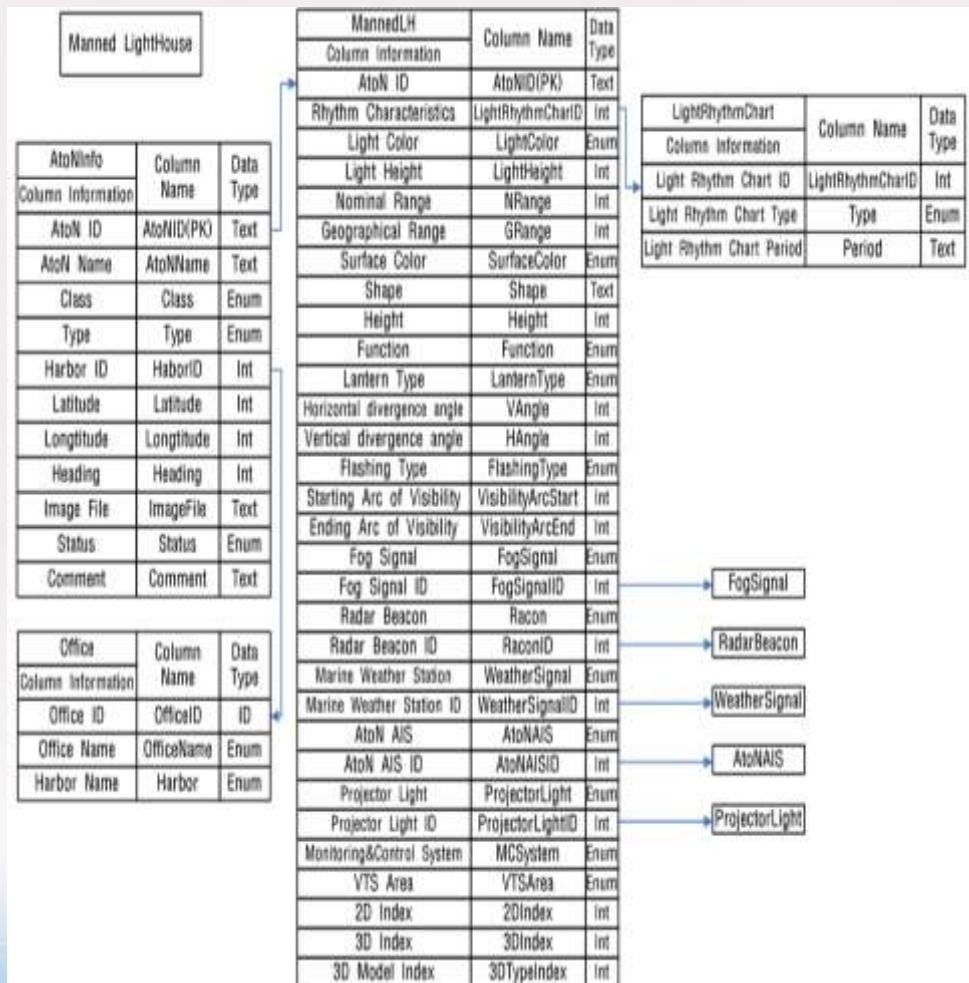


AtoN Modeling for AtoN Simulator

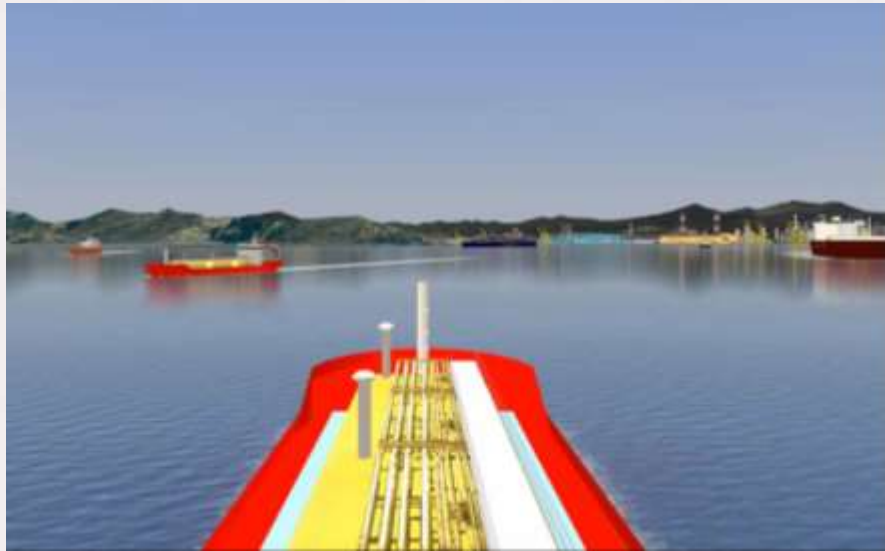
Schema of AtoN Properties database



Schema of Manned Lighthouse table



Real time Control to Environmental factor





Real time Change of AtoN Properties

Various of AtoN Function

◆ Ability to change AtoN function in real time



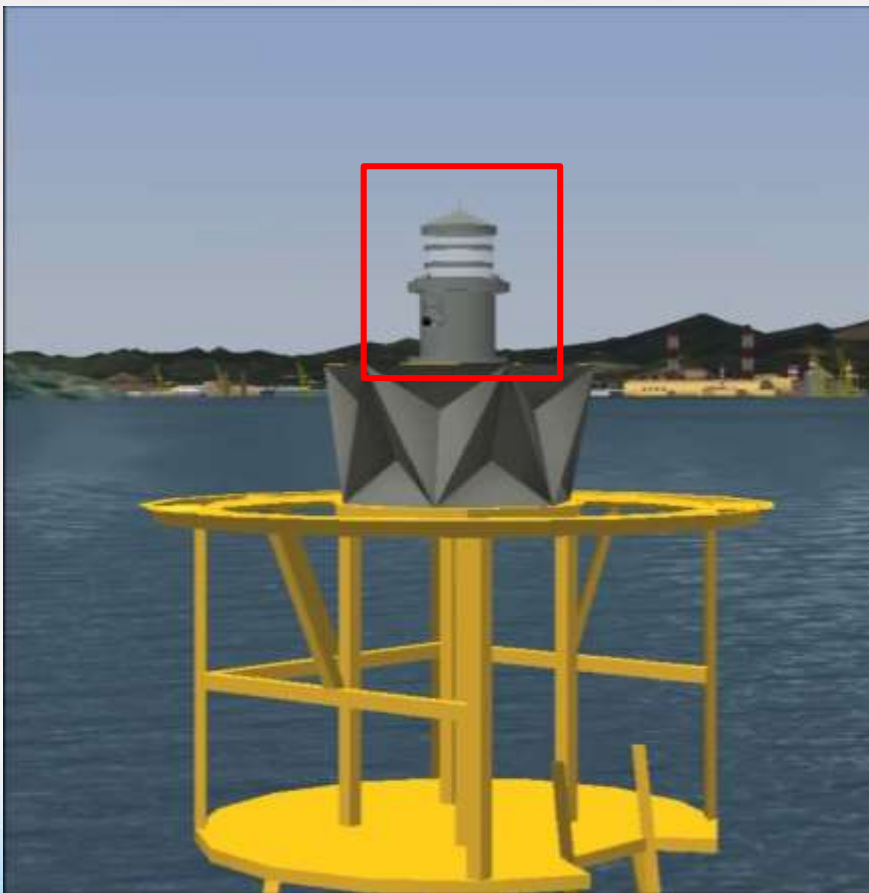
▣ 광달거리(M)	7, 9.58700727241066
명목적	7
지리학적	9.58700727241066
도색/구조/높이	함 말대형 9.415
▣ 번호판	
번호	
번호 색	
기능	특수표지
▣ 등명기	
등명칭	LED-200
발산각	±8
점멸방식	점멸식
▣ 가사	
▣ 명호	0° ~ 360°
시작각	0
끝각	360
레이콘 설치 유무	미설치
해상 기상신호표지 설치 유	미설치
AtoN AIS 설치 유무	미설치
집약관리시스템	미설치
동기점멸 적용	False
형식	LL-26(M)
수심(m)	21.5
배수	1.5
▣ 체인길이(m)	총 길이 42.25m
고배사슬	10
메인사슬	32.25
체인규격(mm)	38
체인단위 중량(kg)	31.62
체인 총 중량(kg)	1335.94
두표	미설치



Real time Change of AtoN Properties

Various of Lantern Type

◆ Ability to change Lantern Type in real time



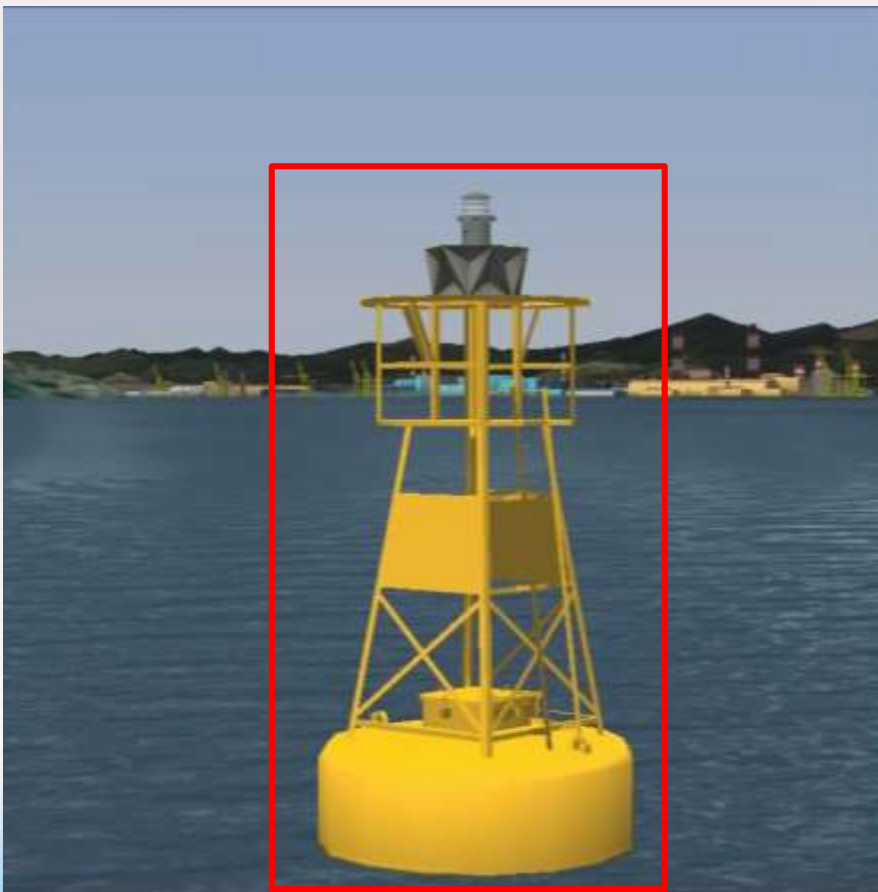
▣ 광달거리(M)	7, 9.58700727241066
명목적	7
지리학적	9.58700727241066
도색/구조/높이	황 망대형 9.415
▣ 번호판	
번호	
번호 색	
기능	특수표지
▣ 등명기	
등명형	LED-200
발산각	±8
점멸방식	점멸식
▣ 기사	
▣ 명호	0° ~ 360°
시작각	0
끝각	360
레이콘 설치 유무	미설치
해상 기상신호표지 설치 유	미설치
AtoN AIS 설치 유무	미설치
집약관리시스템	미설치
동기점멸 적용	False
형식	LL-26(M)
수심(m)	21.5
배수	1.5
▣ 체인길이(m)	총 길이 42.25m
고배사슬	10
메인사슬	32.25
체인규격(mm)	38
체인단위 중량(kg)	31.62
체인 총 중량(kg)	1335.94
두표	미설치
레이더 반사기	설치



Real time Change of AtoN Properties

Various of AtoN Type

◆ Ability to change AtoN Type in real time



□ 광달거리(M)	7, 9.58700727241066
명목적	7
지리학적	9.58700727241066
도색/구조/높이	황 말대형 9.415
□ 번호판	
번호	
번호 색	
기능	특수표지
□ 등명기	
등명칭	LED-200
발산각	±8
점멸방식	점멸식
□ 기사	
□ 명호	0° ~ 360°
시작각	0
끝각	360
레이콘 설치 유무	미설치
해상 기상신호표지 설치 유	미설치
AtoN AIS 설치 유무	미설치
집약관리시스템	미설치
동기점멸 적용	False
회식	LL-26(M)
수심(m)	21.5
배수	1.5
□ 체인길이(m)	총 길이 42.25m
고배사슬	10
메인사슬	32.25
체인규격(mm)	38
체인단위 중량(kg)	31.62
체인 총 중량(kg)	1335.94
두표	미설치
레이더 반사기	설치



Real time Change of AtoN Properties

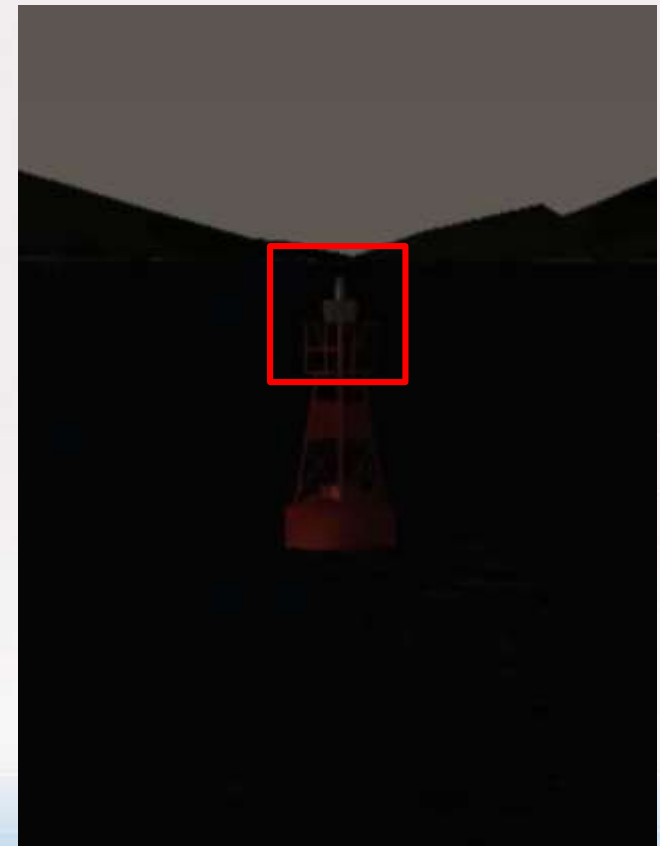
Various of Light Color

◆ Ability to change Light Color in real time

항목 설정

종류 : 종별 추가 참고표 : 종별 : R 7%

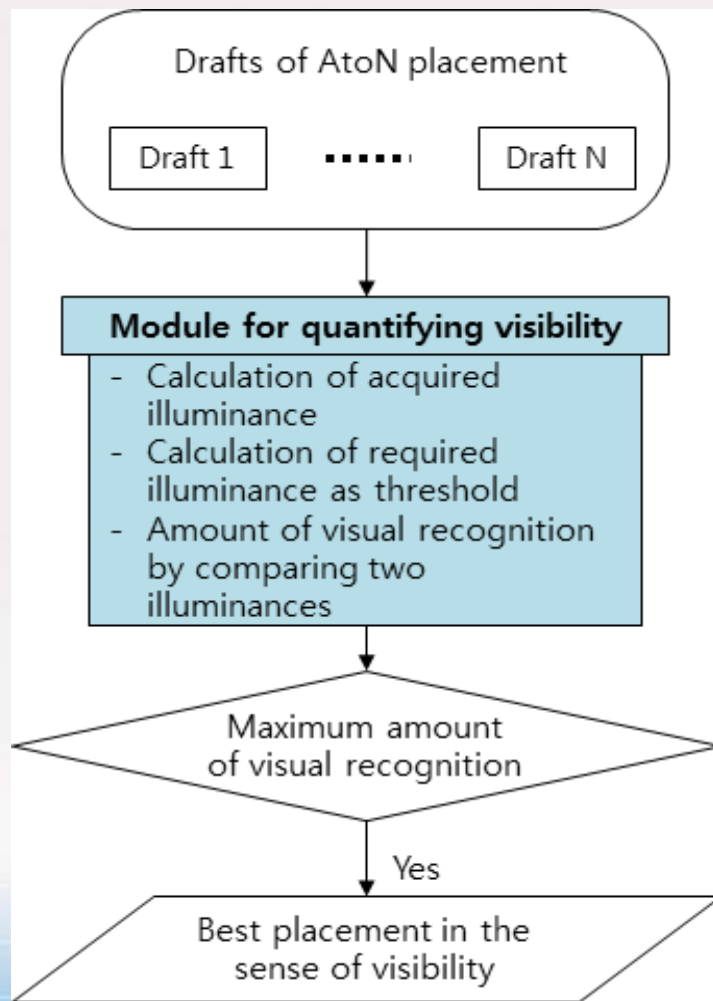
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59	PL (2) 4S	0.50	1.00	0.50	2.00														
60	PL (2) 4.5S	0.30	1.00	0.30	2.90														
61	PL (2) 4.5S	0.40	1.00	0.40	2.70														
62	PL (2) 4.5S	0.50	1.00	0.50	2.50														
63	PL (2) 5S	0.20	0.80	0.20	3.80														
64	PL (2) 5S	0.40	0.60	0.40	3.60														
65	PL (2) 5S	0.50	0.50	0.50	3.50														
66	PL (2) 5S	1.00	1.00	1.00	2.00														
67	PL (2) 5.5S	0.40	1.40	0.40	3.30														
68	PL (2) 6S	0.30	1.00	0.30	4.40														
69	PL (2) 6S	0.40	1.00	0.40	4.20														
70	PL (2) 6S	0.50	0.50	0.50	4.50														
71	PL (2) 6S	0.80	1.20	0.80	3.20														
72	PL (2) 6S	1.00	1.00	1.00	3.00														
73	PL (2) 7S	1.00	1.00	1.00	4.00														
74	PL (2) 8S	0.40	1.00	0.40	6.20														
75	PL (2) 8S	0.50	1.00	0.50	6.00														
76	PL (2) 8S	1.00	1.00	1.00	5.00														
77	PL (2) 10S	0.50	0.50	0.50	8.50														
78	PL (2) 10S	0.50	2.00	0.50	7.00														
79	PL (2) 10S	0.50	1.00	0.50	8.00														
80	PL (2) 10S	0.50	1.50	0.50	7.50														
81	PL (2) 10S	0.80	1.20	0.80	7.20														
82	PL (2) 10S	1.00	1.00	1.00	7.00														
83	PL (2) 10S	1.00	2.00	1.00	6.00														
84	PL (2) 12S	0.50	1.00	0.50	10.00														
85	PL (2) 12S	1.00	1.00	1.00	0.00														





Performance Measures of AtoN Placement

Process of Evaluation of AtoN Placement



Result of Evaluation of AtoN Placement

List of AtoN for Evaluation

ID	시각계수	시각적민감도	시각적인식률	무작위 시각적민감도	무작위 시각적인식률	시각평균인식률	시각평균인식률
EF-2003	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7630E-003	9.4246E-004	9.4246E-004
EF-2005	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7529E-003	9.4104E-004	9.4104E-004
EF-2010.8	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7426E-003	9.3962E-004	9.3962E-004
EF-2010.9	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7325E-003	9.3820E-004	9.3820E-004
EF-2011	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7224E-003	9.3679E-004	9.3679E-004
EF-2012	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7123E-003	9.3538E-004	9.3538E-004
EF-2013	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.7022E-003	9.3398E-004	9.3398E-004
EF-2025.10	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6922E-003	9.3259E-004	9.3259E-004
EF-2025.9	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6822E-003	9.3119E-004	9.3119E-004
EF-2025	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6722E-003	9.2980E-004	9.2980E-004
EF-2022	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6622E-003	9.2842E-004	9.2842E-004
EF-2025.8	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6522E-003	9.2704E-004	9.2704E-004
EF-2025.7	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6422E-003	9.2566E-004	9.2566E-004
EF-2025.6	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6322E-003	9.2428E-004	9.2428E-004
EF-2025.5	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6222E-003	9.2291E-004	9.2291E-004
EF-2025.4	0.0000E+000	0.0000E+000	4.4704E+000	6.2297E-001	6.6122E-003	9.2153E-004	9.2153E-004

Visibility Quantities Result List

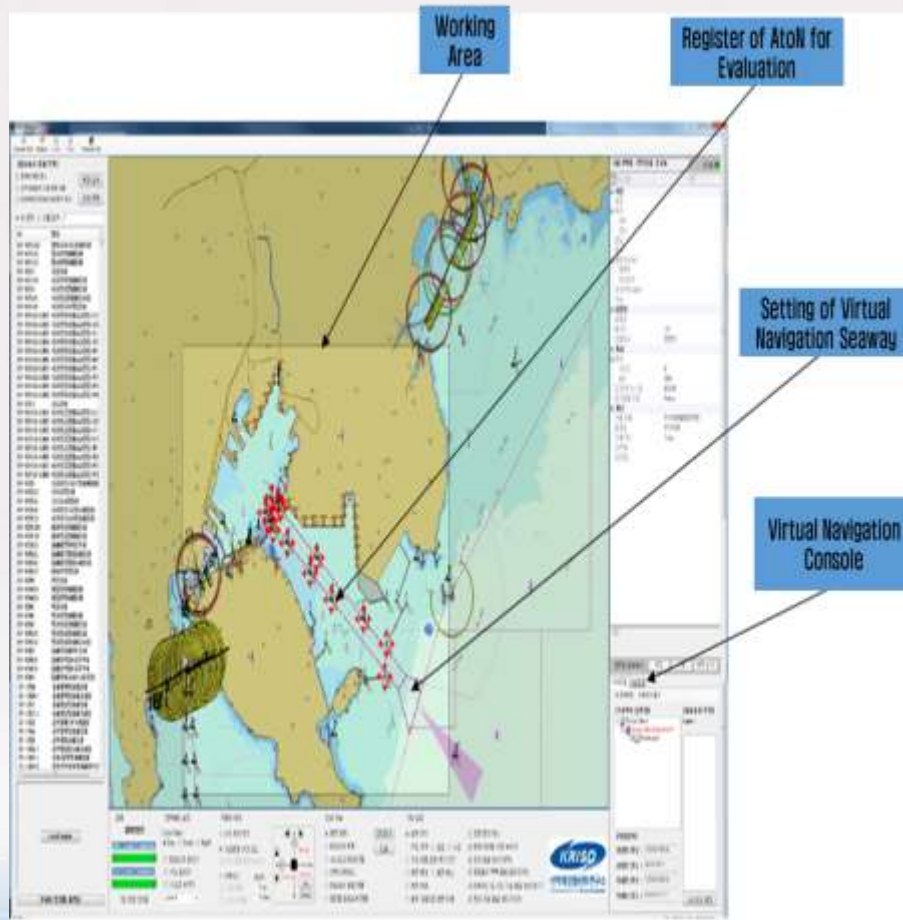


Visibility Quantities Result Chart

Visibility Representatives

Performance Measures of AtoN Placement

Setting of Evaluation of AtoN Placement



Setting of
Working
Area

Register
AtoN for
Evaluation

Setting of
Virtual
Navigation
Seaway

Activating
the Virtual
Navigation
Console

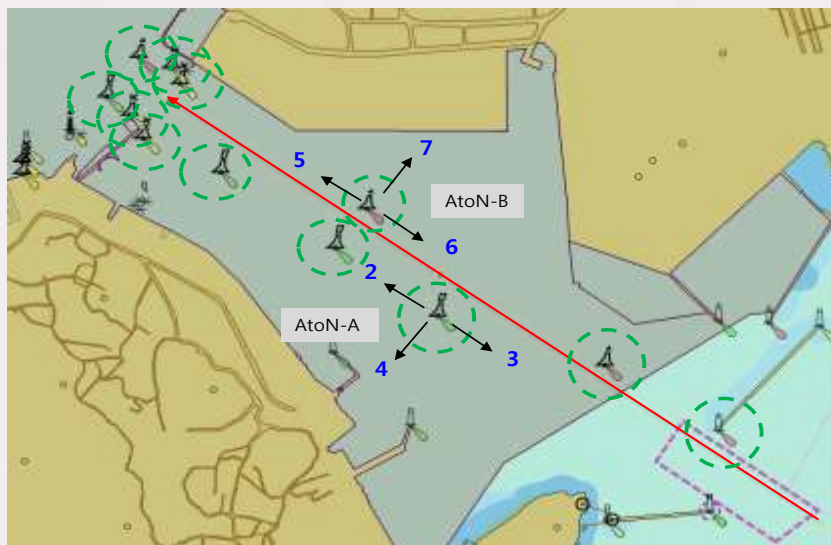
Selection
of Vessel
for Virtual
Navigation

Execution of
Evaluation of
Virtual
Navigation



Performance Measures of AtoN Placement

Evaluation of AtoN Placement Quantification in Busan Port



Register of AtoN for Evaluation in Busan North Port

Moving AtoN-A 300m in each direction

Moving AtoN-B 300m in each direction

Evaluation of Visibility quantification in AtoN Placement Before and After Movement

(Red : max, Blue : min)

MEASURES	Default	CASE 2	CASE 3	CASE 4
MAXCE _{TAR}	2.8909	2.8913	2.8905	2.7955
TOTMCE _{TAR}	3.2640	3.2472	3.2828	3.2001
MAXCE _{AAR}	0.7227	0.7228	0.7226	0.6989
TOTMCE _{AAR}	0.3619	0.3583	0.3658	0.3536
CF (left)	1.8497	1.414	1.3512	–
PDL (left)	100	100	100	100

MEASURES	Default	CASE 5	CASE 6	CASE 7
MAXCE _{TAR}	2.8909	2.8908	2.8894	2.6328
TOTMCE _{TAR}	3.2640	3.2359	3.2940	3.1657
MAXCE _{AAR}	0.7227	0.7227	0.7223	0.6582
TOTMCE _{AAR}	0.3619	0.3555	0.3676	0.3472
CF (right)	4.3136	1.7287	8.7070	–
PDL (right)	100	100	100	100



Acquired Certification for AtoN Simulation

Acquired international Certification

- ◆ The AtoN simulation system was acquired as S class(Special Task) of the ship simulation system according to the international certification of the ship simulation system from KR(Korean Register of Shipping) on April 2017



STATEMENT OF COMPLIANCE

Certificate No. : SEL20987-DS001 Initial Approval : 21st April, 2017
Product : Ship Handling Simulator
Manufacturer : Korea Association of Aids to Navigation
137, Gaeun digital 1-ro, Gyeongsang-gu, Seoul, Republic of Korea

Product Description : Bridge Operation Simulator for Aids to Navigation

- Type : AtoN Simulator
- Category : S (Special task)

* See Appendix 1 & 2

Approval Condition : * See Appendix 2

THIS IS TO CERTIFY THAT the above-mentioned product is found to comply with the relevant requirements of this Society's Rule and/or of the recognized standards as follows.
KR Guideline for the approval of Bridge Operation Simulator, Circular No. 2015-9-E
STCW Convention, Regulation E/12 & STCW Code Part A-II/1, 2, 3, 5

This Certificate is valid until 20th April, 2022.
Issued at Busan, Korea on 21st April, 2017.


General Manager of
Marine and Ocean Equipment Team

Note 1 : The Certificate will be automatically suspended and the Certificate becomes invalid from the expiry date of the Certificate on the event that the premises have not been granted or the renewal of the Certificate is not achieved.
2 : The modifications should notify this Society of any modification or changes that may affect the validity of this Certificate.

AC-24/2011-001



PRODUCT CERTIFICATE

Certificate No. : SEL20987-DS002 Initial Approval : 21st April, 2017
Product : Ship Handling Simulator
Manufacturer : Korea Association of Aids to Navigation
137, Gaeun digital 1-ro, Gyeongsang-gu, Seoul, Republic of Korea

Simulation at : Korea Association of Aids to Navigation (Yeosu City)
1436-29, Hwasang-ro, Hwasang-myeon, Yeosu-si, Jeollanam-do Republic of Korea

Product Description : Bridge Operation Simulator for Aids to Navigation

- Type : AtoN Simulator
- Category : S (Special task)

* See Appendix 1

Approval Condition : * See Appendix 1

THIS IS TO CERTIFY THAT the above-mentioned product is found to comply with the relevant requirements of this Society's Rule and/or of the recognized standards as follows.
KR Guideline for the approval of Bridge Operation Simulator, Circular No. 2015-9-E
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AC-24/2011-001




Application Plan for AtoN Simulation System

Application Plan

- ◆ **Secure technical basis for providing high-quality port services by optimization analysis the installed AtoN and expanding the lack facilities**
- ◆ **Support system for AtoN design and AtoN placement**
 - **Analysis on the influence of changing AtoN placement and flashing interval**
 - **Analysis on the influence of changing types/kinds of AtoN and visible distance or quantity of light**
 - **Analysis on the influence of background lighting and changing the number of AtoN**
- ◆ **Utilizing educational equipment for the WWA which AtoN professional training organization**
- ◆ **Performance evaluation and optimization simulation evaluation of new AtoN technology development performance**

Thank you very much for your attention!



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