



# SABLE

## System Automated Balance and Load Engineering

### Overview

---

July 2021

# SABLE : What is it used for?

- Trim aircraft and decide how to distribute the load on the aircraft
  - Taking the technical limitations of the aircraft into account
  - Taking dangerous goods into account
  - Taking commercial requirements into account
- Produce the Load Plan necessary to load the aircraft
- Produce the Load Sheet (legal documentation) to operate the aircraft with the load on board.
- Generate the messages(LDM, CPM,etc.) for distribution in the network.
- It is a safety critical application

# SABLE Facts

- Developed in 2002 by



an Antwerp (Belgium) based software company

- Initial development took 10 months and has been enhanced and extended ever since
- Passenger module developed in 2008
- Software owned by DHL but commercialised and maintained by B.Rekencentra
- SABLE is one of the few next generation W&B systems

# SABLE Deployment Status

- Approved by multiple CAA's and US FAA authorities
- First used in production on 01 October 2002 and now used to trim 600 + aircraft daily

Customer	Country	# Aircraft
DHL Aviation	Worldwide	± 350
Atlas Air	USA	60
Cathay Pacific	Hong Kong	31
Qatar Airways Cargo	Qatar	25
Cargo Jet	Canada	23
ATSG	USA	44
Sun Country	USA	10
ASL Ireland/ France	Ireland	17
Amazon	USA / Europe	70
Air Belgium	Belgium	4
Silver Airways	USA / Florida	5
Northern Aviation Services	USA / Alaska	12

# SABLE : Benefits

- Safety
  - ▣ LIR & Load sheet production prevented if any limit is exceeded
  - ▣ Extended checks specially developed for cargo aircraft
- Ease of use
  - ▣ Natural look and feel
  - ▣ Precise information shown in case of W&B issues
  - ▣ Full integration with other systems
  - ▣ Autoload feature available
- Different working modes
  - ▣ Thin client mode for use in the office
  - ▣ Monitoring tools for central load planning (CLP)
  - ▣ Stand-alone mode for plane side operations (Load masters)
- Service level
  - ▣ 24 \* 7 support
  - ▣ Flexible and quick turn around

# SABLE : Actual used A/C types

- Aerospatiale
  - ATR42
- Airbus
  - A300
  - A330
  - A340
- Boeing
  - B727
  - B737
  - B747
  - B747 LCF
  - B757
  - B767
  - B777
- Convair 580
- Mc Donnell Douglas
  - DC 8
  - DC 10
  - MD 11
- Lockheed
  - L188
- Tupolev
  - TU204C

# SABLE Next Steps

- Software is constantly enhanced with new functions
  - ▣ At least 1 Software release planned per year
  
- Planned enhancements (major topics)
  - ▣ Fully automated W&B
  - ▣ Enhanced history of changes

# SABLE Functional highlights

- Visual representation of decks and load (colors and icons)
- Load freight by
  - Drag and drop
  - Automatic loading procedure
  - Dummy weights for simulations
- Missing restraints resulting in weight limitations
- Multiple deck configurations can be mixed
- Load sheet
  - Prevents production if checks are violated
  - Every version is kept in the database (PDF)
  - History can be printed again
- Post flight documentation
  - LDM, CPM, UCM, NTM



# SABLE Functional highlights

## ❑ Executed checks

- ❑ Aircraft weights
- ❑ CG at ZWF, TW, TOW and LW
- ❑ Lateral imbalance
- ❑ Unsymmetrical load
- ❑ Position weight
- ❑ Floor limits per deck
- ❑ Linear load per deck
- ❑ Cumulative loads per zone
- ❑ Mixed load (compressible versus incompressible)
- ❑ Dangerous goods
- ❑ String Loading

# SABLE Functional highlights

- Configurable for virtually every A/C type
- System Security
  - ▣ All functions and actions protected by access authorization rules
- Client installation
  - ▣ First installation by means of distributed installer
  - ▣ Upgrades of the software install automatically

# SABLE Functional highlights

## Flight screen

Sable Weight and Balance

Flight 1 [0 - CX2001:06 HKG NRT BLIB - B - java.awt ...]

Record 613 / 1141

Flight

Operator: CX - Cathay Pacific

Flight no: CX2001

Trim flag: Trimmed

(In) Use

In Use ☐

User

Date

Sched date/time: 06/03/2011 17:00

Airport from: HKG

Airport to: NRT

AC Type/Version: B747-4ERF 1

AC Reg/Version: BLIB 1

BAR ☒

Flight Mode: STANDARD AFT CUM

Flight Type

Time Mode: UTC

Flight Info() Lo(a)d Status

Fuel() C(h)ange History

Final Fuel ☒ Transmit Msg ☐

Fuel Tank Status

ALL FUEL TANKS OK

	Fuel (kg)	Maximum
Ramp	60,000	167,269
Taxi	1,000	1,361
Trip	58,000	59,000
Ballast	0	

SI

GPLD: 73,201 kg ULDs: 30 Bellies: 0

Delete all the ULDs Delete all the bellies

(ULD (kg))

	Type	ULD#	Own	From	To	Gross	Grp	Contour...	Freight	Remarks	DGR	STACKED
1	✓	AMA	7001	CX	HKG	NRT	3,200	Q6	C		DGR	STACK...
2	✓	AMA	7002	CX	HKG	NRT	3,450	Q6	C		DGR	STACK...
3	✓	AMA	7008	CX	HKG	NRT	1,230	Q6	C		DGR	STACK...
4	✓	AMA	7321	CX	HKG	NRT	3,860	Q6	C		DGR	STACK...
5	✓	AMA	7381	CX	HKG	NRT	2,100	Q6	C		DGR	STACK...
6	✓	AMA	7771	CX	HKG	NRT	1,336	Q6	C		DGR	STACK...
7	✓	P1P	2349	CX	HKG	NRT	1,905	A2	C		DGR	STACK...
8	✓	P1P	2374	CX	HKG	NRT	1,630	Q6	C	*AM	DGR	STACK...
9	✓	P1P	2399	CX	HKG	NRT	3,800	Q7	C	*HEA	DGR	STACK...
10	✓	P1P	2978	CX	HKG	NRT	3,200	Q7	C		DGR	STACK...
11	✓	P6P	9005	CX	HKG	NRT	1,390	A2	C	*OHG	DGR	STACK...
12	✓	P6P	9011	CX	HKG	NRT	1,890	Q6	C		DGR	STACK...
13	✓	P6P	9021	CX	HKG	NRT	3,100	Q6	C		DGR	STACK...
14	✓	P6P	9030	CX	HKG	NRT	2,200	Q7	C		DGR	STACK...
15	✓	P6P	9111	CX	HKG	NRT	1,706	Q6	C	*OHG	DGR	STACK...
16	✓	P6P	9222	CX	HKG	NRT	1,402	Q6	C		DGR	STACK...
17	✓	P6P	9273	CX	HKG	NRT	1,500	A2	C		DGR	STACK...
18	✓	P6P	9324	CX	HKG	NRT	2,800	Q7	C	*OHG	DGR	STACK...
19	✓	P6P	9379	CX	HKG	NRT	2,600	Q7	C		DGR	STACK...

(B)elly (kg)

	ID	From	To	Gross	Grp	Contour...	Freight	Remarks	DGR	STACKED
1									DGR	STACK...
2									DGR	STACK...
3									DGR	STACK...
4									DGR	STACK...
5									DGR	STACK...
6									DGR	STACK...
7									DGR	STACK...
8									DGR	STACK...
9									DGR	STACK...
10									DGR	STACK...

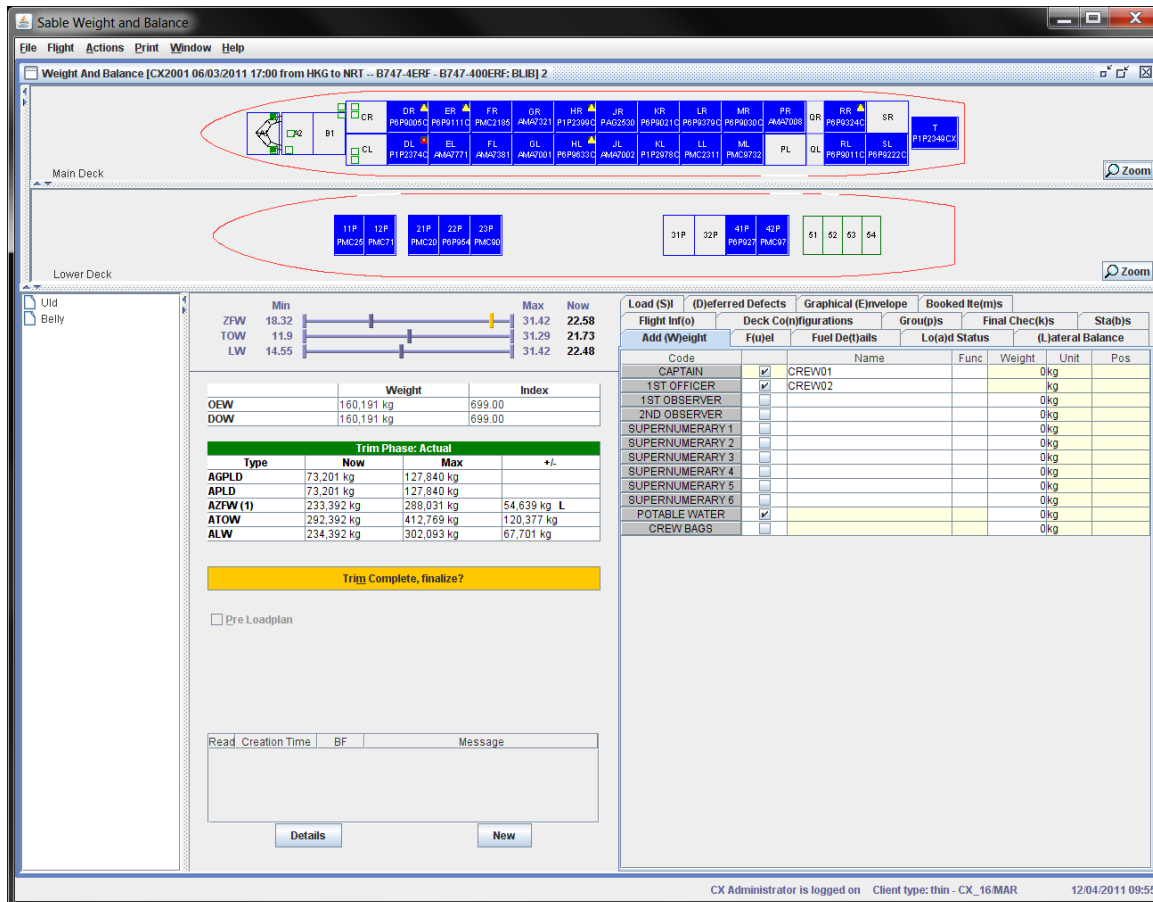
Weight And Balance

CX Administrator is logged on Client type: thin - CX\_16/MAR 12/04/2011 09:50

- Flight list on the left
- Flight details on top center
- Fuel details on the right
- Center:
  - Top: ULD info
  - Bottom: Loose freight
- Screen is configurable

# SABLE Functional highlights

## Weight & Balance screen



- Top: Graphical view
  - Per Deck
  - Zoom capability
- Middle:
  - Trim conditions
  - DOW build-up
  - A/C weights
- Right: additional info

# SABLE Functional highlights

## W&B: Additional Weights

Load (S)l	(D)eferred Defects	Graphical (E)nvelope	Booked lte(m)s			
Flight Inf(o)	Deck Co(n)figurations		Grou(p)s	Final Chec(k)s	Sta(b)s	
Add (W)eight	F(u)el	Fuel De(t)ails	Lo(a)d Status	(L)ateral Balance		
Code		Name	Func	Weight	Unit	Pos
CAPTAIN	<input checked="" type="checkbox"/>	CREW01		0 kg		
1ST OFFICER	<input checked="" type="checkbox"/>	CREW02		kg		
1ST OBSERVER	<input type="checkbox"/>			0 kg		
2ND OBSERVER	<input type="checkbox"/>			0 kg		
SUPERNUMERARY 1	<input type="checkbox"/>			0 kg		
SUPERNUMERARY 2	<input type="checkbox"/>			0 kg		
SUPERNUMERARY 3	<input type="checkbox"/>			0 kg		
SUPERNUMERARY 4	<input type="checkbox"/>			0 kg		
SUPERNUMERARY 5	<input type="checkbox"/>			0 kg		
SUPERNUMERARY 6	<input type="checkbox"/>			0 kg		
POTABLE WATER	<input checked="" type="checkbox"/>			0 kg		
CREW BAGS	<input type="checkbox"/>			0 kg		

- Cockpit crew
- Jump seats
- Service weight adjustments

# SABLE Functional highlights

## W&B: Fuel

The screenshot displays the 'Fuel' tab within the SABLE interface. The top navigation bar includes tabs for 'Load (S)', 'Deferred Defects', 'Graphical (E)nvelope', and 'Booked It(e)m(s)'. Below this, a secondary bar contains 'Flight Inf(o)', 'Deck Co(n)figurations', 'Grou(p)s', 'Final Chec(k)s', and 'Sta(b)s'. The 'Fuel' tab is active, showing sub-tabs for 'Add (W)eight', 'F(u)el', 'Fuel De(t)ails', 'Lo(a)d Status', and '(L)ateral Balance'. The 'F(u)el' sub-tab is selected, revealing controls for 'Final Fuel' (checked), 'Transmit Msg' (unchecked), 'Fuel Density' (0.79 kg/liter), and 'Tank Status' (ALL FUEL TANKS OK). A table below these controls shows fuel quantities for different stages: Ramp (60,000 kg), Taxi (1,000 kg), Trip (58,000 kg), and Ballast (0 kg), with their respective maximums (167,269, 1,361, 59,000, and 0 kg).

	Fuel (kg)	Maximum
Ramp	60,000	167,269
Taxi	1,000	1,361
Trip	58,000	59,000
Ballast	0	0

- Fuel quantities
- Fuel status (Automatic or manual distribution)
- Fuel density
  - Defaults defined per origin and month
  - Changeable by access right

# SABLE Functional highlights

## W&B: Fuel details

Load (S)	(D)eferred Defects	Graphical (E)nvelope	Booked Ite(m)s	
Flight Inf(o)	Deck Co(n)figurations	Grou(p)s	Final Chec(k)s	Sta(b)s
Add (W)eight	F(u)el	Fuel De(t)ails	Lo(a)d Status	(L)ateral Balance
Unit kg				
TW				
Tank	Fuel	Ballast	Total	
CENTER TANK	0	0	0	
MAIN TANK 1	13,403	0	13,403	
MAIN TANK 2	16,597	0	16,597	
MAIN TANK 3	16,597	0	16,597	
MAIN TANK 4	13,403	0	13,403	
RESERVE TANK 2	0	0	0	
RESERVE TANK 3	0	0	0	
Total	60,000	0	60,000	
TOW				
Tank	Fuel	Ballast	Total	
CENTER TANK	0	0	0	
MAIN TANK 1	13,403	0	13,403	
MAIN TANK 2	16,097	0	16,097	
MAIN TANK 3	16,097	0	16,097	
MAIN TANK 4	13,403	0	13,403	
RESERVE TANK 2	0	0	0	
RESERVE TANK 3	0	0	0	
Total	59,000	0	59,000	
LW				
Tank	Fuel	Ballast	Total	
CENTER TANK	0	0	0	
MAIN TANK 1	250	0	250	
MAIN TANK 2	250	0	250	
MAIN TANK 3	250	0	250	
MAIN TANK 4	250	0	250	
RESERVE TANK 2	0	0	0	
RESERVE TANK 3	0	0	0	
Total	1,000	0	1,000	

- Fuel distribution per individual tank
- Possibility to add ballast fuel

# SABLE Functional highlights

## W&B: Manual Fuel

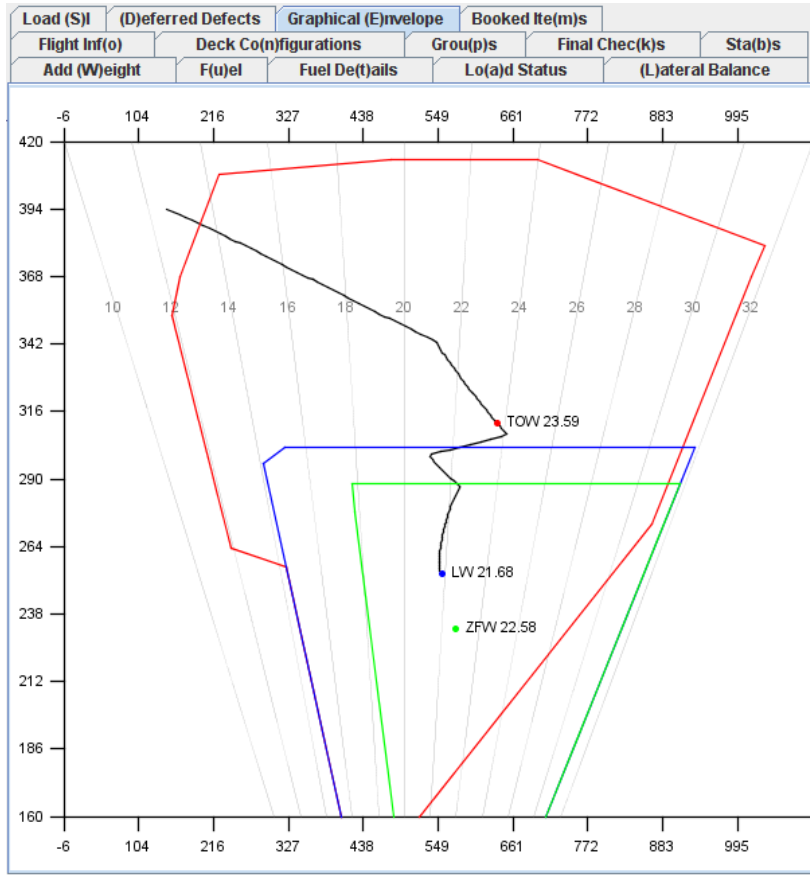
Group(s)	Final Chec(k)s	Sta(b)s	Load (S)	(D)eferred Defects	Graphical (E)nvelope	Booked It(e)m(s)
Add (W)eight	F(u)el	Fuel De(t)ails	Lo(a)d Status	(L)ateral Balance	Flight Inf(o)	Deck Co(n)figurations
Unit kg		Distribution: Manual			Calculate TOW and LW Fuel	
TW						
Tank	Fuel	Ballast	Total			
CENTER TANK	4,800	0	3,439.28			
MAIN TANK 1	13,000	0	13,233.48			
MAIN TANK 2	37,000	0	37,043.76			
MAIN TANK 3	37,000	0	37,043.76			
MAIN TANK 4	13,000	0	13,233.48			
RESERVE TANK 2	3,500	0	3,903.12			
RESERVE TANK 3	3,500	0	3,903.12			
Total	111,800	0	111,800			
TOW						
Tank	Fuel	Ballast	Total			
CENTER TANK	2,439.28	0	2,439.28			
MAIN TANK 1	13,233.48	0	13,233.48			
MAIN TANK 2	37,043.76	0	37,043.76			
MAIN TANK 3	37,043.76	0	37,043.76			
MAIN TANK 4	13,233.48	0	13,233.48			
RESERVE TANK 2	3,903.12	0	3,903.12			
RESERVE TANK 3	3,903.12	0	3,903.12			
Total	110,800	0	110,800			
LW						
Tank	Fuel	Ballast	Total			
CENTER TANK	0	0	0			
MAIN TANK 1	4,050	0	4,050			
MAIN TANK 2	4,050	0	4,050			
MAIN TANK 3	4,050	0	4,050			
MAIN TANK 4	4,050	0	4,050			
RESERVE TANK 2	0	0	0			
RESERVE TANK 3	0	0	0			
Total	16,200	0	16,200			

- Enter fuel per tank for taxi weight
- Button to automatically distribute fuel for TOW and LW
- Fuel details can come from aircraft through ACARS



# SABLE Functional highlights

## W&B: Graphical envelope



- Plotting of envelope for
  - ZFW
  - TOW
  - LW
- Plot actual CG at ZFW, TOW, LW
- Plot fuel curve until tanks full
- Envelope definition depending on CLIM (Cargo Lateral Imbalance Moment)

# SABLE Functional highlights

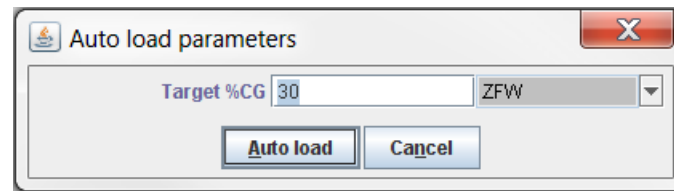
## W&B: Final Checks

Load (S)l	(D)eferred Defects	Graphical (E)nvelope	Booked Ite(m)s	
Flight Inf(o)	Deck Co(n)figurations	Grou(p)s	Final Chec(k)s	Sta(b)s
Add (W)eight	F(u)el	Fuel De(f)ails	Lo(a)d Status	(L)ateral Balance
Cumulative loads per zone				OK
Floor Limits				OK
Linear Load Limits				OK
Unsymmetrical Load Limits				OK
Never Void / Always Void Positions				OK
Crew Members				OK
JSB Accepted				OK
Final Figures				OK
Fuel Distribution				OK
Dummy Weights				OK
Overloaded Positions				OK
CG				OK
Weights				OK
Lateral Balance				OK
Underloaded tanks				OK
Load Status				OK
Mixed load checks				OK
Danger Positions				OK
Counterbalance				OK
All Cargo is loaded				OK
Volumes				NOK
ULD data				OK

- Checks all constraints defined in the aircraft configuration
- Gives status of each check
- Pink color is a soft warning
- Details in case of NOK

# SABLE Functional highlights

## W&B: Auto-load

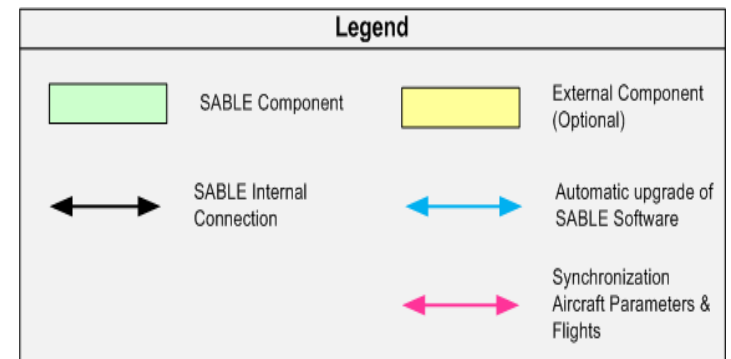
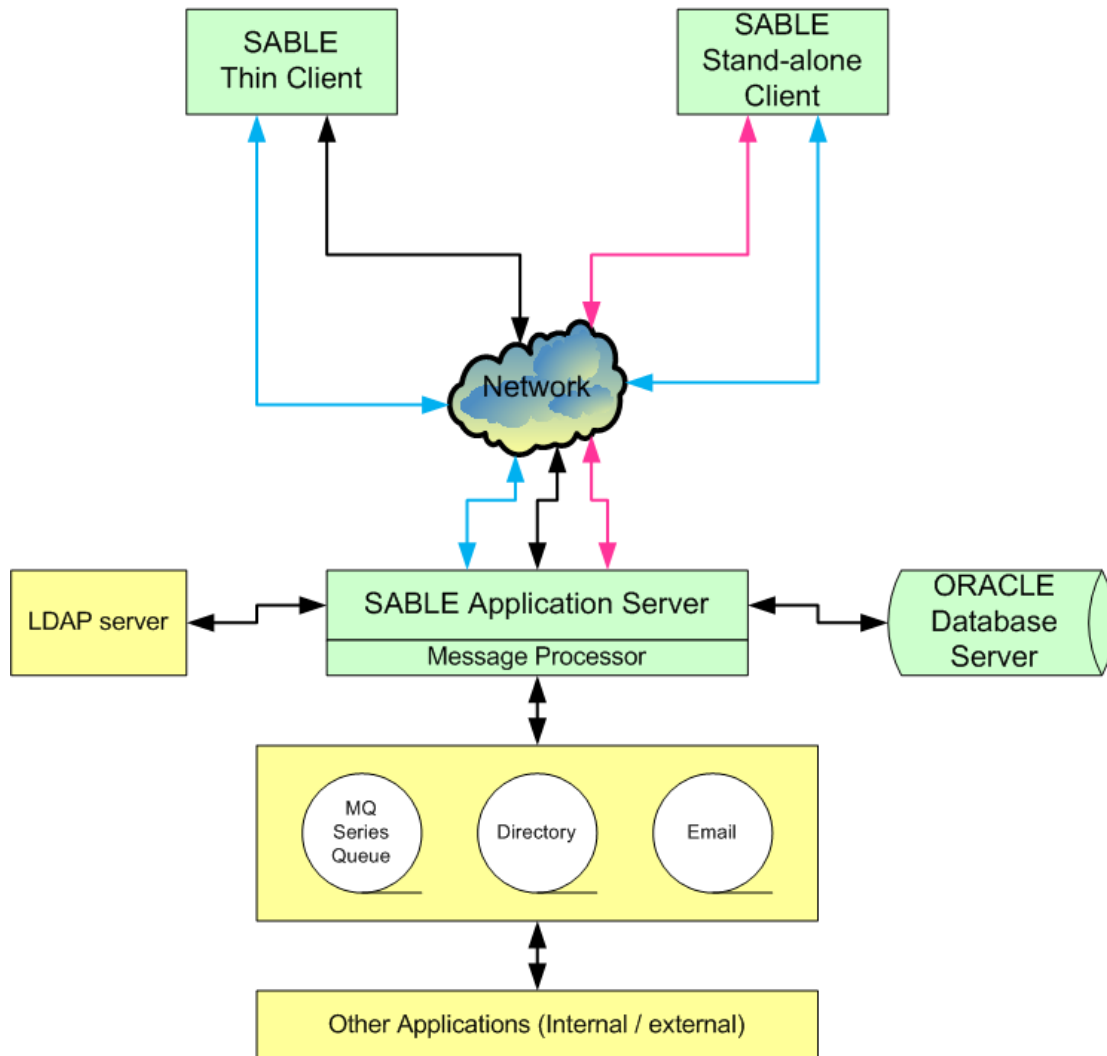


- Indicate target CG
- Places load automatically and optimizes to target CG
- Already loaded positions are discarded for auto-load
- All Checks taken into account

# SABLE Technology

- Database
  - Oracle 18c or higher
- Server Application
  - BEA WebLogic – Websphere - Jboss (Other application servers on request)
  - J2EE and AJB 2.0
- Server Hardware
  - Windows
  - Unix
  - Linux
- Client PC
  - Normal desk top PC specifications - Windows
  - Thin Client technology developed in Java 1.8
  - Uses a JAVA shell not a browser
  - Stand Alone with data synchronisation

# SABLE Operation Modes

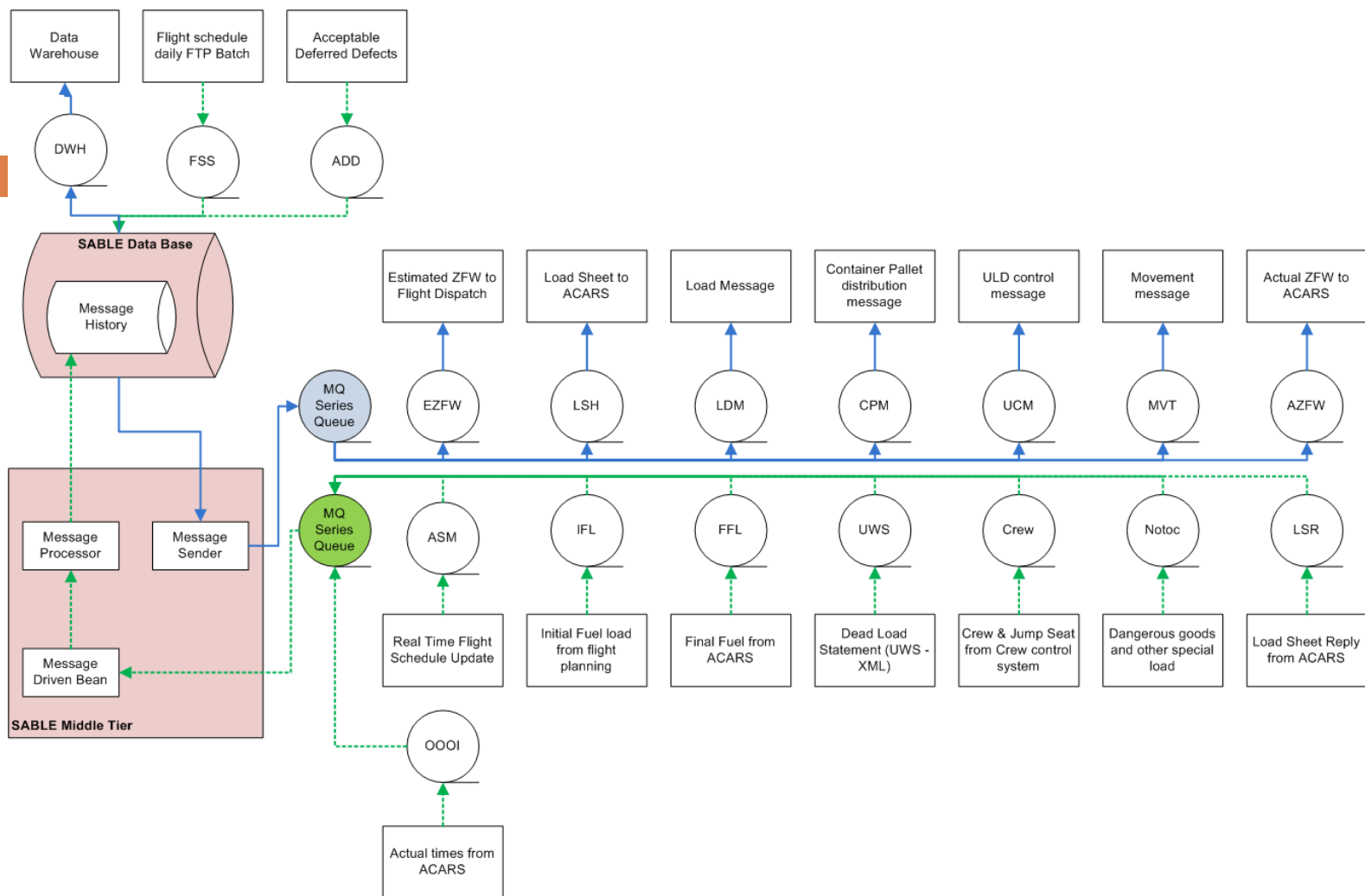


# SABLE Operation modes

- Mode 1: Thin clients connected through LAN or WAN
  - ▣ First installation by means of automatic installer
  - ▣ Automatic upgrade of new software versions
  
- Mode 2: Thin clients with external data feeds
  - ▣ Flight Schedule
  - ▣ Load Information (passengers & cargo)
  - ▣ Fuel – scheduled and actual
  - ▣ Crew information
  - ▣ Etc.

# SABLE Operation modes

- Mode 3: Stand Alone
  - ▣ Installation of Oracle XE required
  - ▣ Automatic synchronization upon connection with server
    - Aircraft parameters
    - Flight data
  - ▣ Automatic upgrade of new software version
- Mode 4: Server installation in Cloud environment
  - ▣ Thin clients run via Citrix
  - ▣ Stand-alone clients update via http
  - ▣ External feeds and outgoing messages only via E-mail





# SABLE Hardware requirements

## □ Oracle Server: Standard edition

- 2 CPU's
- 4 GB memory
- 120 GB storage

Operating system of the server is irrelevant for SABLE

## □ Application Server

- 4 CPU's
- 16 GB memory
- 100 GB storage

Windows or Linux operating system

Websphere, WebLogic, Jboss or WildFly (preferable) possible.

## □ Client

- Windows operating system
- Screen resolution minimum 1024 \* 768
- 4 to 8 GB memory
- 100 GB storage

# SABLE Pricing Model

- License fee : one time only
  - ▣ Use of Software (12 A/C registrations included)
  - ▣ License per additional aircraft registration
- Initial set-up costs
  - ▣ Implementation guide
  - ▣ Aircraft type configuration
  - ▣ Aircraft registration configuration
  - ▣ System configuration
  - ▣ Installation
  - ▣ Training
- Yearly recurring costs
  - ▣ Upgrade subscription
  - ▣ Support
    - Regular support (Belgian business hours)
    - Extended support (24 \* 7)
    - Extended support + Autoload

# THANK YOU FOR YOUR ATTENTION



Kromstraat 50  
2520 Ranst  
Belgium  
Tel: +32 3 470 14 00  
Fax: +32 6 47 14 01

## Contact:

Mr. Karel Tavernier  
Technical Director

## Email:

[Karel.Tavernier@Rekencentra.be](mailto:Karel.Tavernier@Rekencentra.be)