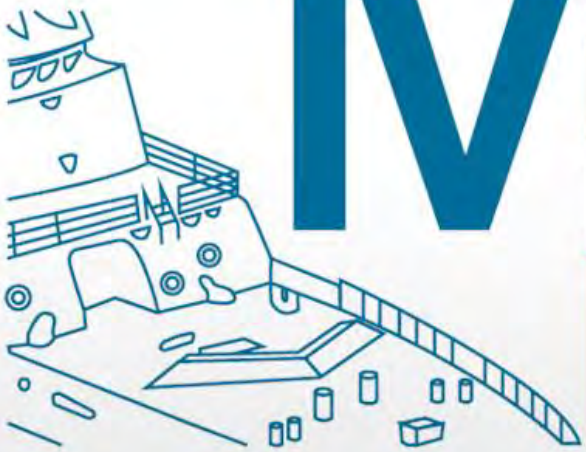

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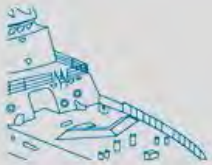
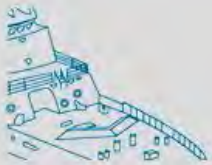
Moving-Object Management method of combat system using main memory DBMS

LIG Nex1 Jongsu Hwang



Content

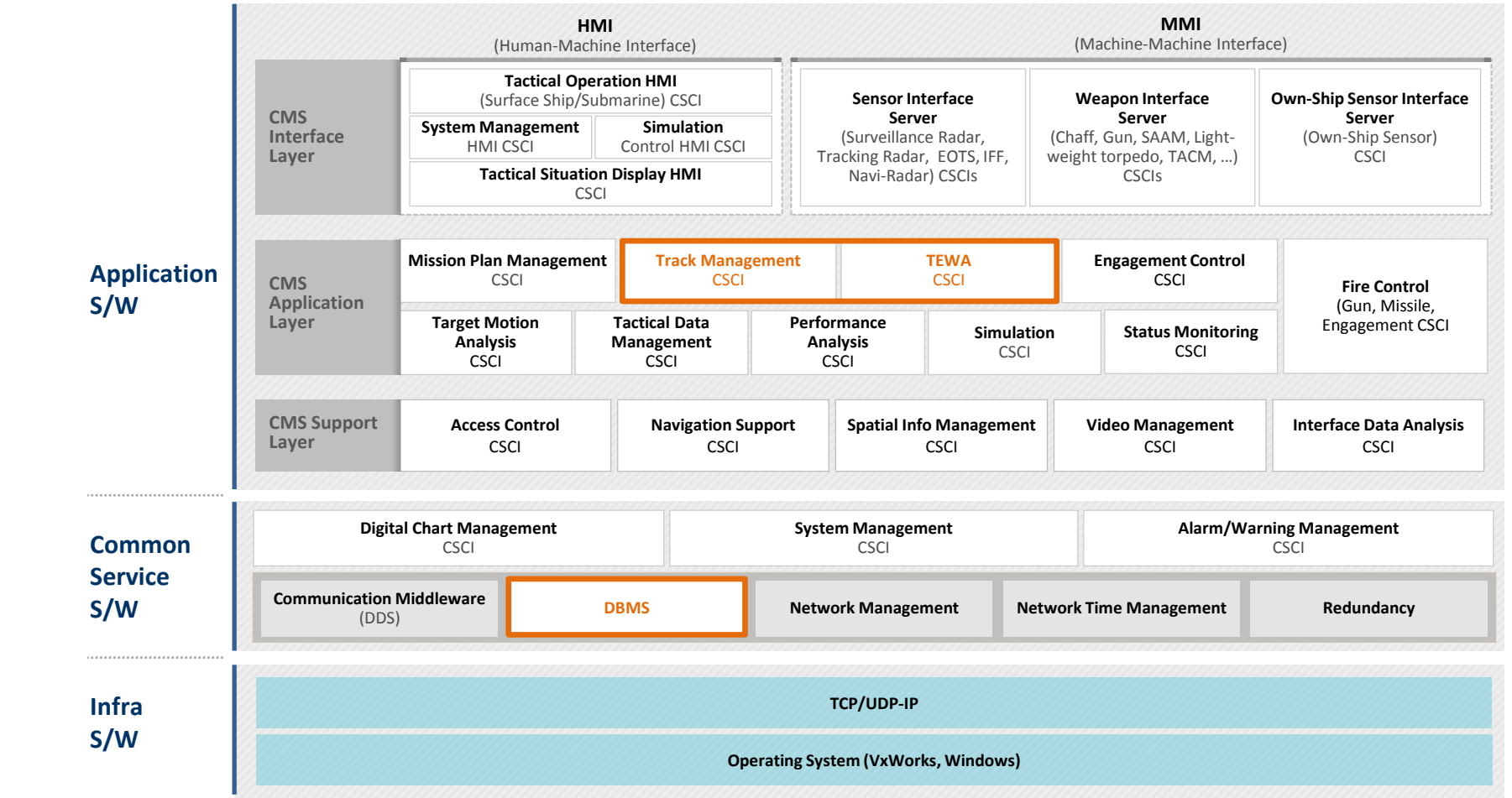
1. Naval Combat System
2. Track Management System
3. Main Memory Database
4. Moving-Object Database
5. J-Track Management
6. Performance



1. Combat System

System for command and control, fire control, and command support
by integrating the available sensors, weapon, navigation and communication systems

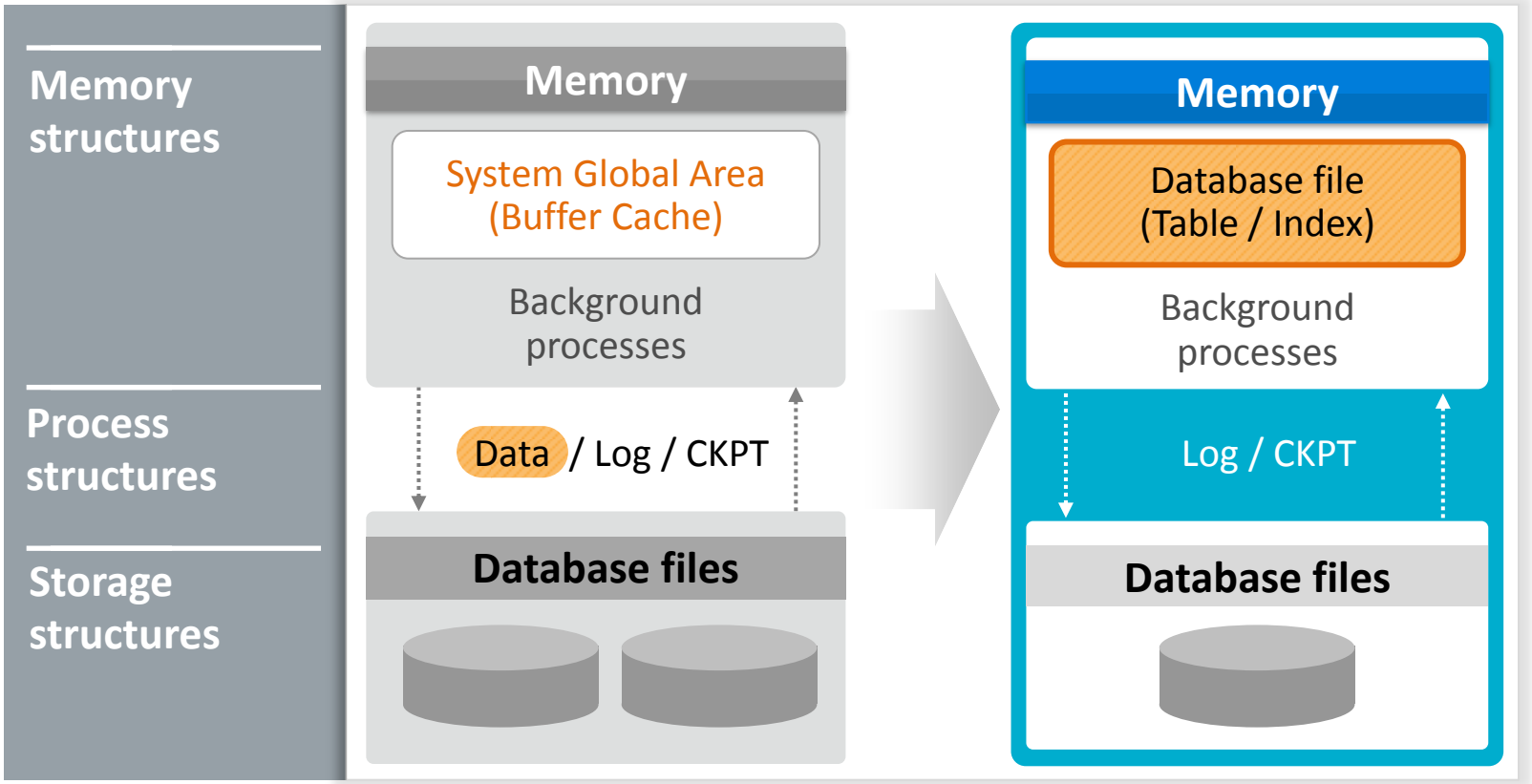
2. Combat System Architechure



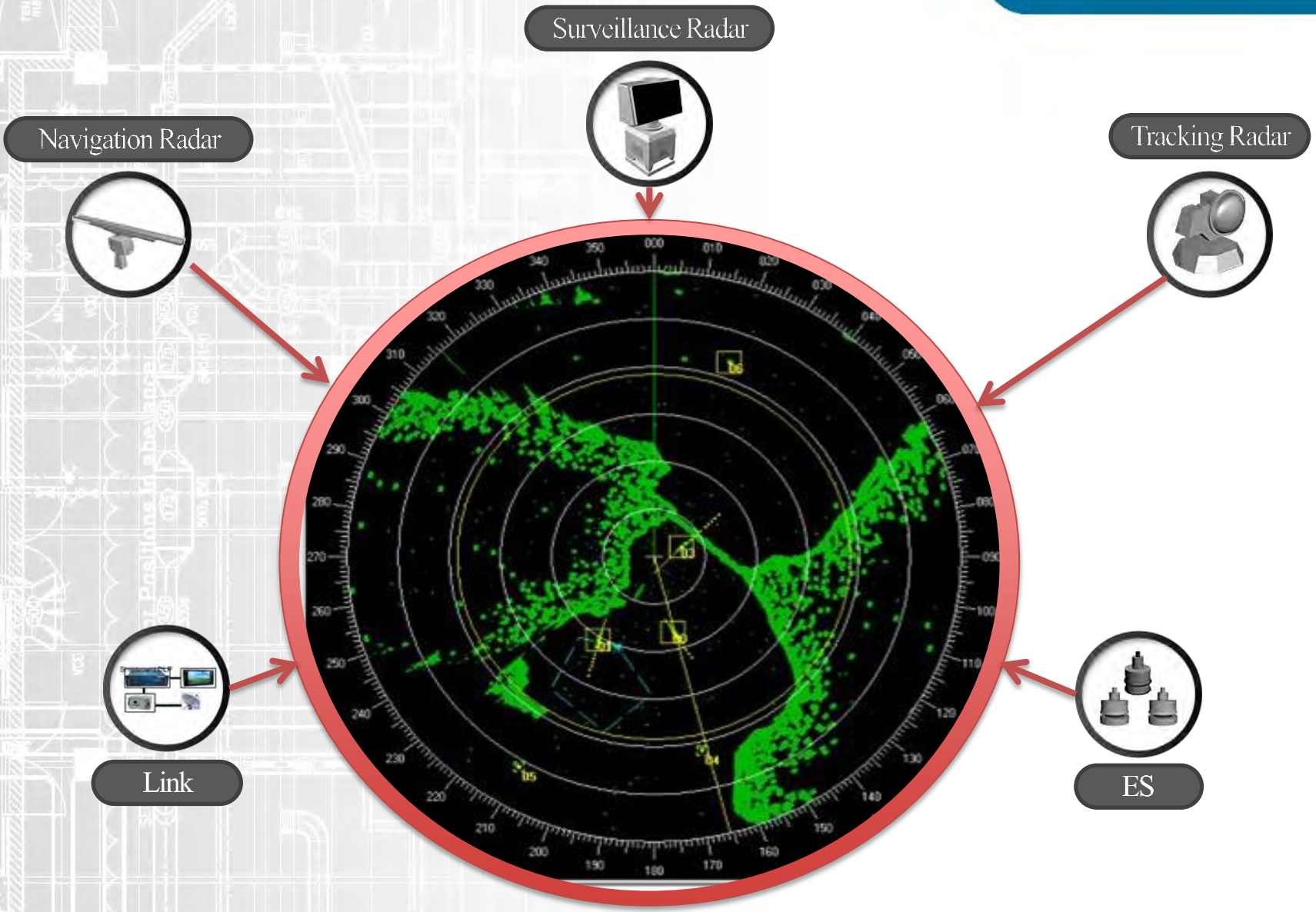
2. Combat System Architechure

2. Combat System Architechure

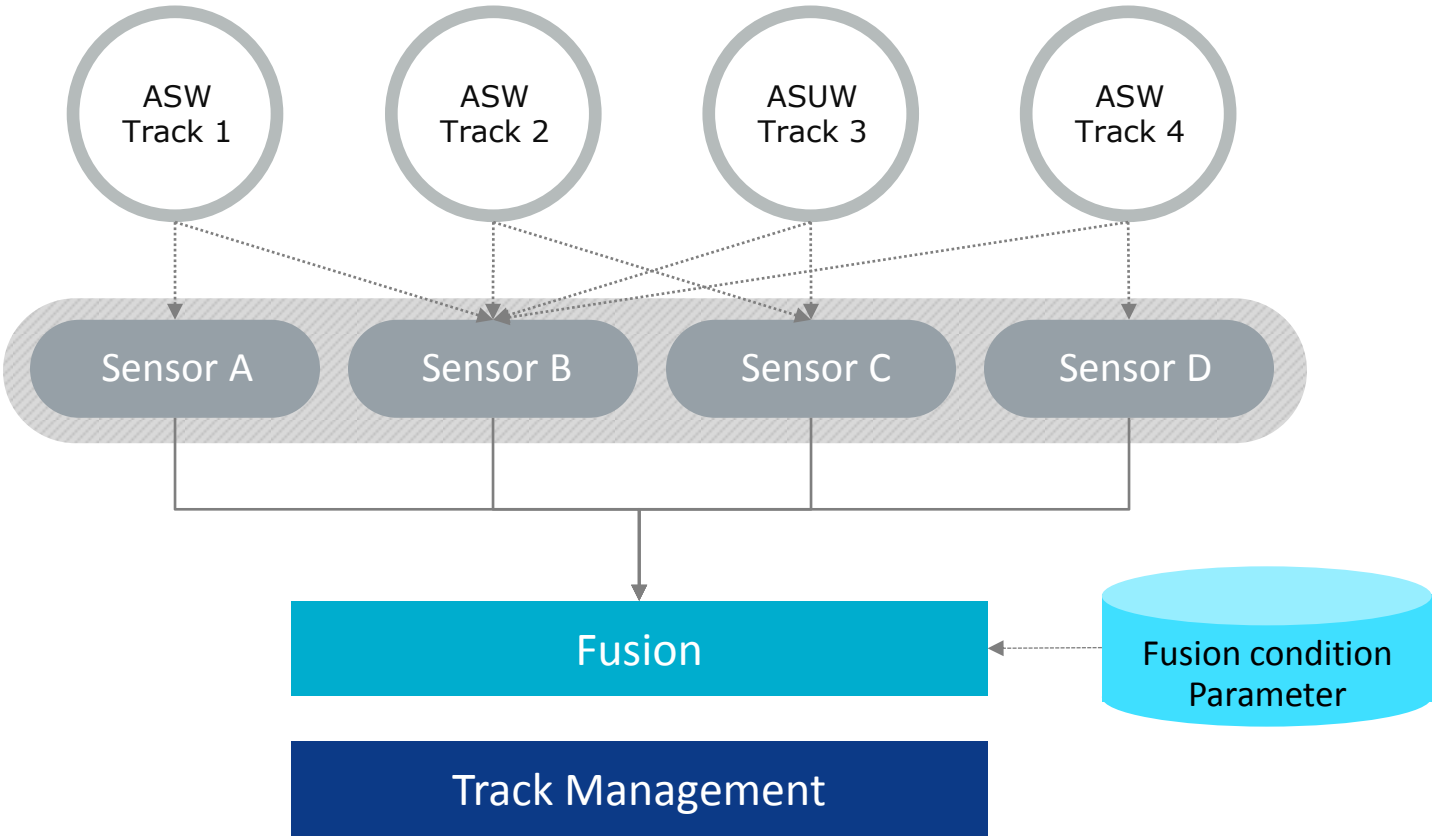
+ High speed Transaction processing Database



3. Track Manager



3. Track Fusion



4. Aegis Modernization(AMOD)

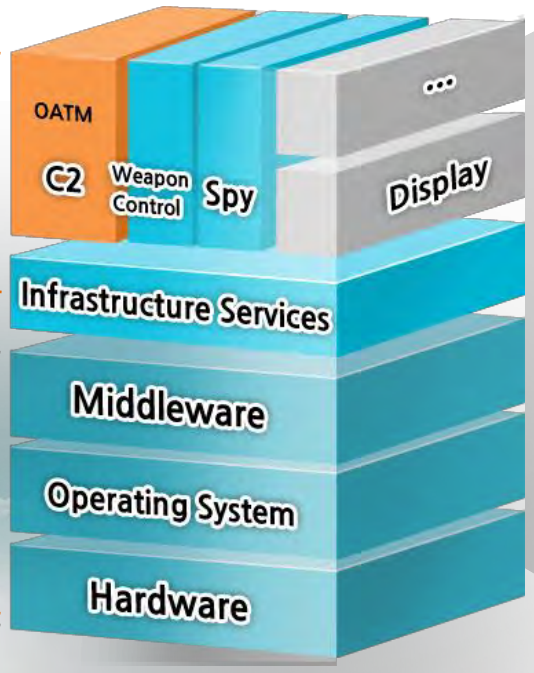
AMOD,
DDG-1000
(US Navy)

OACE-CAT 4

- Common Services and APIs
- Flexibility to Support and Back-Fit

OACE-CAT 3

- Standards-based Interface
- Commercial Mainstream
- Products and Technologies



Application SW:

- Common Reusable Components
- Platform Specific Components

Non – LM Software

Net-SNMP MPI/Pro HAWK WIND RIVER GOAHEAD RTI ca Galium Visual Systems Inc.

1. Real Time Operating System
2. Pub-Sub Communications
3. High Availability Middleware
4. Enterprise System Management
5. Human-Systems Software
6. Network Management Tools

5. Open Architecture TM

Joint Track Management Alignment

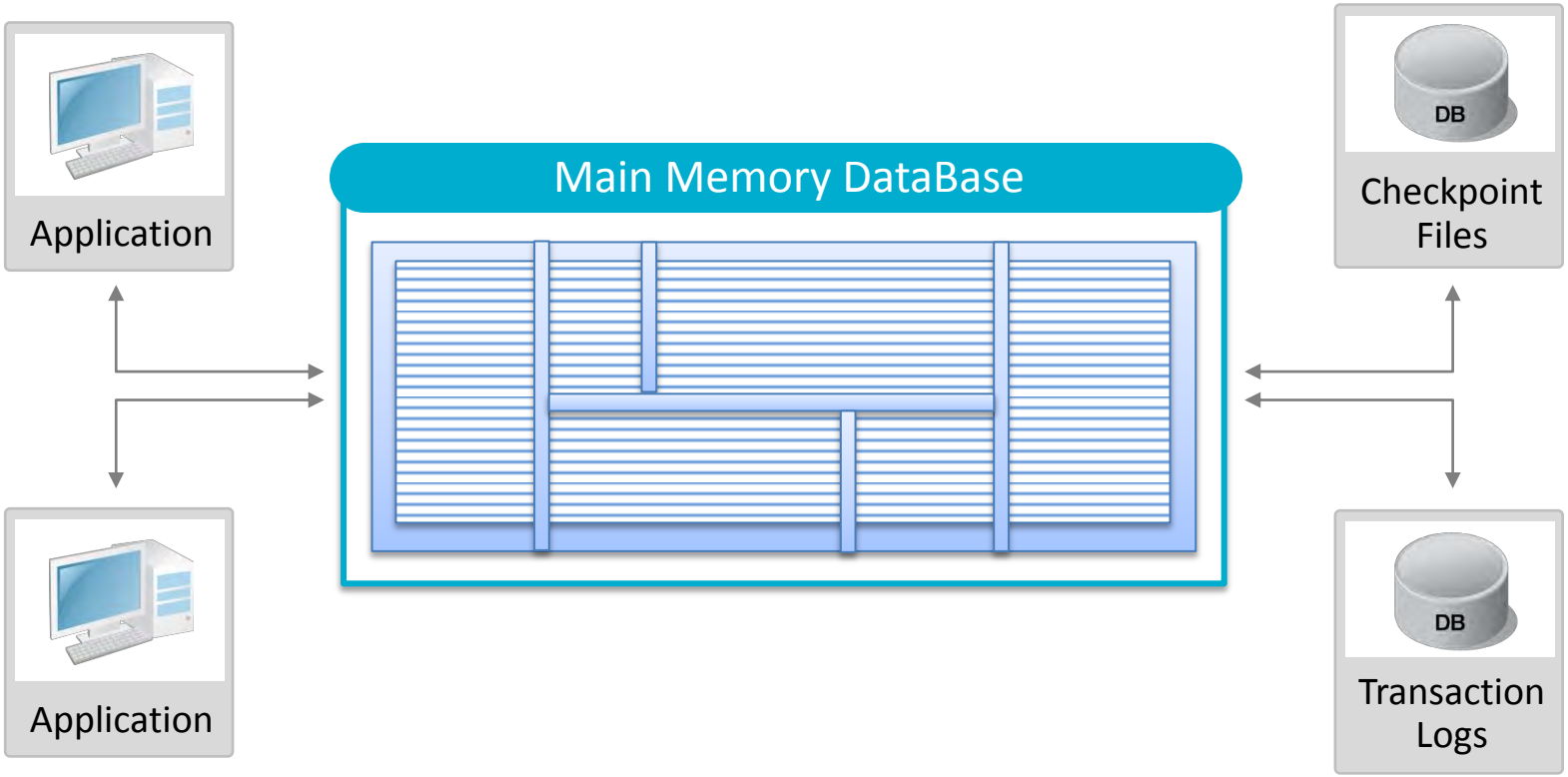
overview

LOCKHEED MARTIN

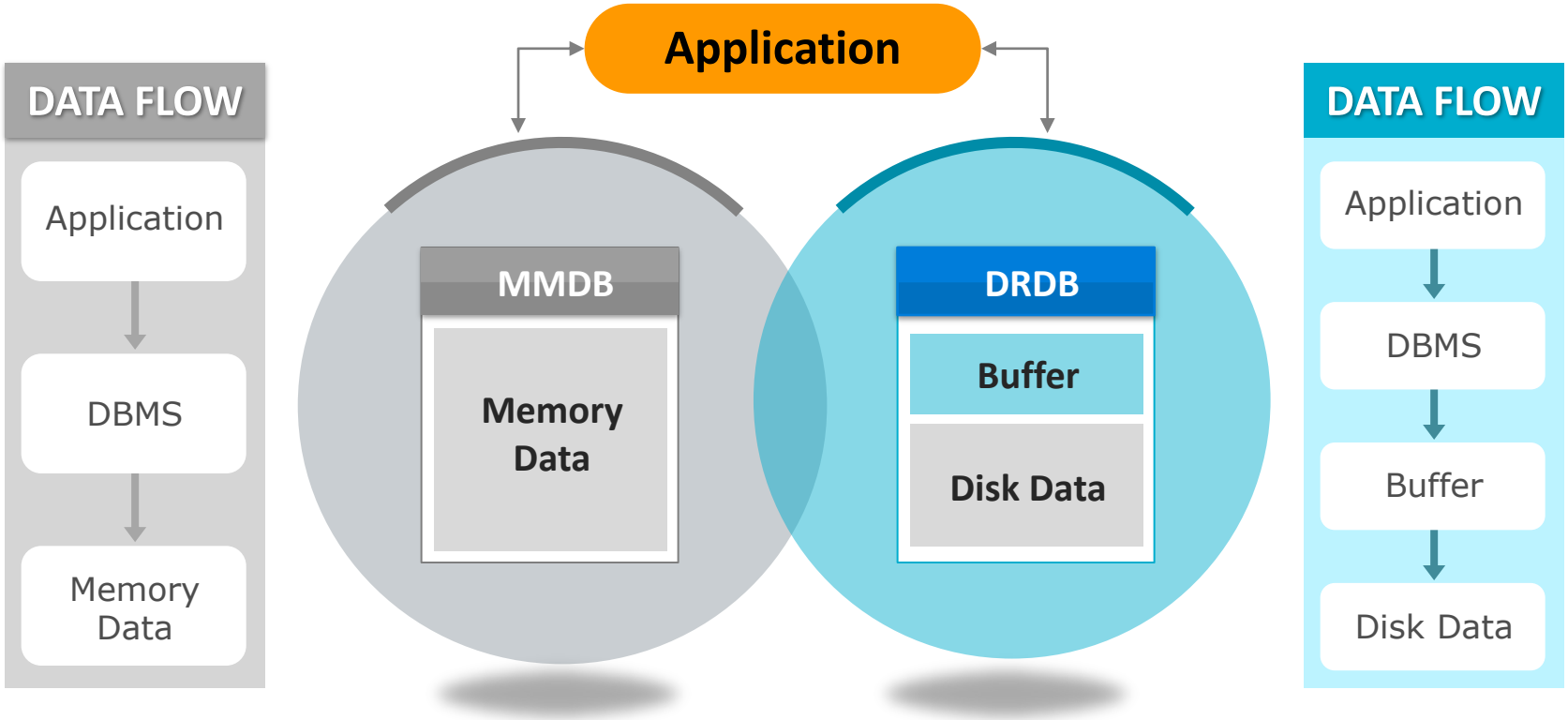
+ Align AMOD and SSDS Track Management to a Common Architecture
  - Provide Consistent Functional Allocation, Data Representation and Attributes
  - Incorporate Reusable System Track Manager and Track Server Components
+ Provides Hierarchical Track File(System Level – Source Level)
  - Track Server Standard Access Interface for Client Applications
  - Track Manager Integrates Track Data Source via Common Interface
  - Extensible for New Track Data Sources
+ Provides Two Complete Versions of Live Training Tracks
  - Allows Training Override of Multiple Attributes
  - Training Tracks Can be Physically Relocated From Live Location.
+ Provides Dual Ownship – Tactical and Training
  - Allows Training View to be Repositioned with No Impact to Tactical View

Ref. The Modernization of the Aegis Fleet with Open Architecture , Lockheed Martin, ’11. 09

6. Main Memory Database



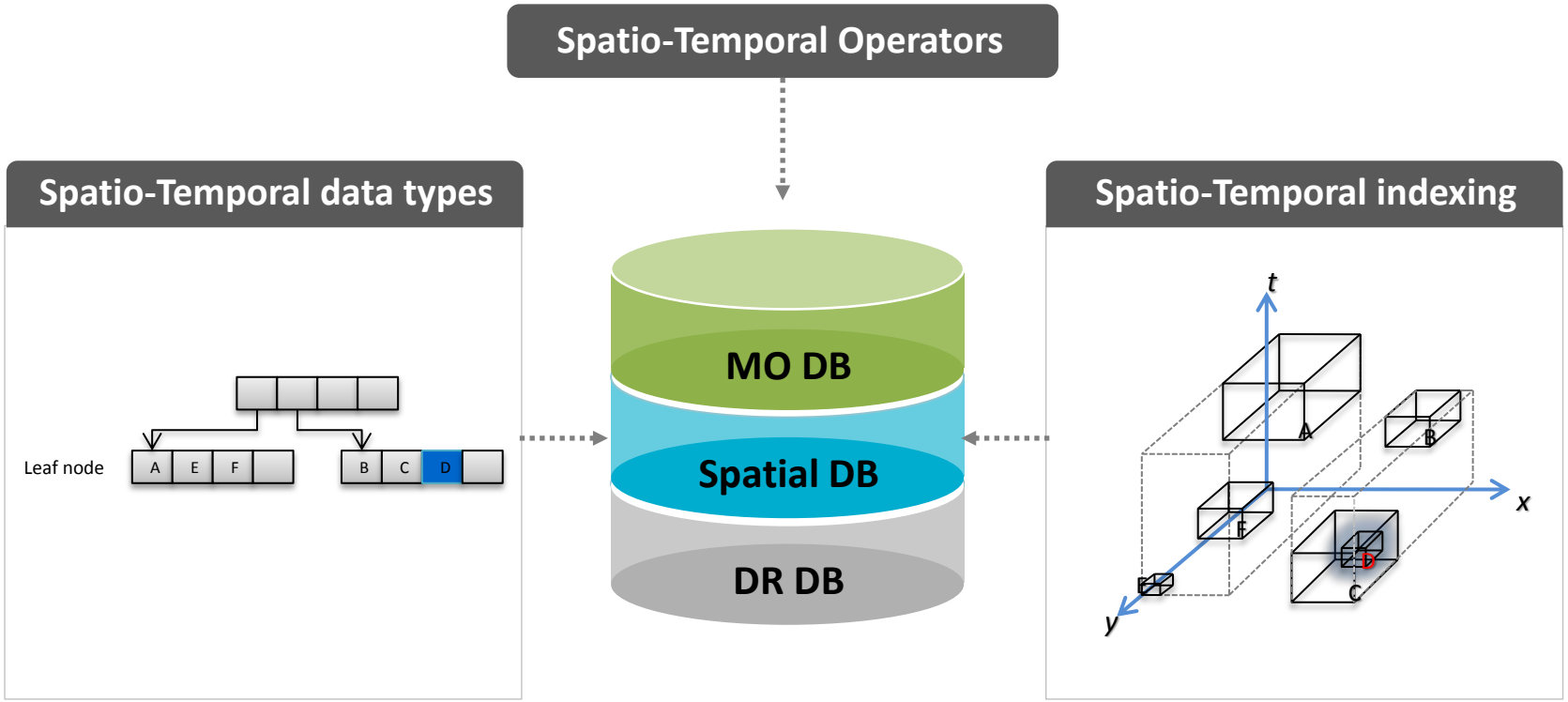
7. MMDB & DRDB


DATA FLOW
Application
DBMS
Memory Data
Application
MMDB
Memory Data
DRDB
Buffer
Disk Data
DATA FLOW
Application
DBMS
Buffer
Disk Data

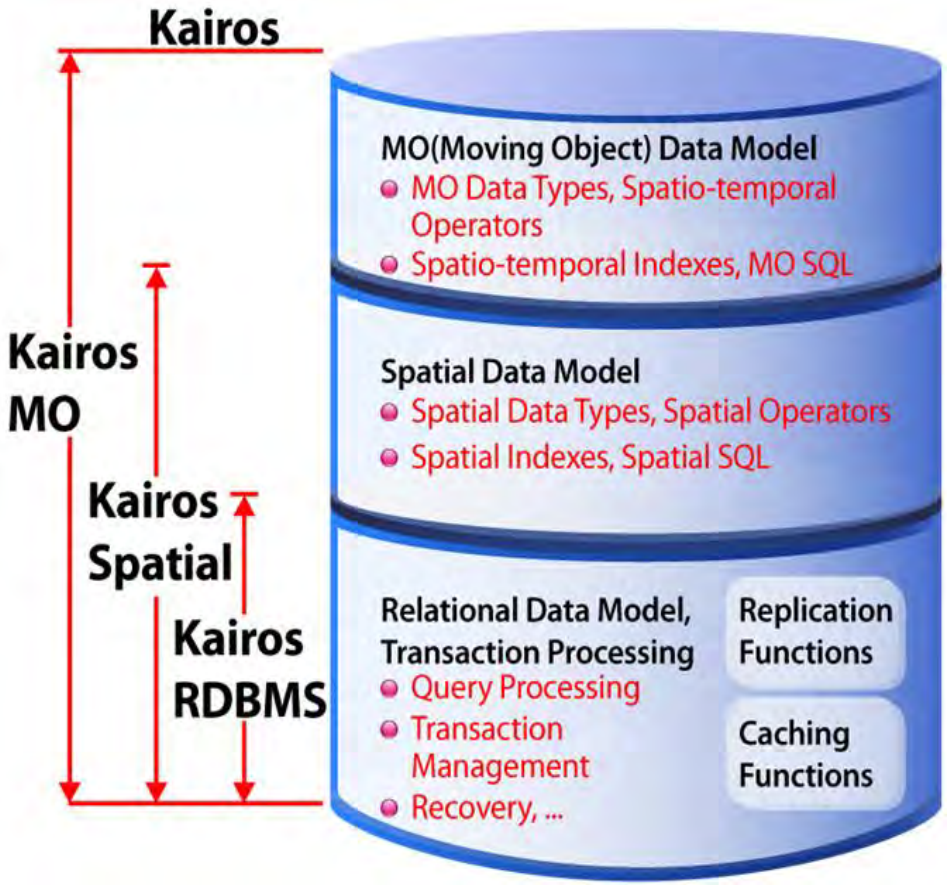
7. MMDB & DRDB

	MMDB	DRDB
Data model	Relational	Relational
System Structure	Client/Server and inner DB	Client/Server
Server Structure	Multi-Thread	Multi-Thread / Multi-Process
CPU Use Rate	lower CPU use rate using simple search Algorithm	Higher CPU use rate using complicate search Algorithm
DISK I/O	Minimum disk I/O in order to Recovery	Normal disk I/O in order to Select, Insert, Update, Delete

8. Moving Object DataBase



9. Kairos Database Overview



REAL TIME TECH

A. Spatio-Temporal Data Type

DR DB Data Type

ID	Gender	Name	Current position(X,Y)
01	man	Bred	(120,150)
02	woman	Ray	(130,140)
03	woman	Ray	(160,150)

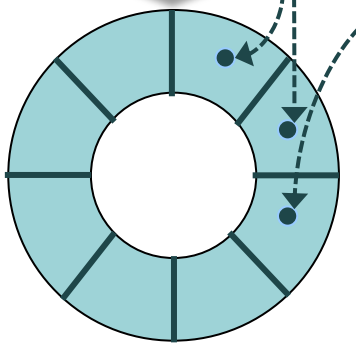
Insert

ID	Gender	Name	Current position(X,Y)
01	man	Bred	(120,150)
02	woman	Ray	(130,140)
03	woman	Ray	(160,150)

MO DB Data Type

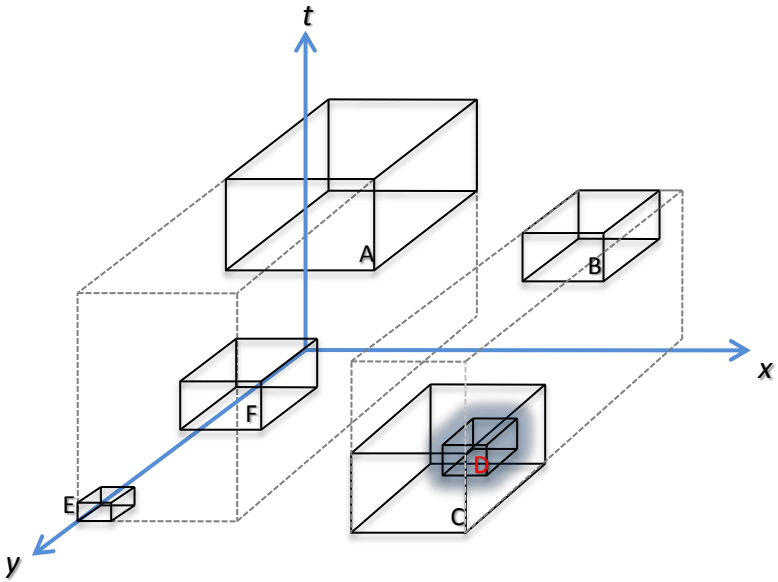
ID	Gender	Name	Current position(X,Y)
01	man	Bred	
02	woman	Ray	

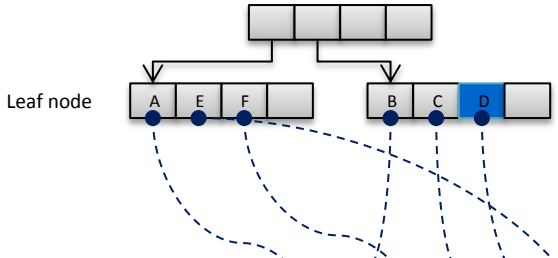
Insert



B. Spatio-Temporal Index

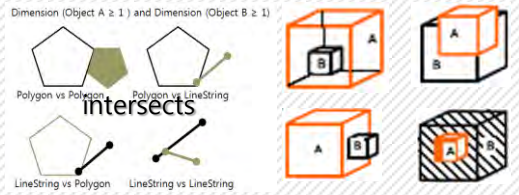
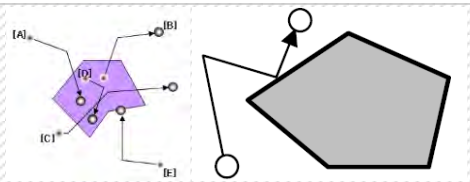
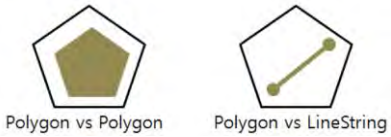
+ Spatio-temporal index of a 3D R*- Tree Structure
+ Use minimum bounding rectangle information





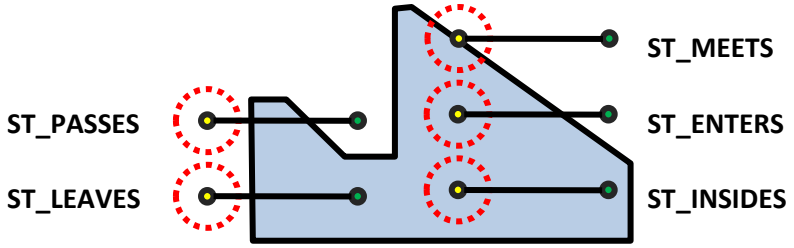
ID	Phone	Name	MPoint
1	010-xxxxxxx	anton	
2	010-xxxxxxx	robert	

C. Spatio-Temporal Operator

Operator group	Description	Sample
Spatio- Temporal Relation Operators	Analysis spatial phase relationship between moving spatial object- moving spatial object or moving spatial object-spatial object Operator : Intersects, Overlaps, Crosses, Within, Contain, Disjoint, Equals, Touches	
Set Operators	- One moving spatial object or moving spatial objects. - Operator : Union, Difference, Intersection	
Trajectory Relation Operators	Analysis phase relationship of trajectory of moving object. Operator : Enter, Leaves, Meets, Passes, Insides	
Temporal Relation Operators	- Analysis time phase relationship between temporal object – temporal object Operator : Contains, Overlaps, Precedes	

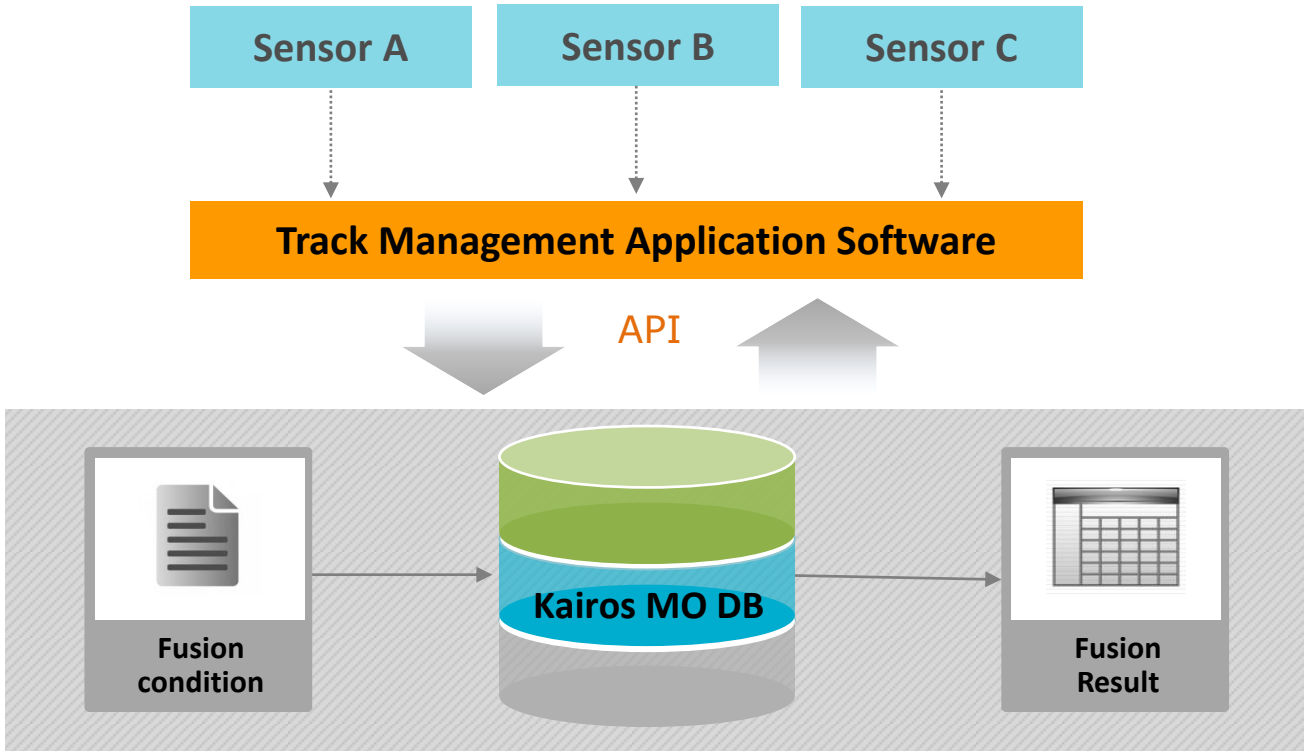
C. Spatio-Temporal Operator

+ Trajectory Relation Operators



Return Value	Operator name	Type	Description
Int	ST_ENTER(A,B)	Mgeometry	The operator will be evaluated that “A” moving-object entered into “B” moving-object from outside to inside
Int	ST_LEAVES(A,B)	Mgeometry	The operator will be evaluated that “A” moving-object entered into “B” moving-object from inside to outside
Int	ST_PASSES(A,B)	Mgeometry	The operator will be evaluated that “A” moving-object penetrated “B” moving-object
Int	ST_MEETS(A,B)	Mgeometry	The operator will be evaluated that they met at the border of “A” and “B” object
Int	ST_INSIDES(A,B)	Mgeometry	The operator will be evaluated that “A” moving-object is staying in the “B” moving-object inside.

10. J-TM Design



11. J-TM Procedure

+ Joint track Management Procedure using moving-object database

01 **Create table with a reference to parameter for the target fusion's available condition**

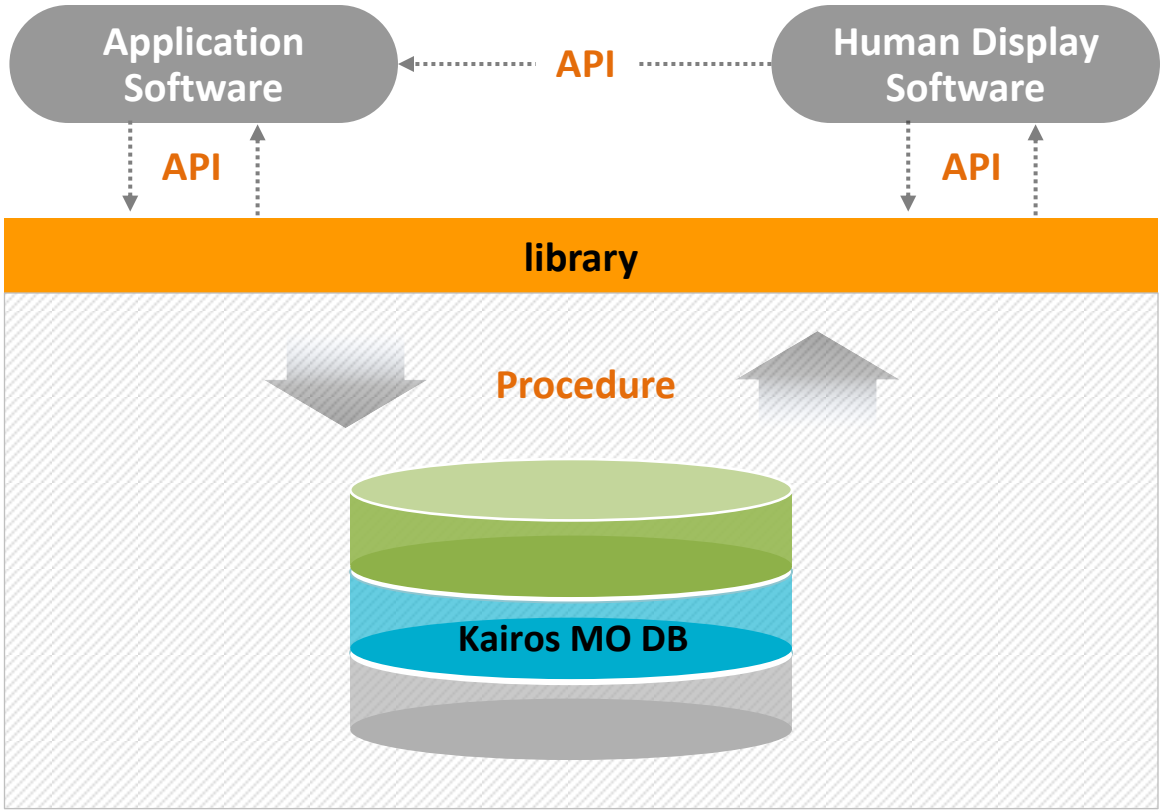
02 **Database API (application program interface) calls using triggers when sensor track information is input**

03 **Determine fusion availability according to the target's location using the moving object database function**

04 **Insert results into the fusion table**

05 **Return the fusion table value from the database**

11. J-TM API Design



11. J-TM API List

+ **Provide About 100 API**

IFF Code

Initial Schema

Set Fusion

Get Conflict Table

Delete Track

Get Confirm

Set Correlation

Get Alert

Set Parameter

Set DeFusion

Reset Schema

Save Track

Get Correlation

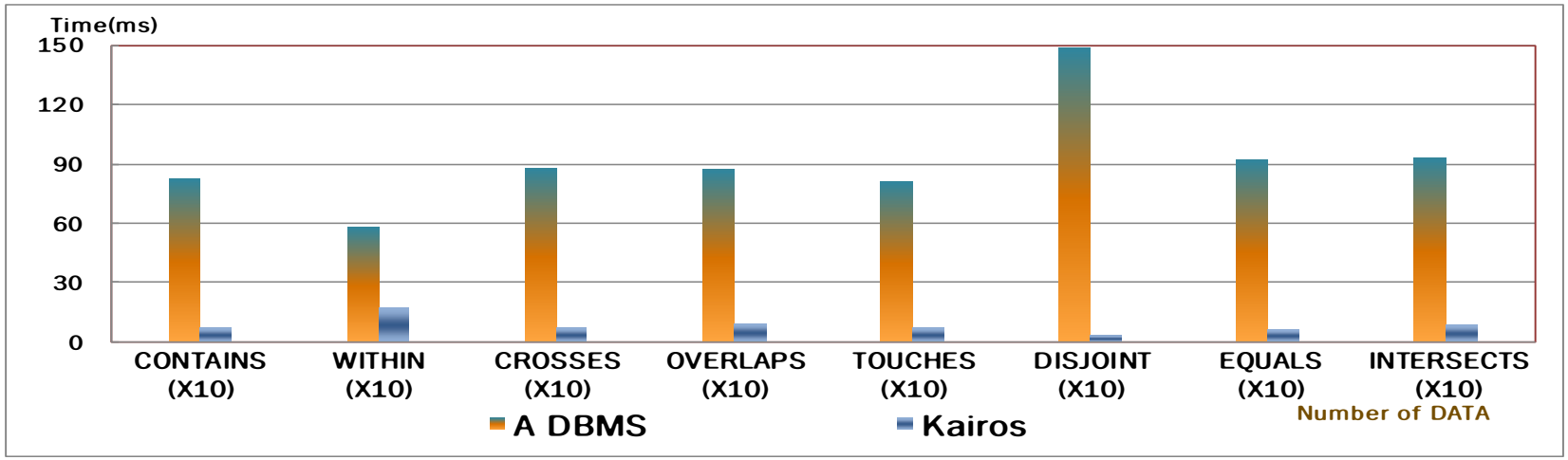
Set Track

12. Performance

+ Spatio Query Performance

- **Test Environment**
  - Windows 2003/Xeon * 16CPU, 64G Memory
- **Test Model**
  - Performance of Spatio Relation Operators
  - Data : 248,115 Polygons

- **Result**
  - MM DBMS(Kairos DBMS) is 10 times faster than other DR DBMS



13. Conclusion

+ Many Benefit of Implementation of Joint-TM

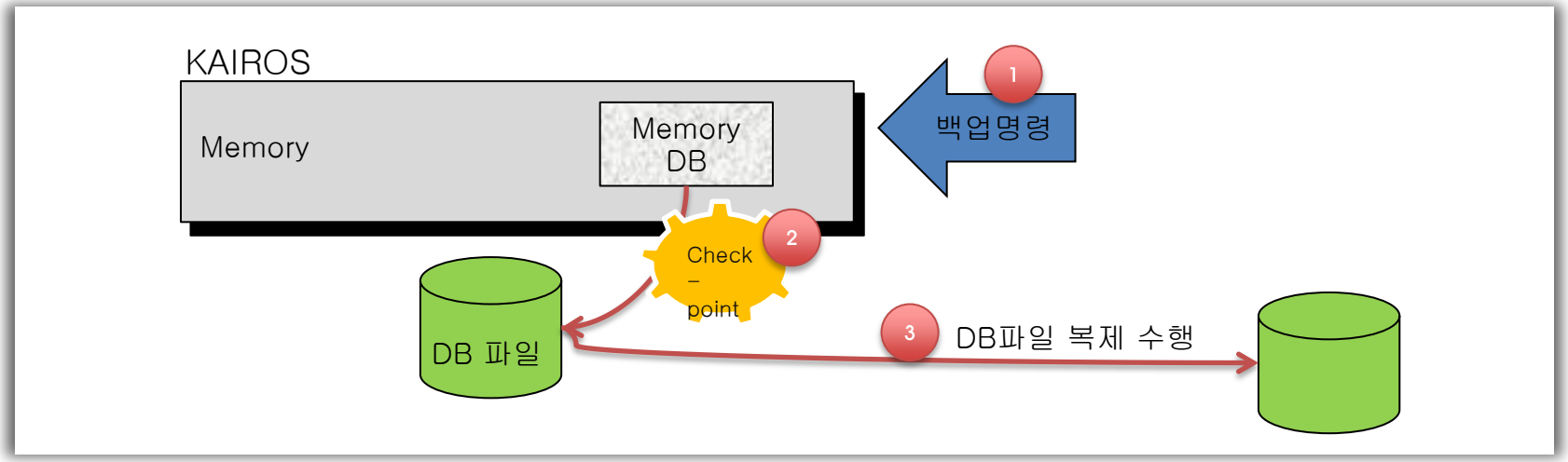
- Databases can replace the track-management function of combat management systems
- As a common module, it can also be applied to various combat management systems

Benefit	Explanation
Reduction in Time to Field	- Decreased development and acquisition cycle times to field new capabilities - Faster integration of open standards based systems
Improved Interoperability	- Use of common warfighting applications (joint-TM)
Reduction in Risk	- Leverage proven reusable components - Test early and often in the developmental cycle to minimize risk of delivering non-interoperable products
Cost Avoidance	- Cost avoidance from software re-use and use commodity COTS products at optimum prices - Reduced training and streamlined lifecycle support

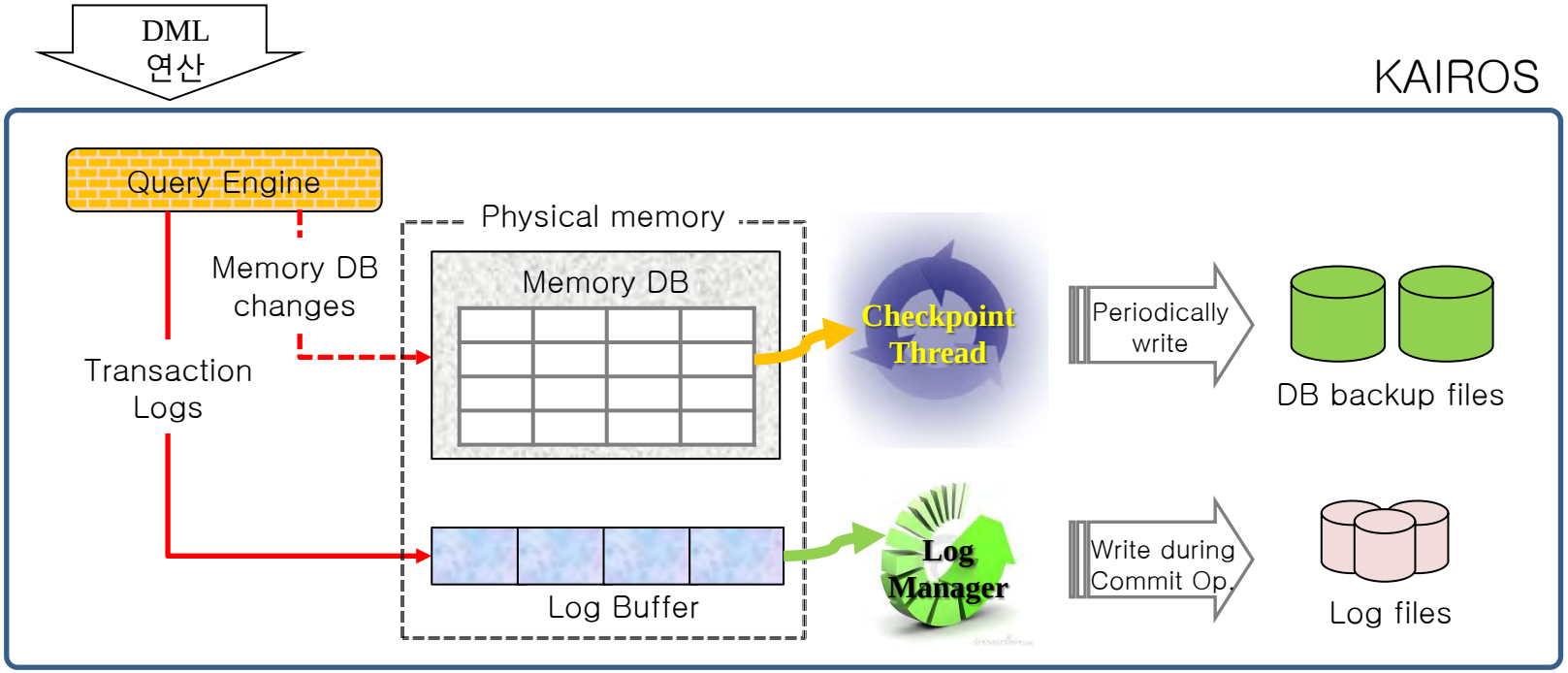
Thank you

Appendix

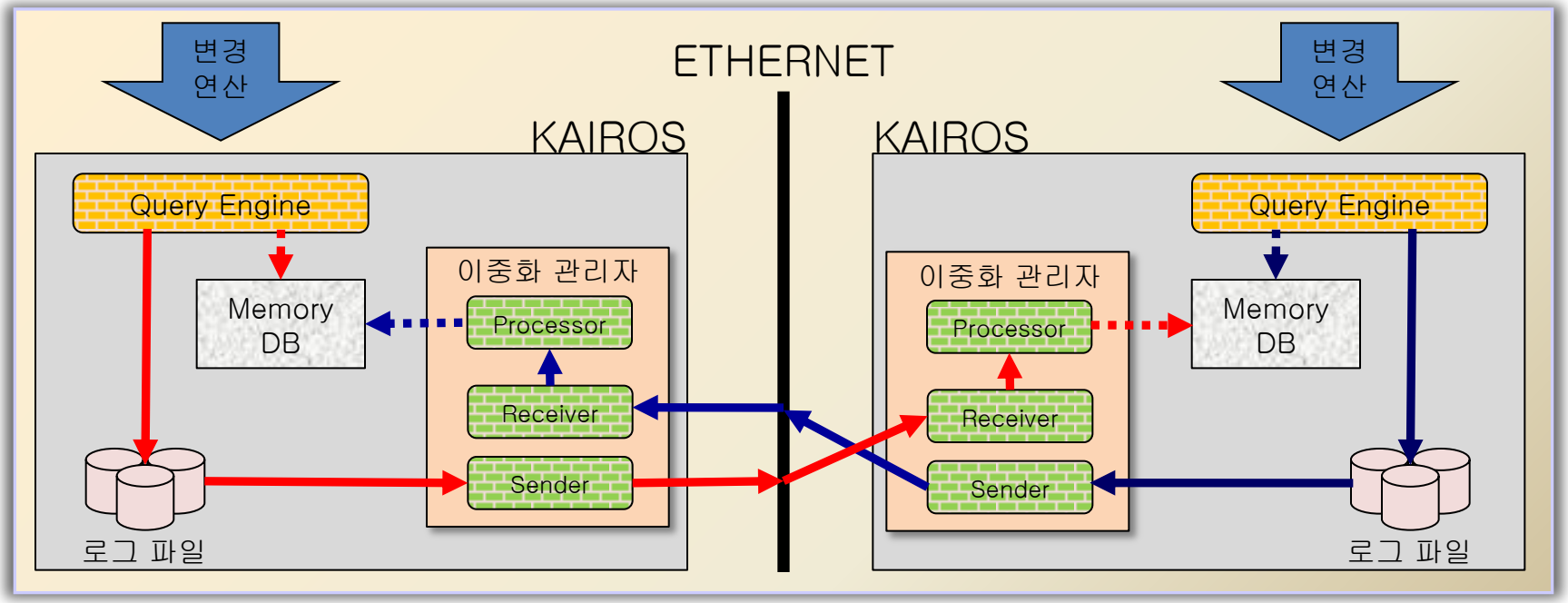
A. DataBase Backup



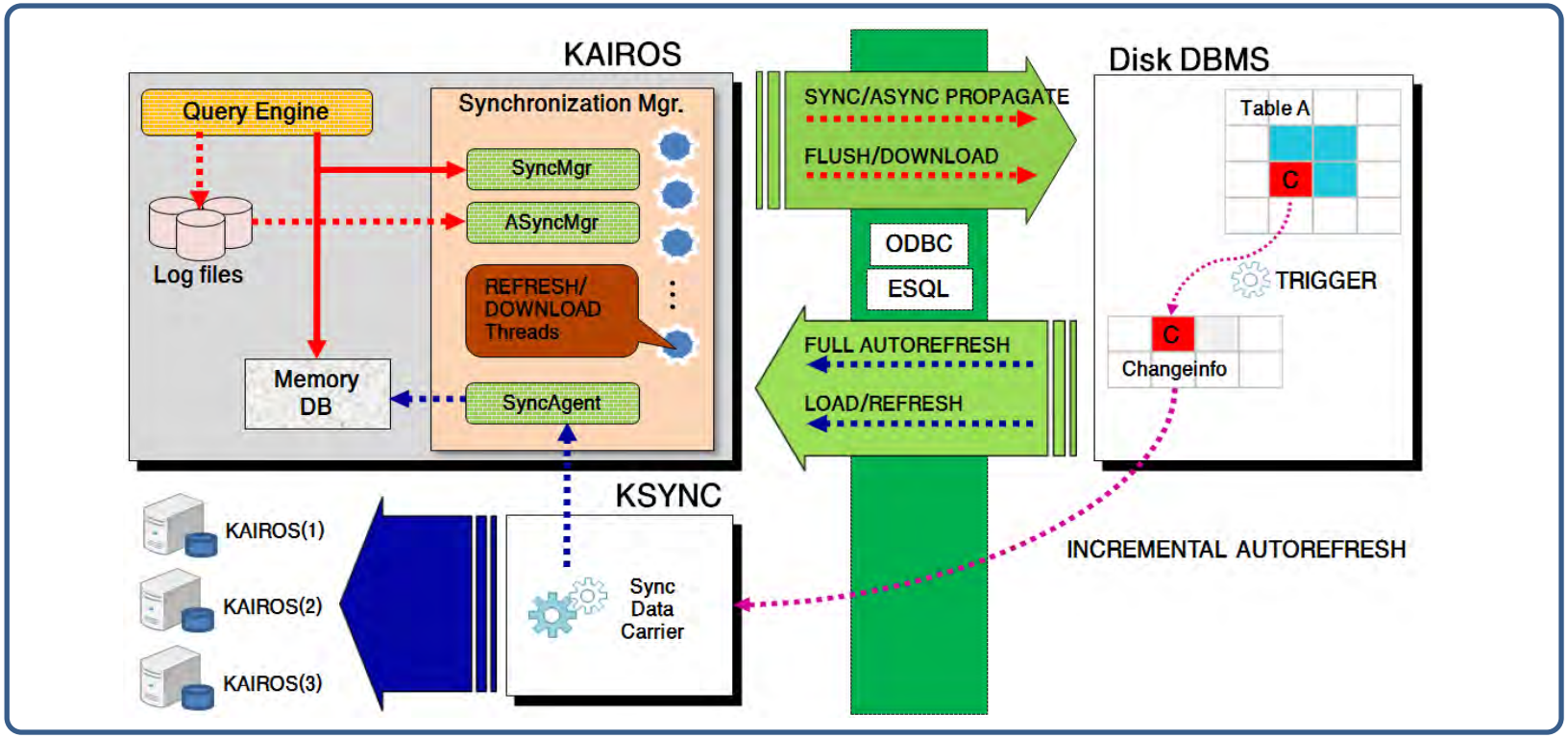
B. Database Recovery

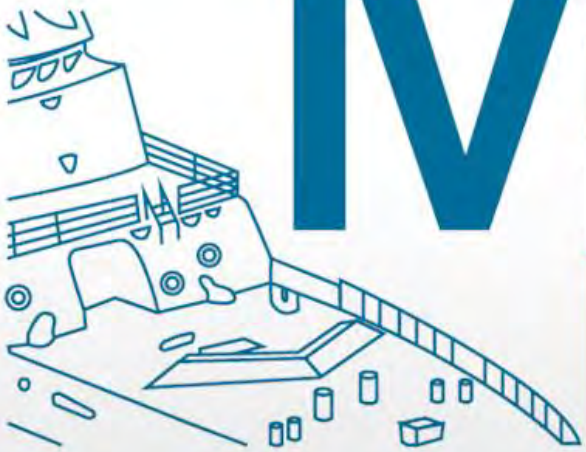


C. Dual Replication



D. RD-DBMS SYNC





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