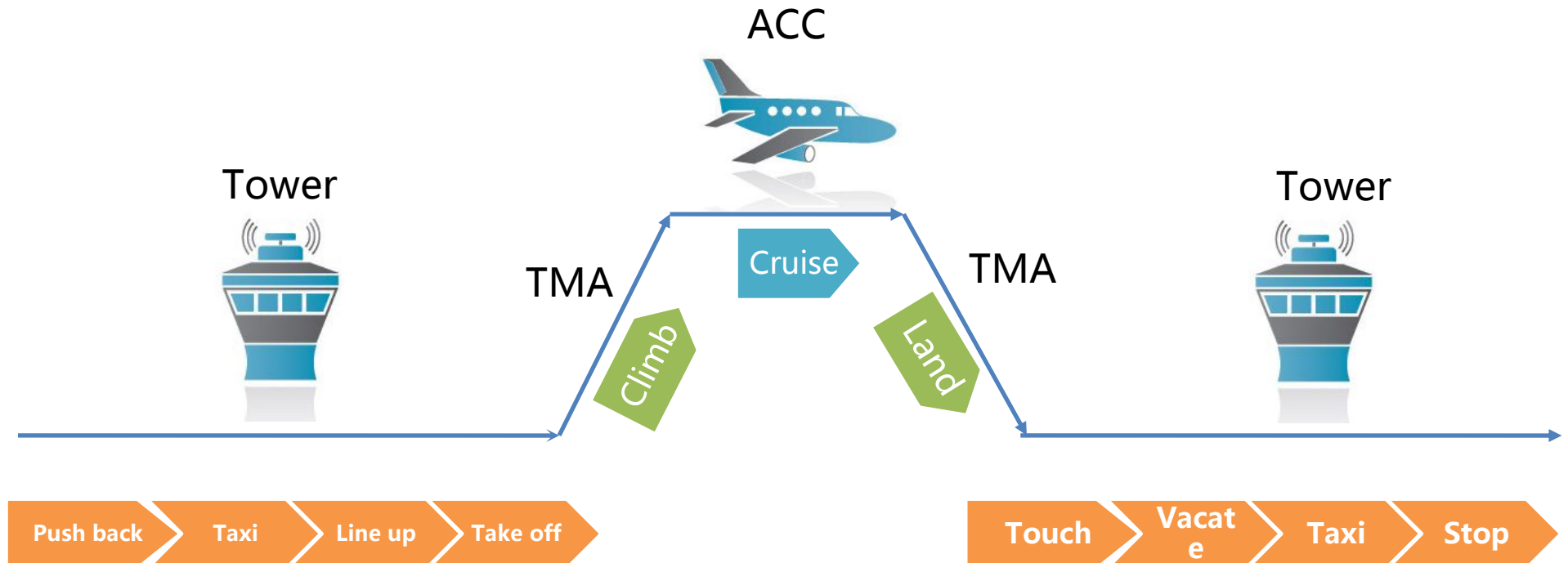




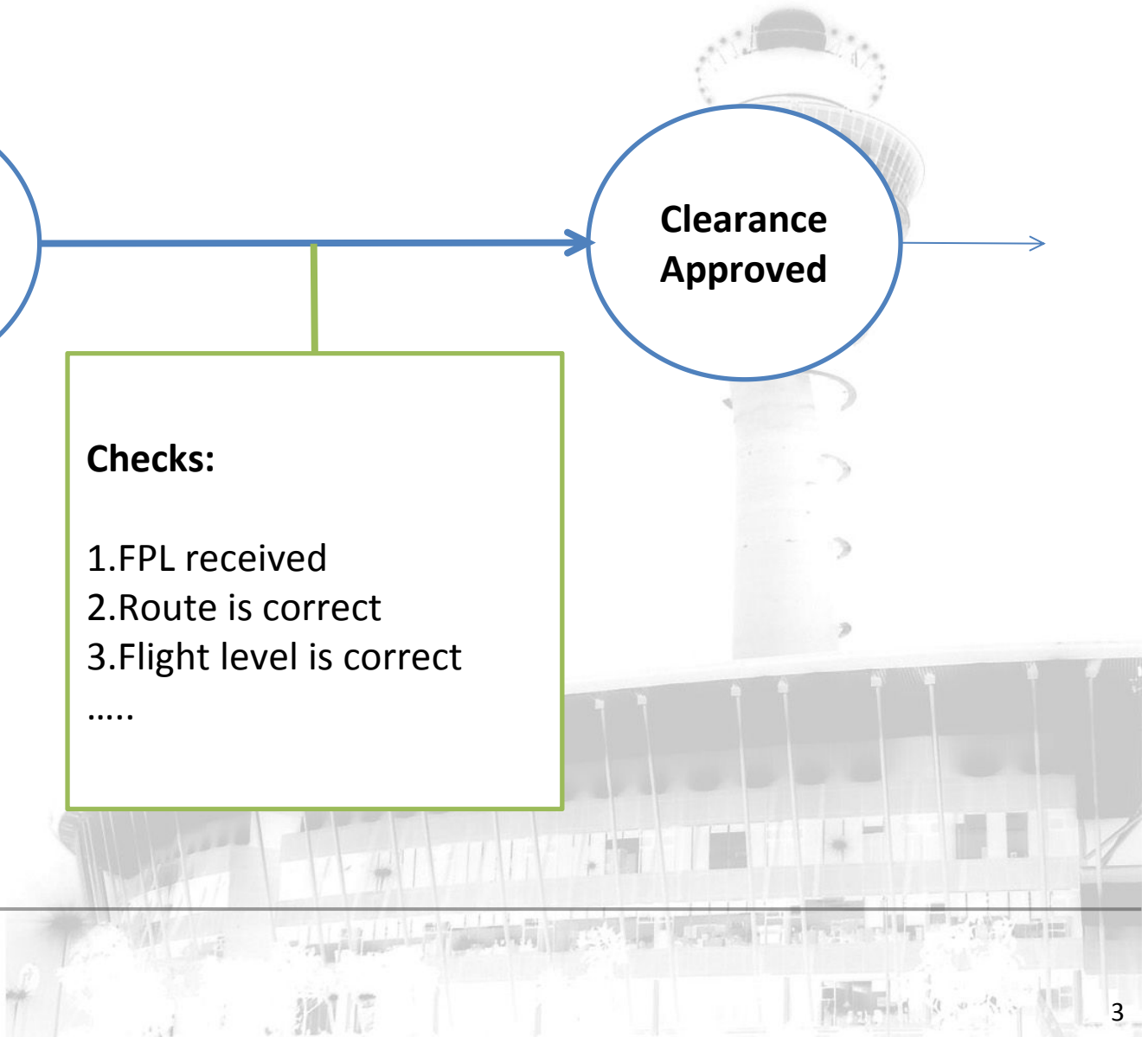
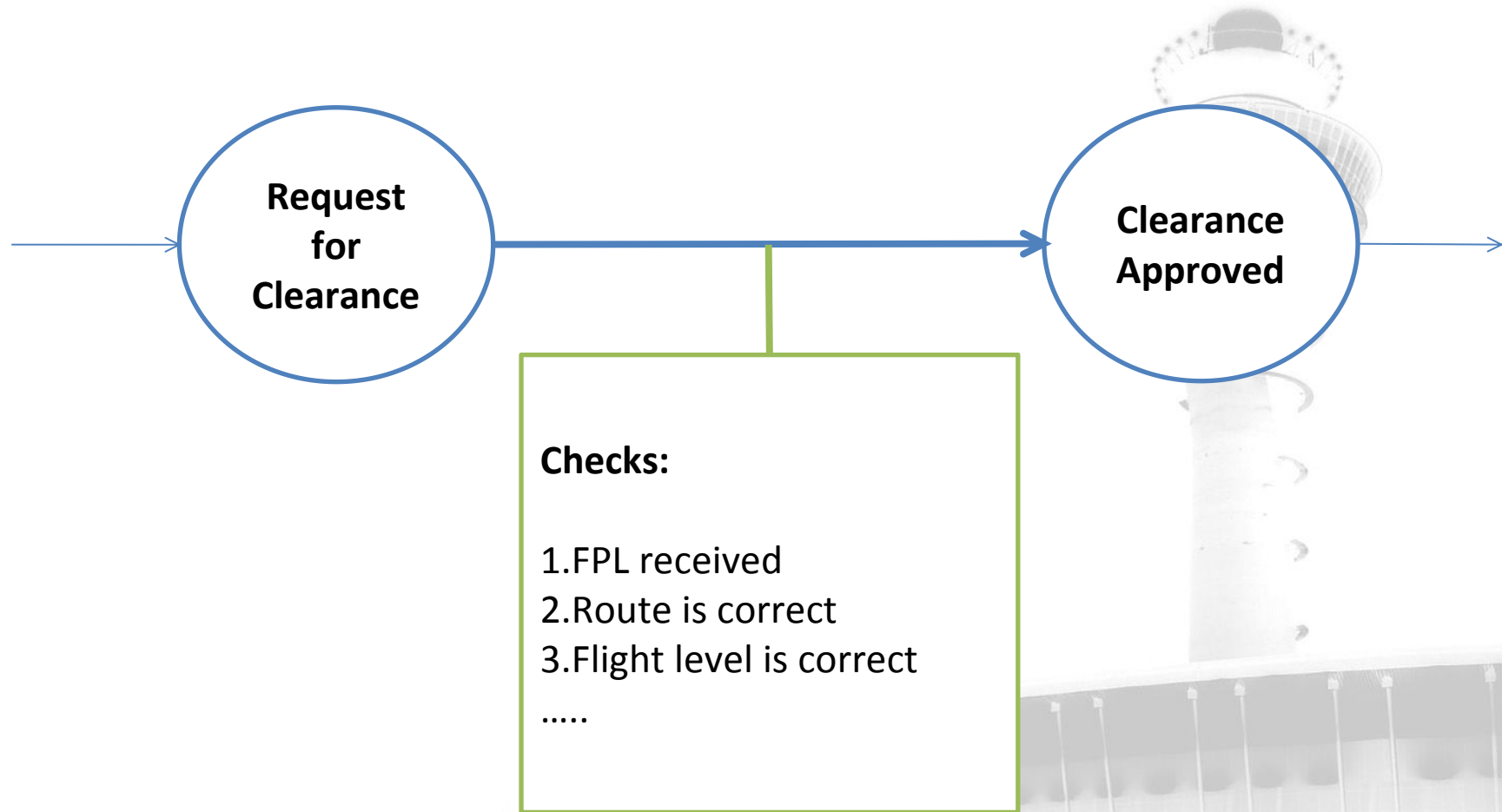
Tower Operation Management System (TOMS) Hu Yuming, China

Background

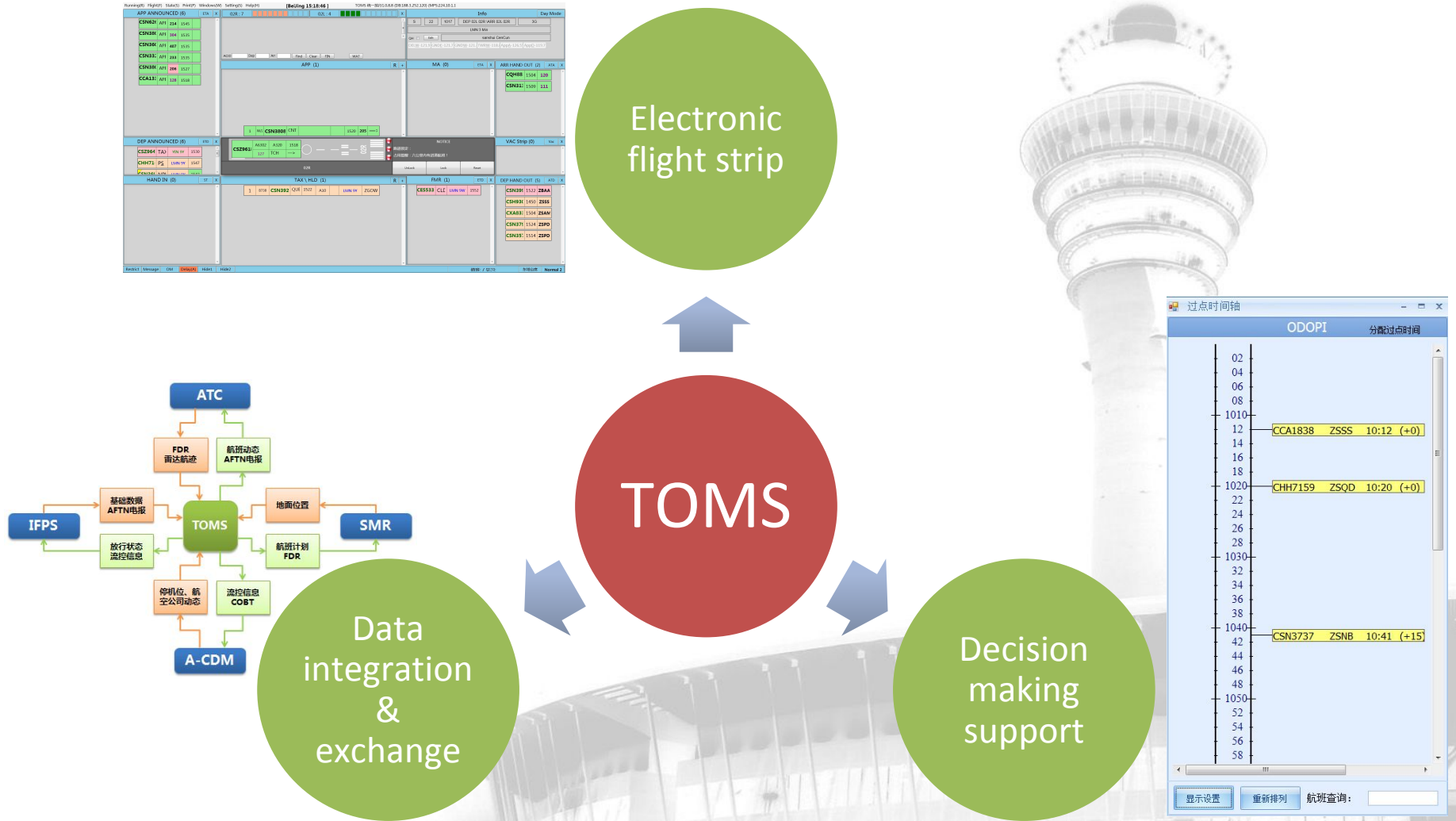
Tower control is one of the most **complex** parts in ATC service. A typical tower control consists of many particular **procedures and steps**.



Finite State Machine Concept



Tower Operation Management System



Goals



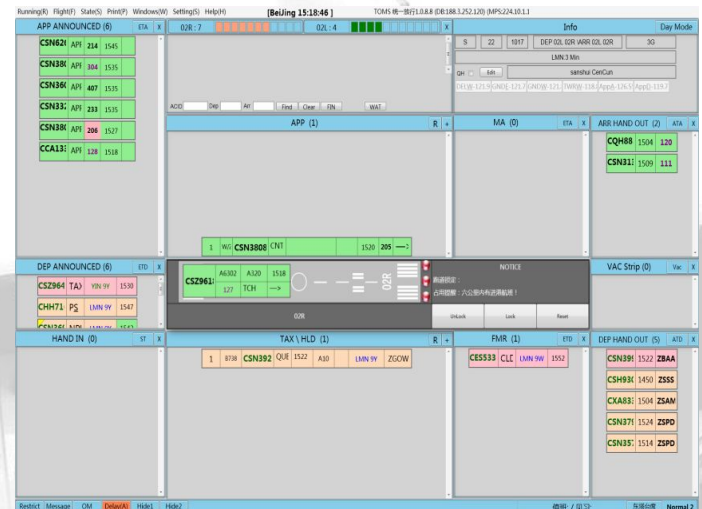
Standardization



Collaboration



Simplification



Flight state definition

CATEGORY	CODE	DESCRIPTION
Departure	FPL	Flight plan has been received by ATC.
Departure	PRE	Pre-Active, usually 30 minutes before EOBT.
Departure	REQ	The Pilot requested a departure clearance to ATC.
Departure	CLD	Departure clearance is approved.
Departure	RDY	The Pilot reported that the flight is ready to push back.
Departure	HLD	The flight is ready, but has to be held at the gate for some reason.
Departure	NPU	The flight is transferred to ground control and wait for push back.
Departure	PUS	The flight is approved to push back.
Departure	STR	The flight is approved to start its engine.
Departure/Arrival	TAX	The flight is approved to taxi out.
Departure/Arrival	STP	The ground control stopped the flight's taxing for some reason.
Departure/Arrival	CRS	The flight is approved to cross a runway during its taxing.
Departure	QUE	The flight has joined a departure queue out of a runway after taxing.
Departure/Arrival	CON	The pilot has made contact with tower control in order to take off or land.
Departure	LIN	The departure flight is approved to enter the runway and line up.
Departure	TAK	The flight is approved to take off.
Departure	ABT	The flight's taking off is aborted for some reason.
Arrival	APP	The flight is in approach control for arrival.
Arrival	LND	The flight is approved to land.
Arrival	TCH	The flight is touching the runway.
Arrival	VAC	The flight is vacating the runway after landing.
Arrival	MSA	The flight has missed its approach.
Arrival	TNG	The flight has touched the runway, but failed to land successfully and needs to pull up again.
Departure/Arrival	FIN	All works finished. The flight is out of tower's control.



Controller operation

Running(R) Flight(F) State(S) Print(P) Windows(W) Setting(S) Help(H) [Beijing 17:28:01] TOMS 1.0.8.6 (DB:188.3.4.60) (MPS:188.3.4.60)

Info Day Mode

P 30 1004 DEP 20L 20R VARR 20L 20R L 2G

J=OPEN

GND#-121.75 GND#-121.85 TW#-118.1 TW#-118.8 App#-119.6 App#-126.55

20L : 1 20R : 1

2 REQ

1 PRE

3 CLD

4 HLD

To Next Position

CSN	Time	Origin	Destination	Status
CSN3817	1630	ZSOF	GY12	PRE
CSN3083	1635	VRMM	307	PRE
CCA1722	1635	ZSHC	123	PRE
CSN387	1710	W111	102	PRE
CXA8348	1715	ZSFZ	227	PRE
CCA8232	1720	ZHHH	115	PRE
CSN365	1720	WMKK	108	PRE
CAL522	1730	RCTP	104	PRE
CCA4302	1730	ZUUL	113	PRE
CES5308	1730	ZSSS	228	PRE
CSN3707	1735	ZSJD	203	PRE
CSN3858	1735	ZGOW	236	PRE

Seq	W/Z	CSN	CLD	Origin	Time	Destination	Status
1		CSN3877	ZSFZ	1635	A320	1723	900 P
2		CSN3877	ZSFZ	1635	A320	1723	900 P
3		CSN3113	CLD	ZBAA	1700	YIN 9X	20R 218
4		CSN3346	CLD	ZHHH	1705	YIN 9X	20R 222
5		CSN339	CLD	RKSI	1705	LMN 9Z	20L 108
6		CSN3703	CLD	ZBYN	1705	YIN 9X	20R 202

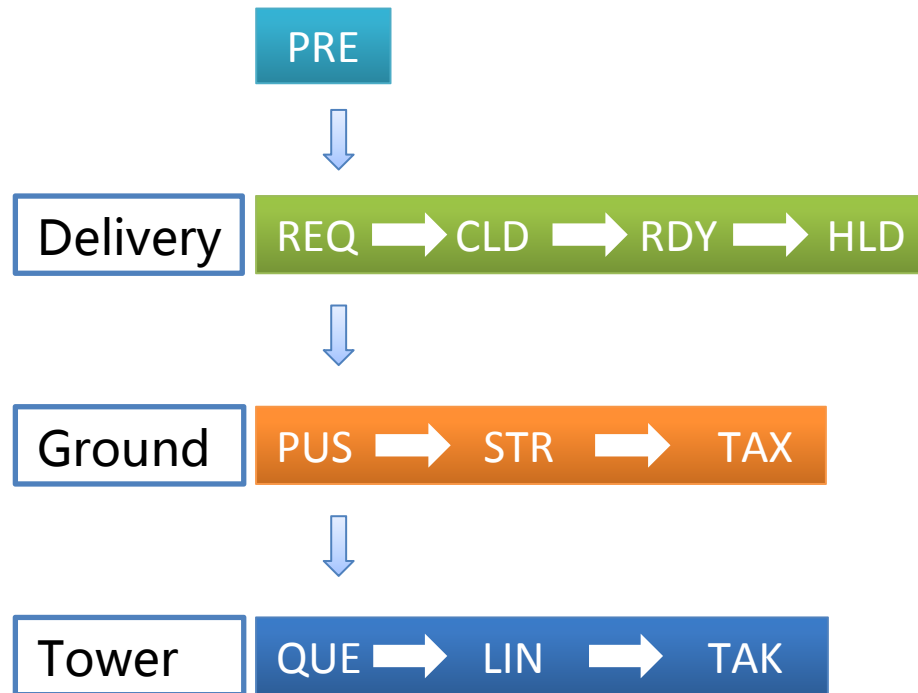
Seq	W/Z	CSN	RDY	Origin	Time	Destination	Status
1		CSN3429	RDY	ZUNC	1635	1723	YIN 9X 20R 405
2		CSN3877	RDY	ZSFZ	1635	1723	LMN 9Z 20L 202
3		CSZ9621	RDY	ZSNJ	1733	1723	LMN 9Z 20L 126
4		CSN6262	RDY	ZYTL	1739	1723	LMN 9Z 20L
5		CSN3501	RDY	ZSHC	1745	1723	LMN 9Z 20L 201
6		CSN363	RDY	VTBS	1740	1723	VIB 9X 20R 301
7		CES5256	RDY	ZSCN	1751	1723	LMN 9Z 20L 232
8		CSN6322	RDY	ZYTL	1757	1723	LMN 9Z 20L 209

CSN	Time	Origin	Destination	Status
CSN3376	1012	ZGHA		
HDA783	1026	VHHH		
CSN345	1024	ZBAA		
CSN3899	1023	ZSCG		
CSN3803	1635	ZSHC		
CHH7343	1029	ZSCN		

Restrict Message OM Delay(A) Hide1 Hide2

值班: / 见习: 西放行席 Normal

Flight States (Departure)



PRE : PRE Active

REQ : Request clearance

CLD : Clearance approved

RDY : Flight ready

HLD : Gate Hold

PUS : Push back

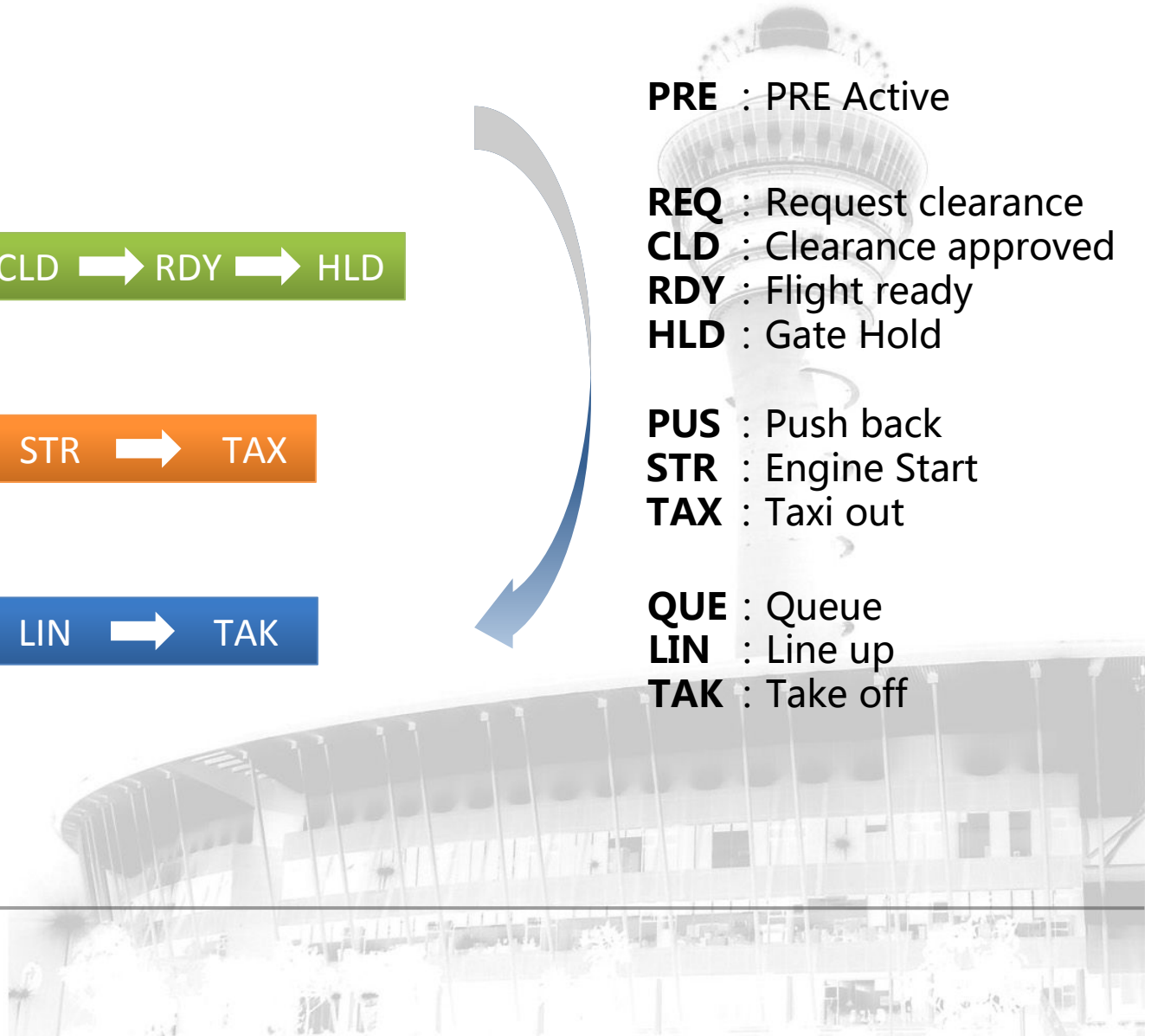
STR : Engine Start

TAX : Taxi out

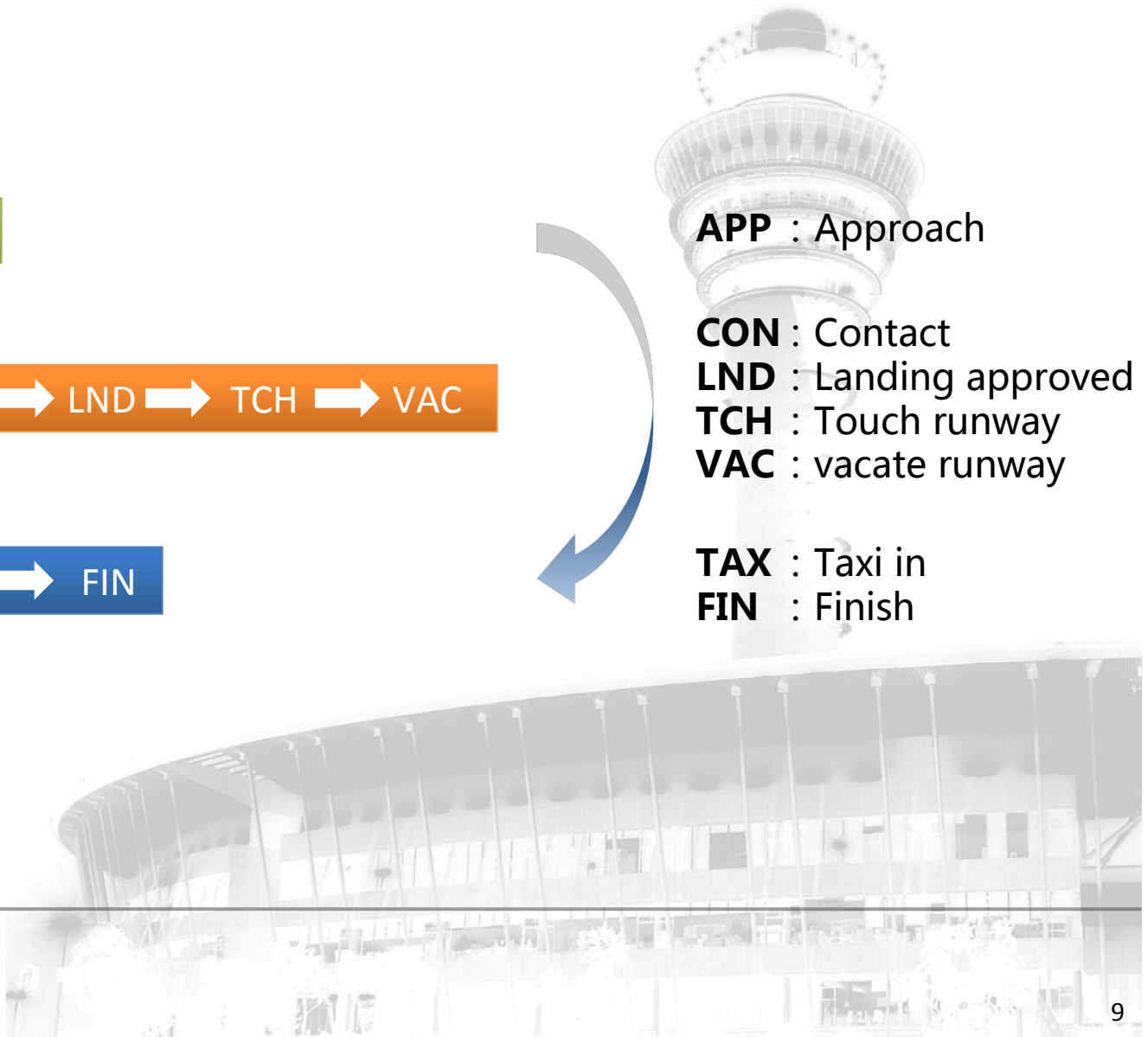
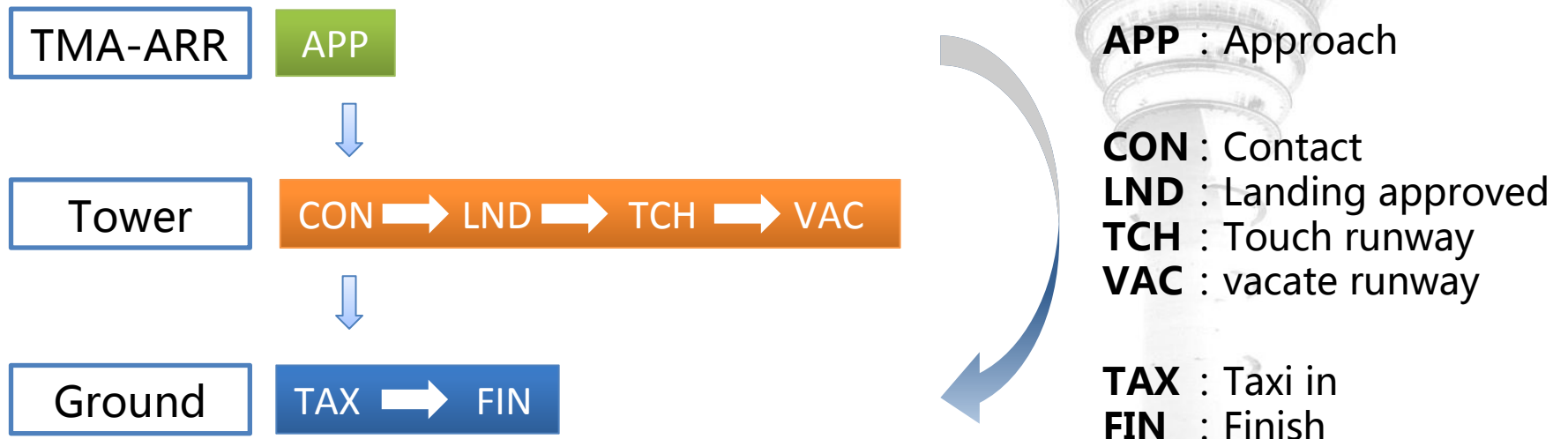
QUE : Queue

LIN : Line up

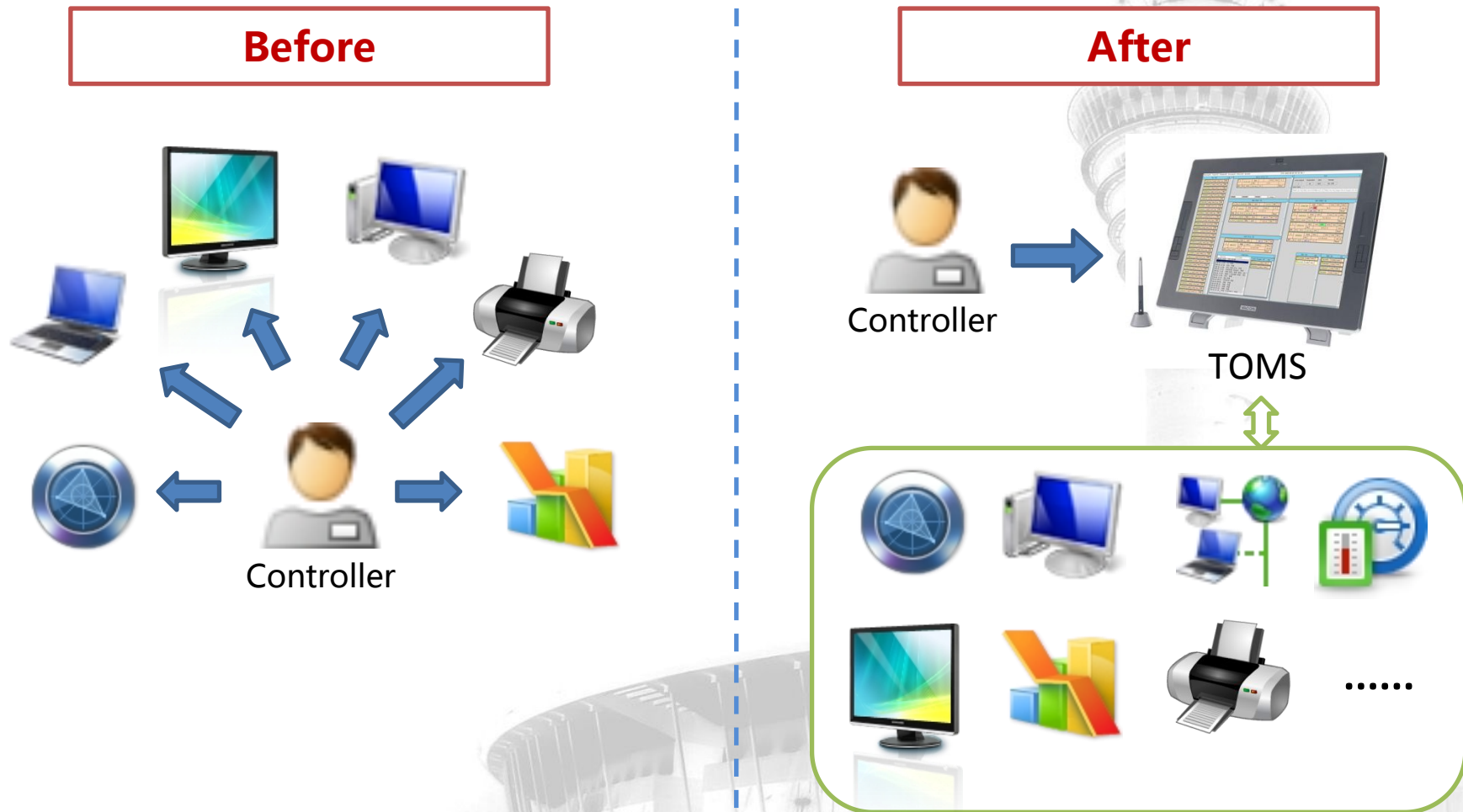
TAK : Take off



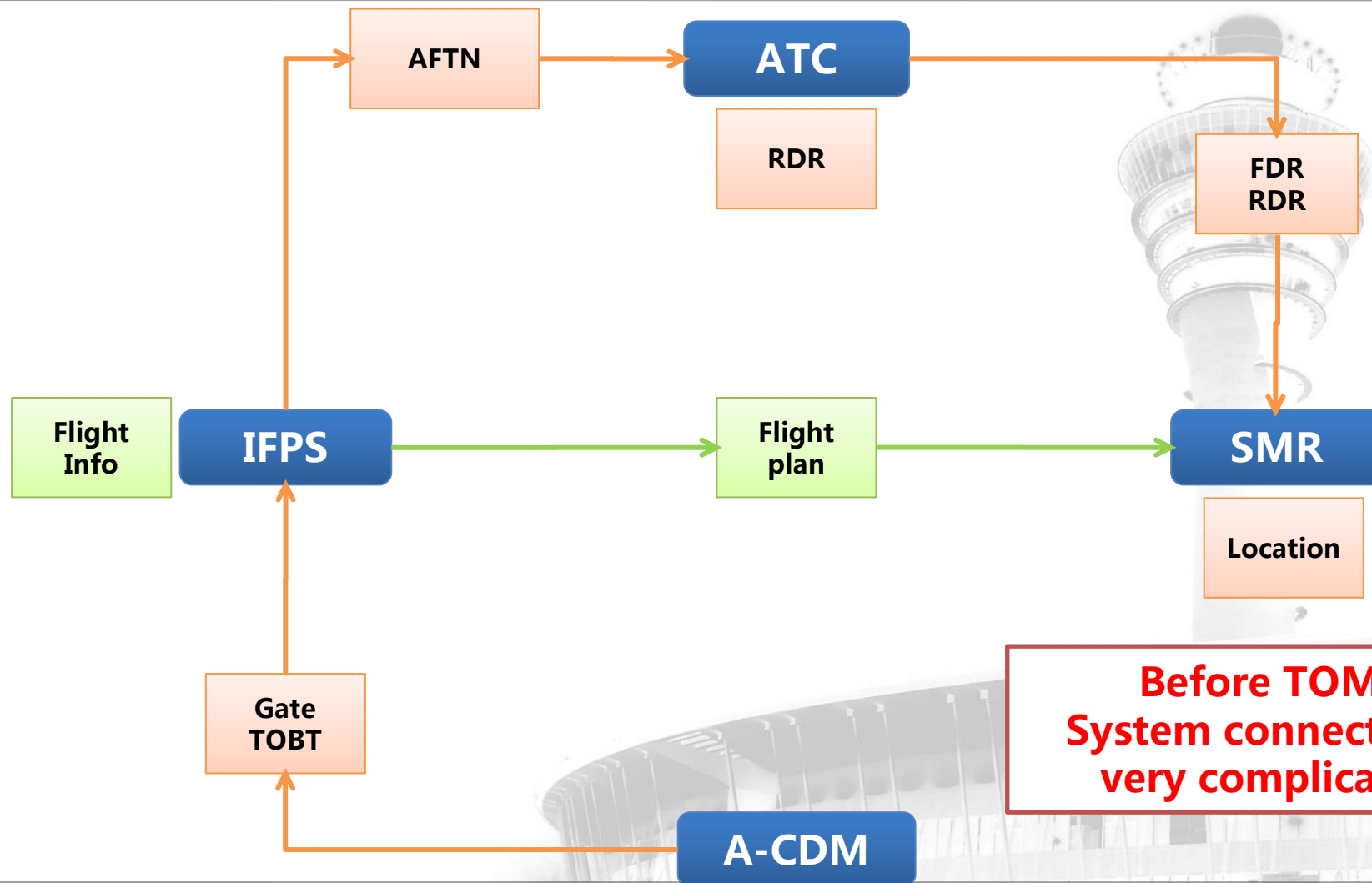
Flight States (Arrival)



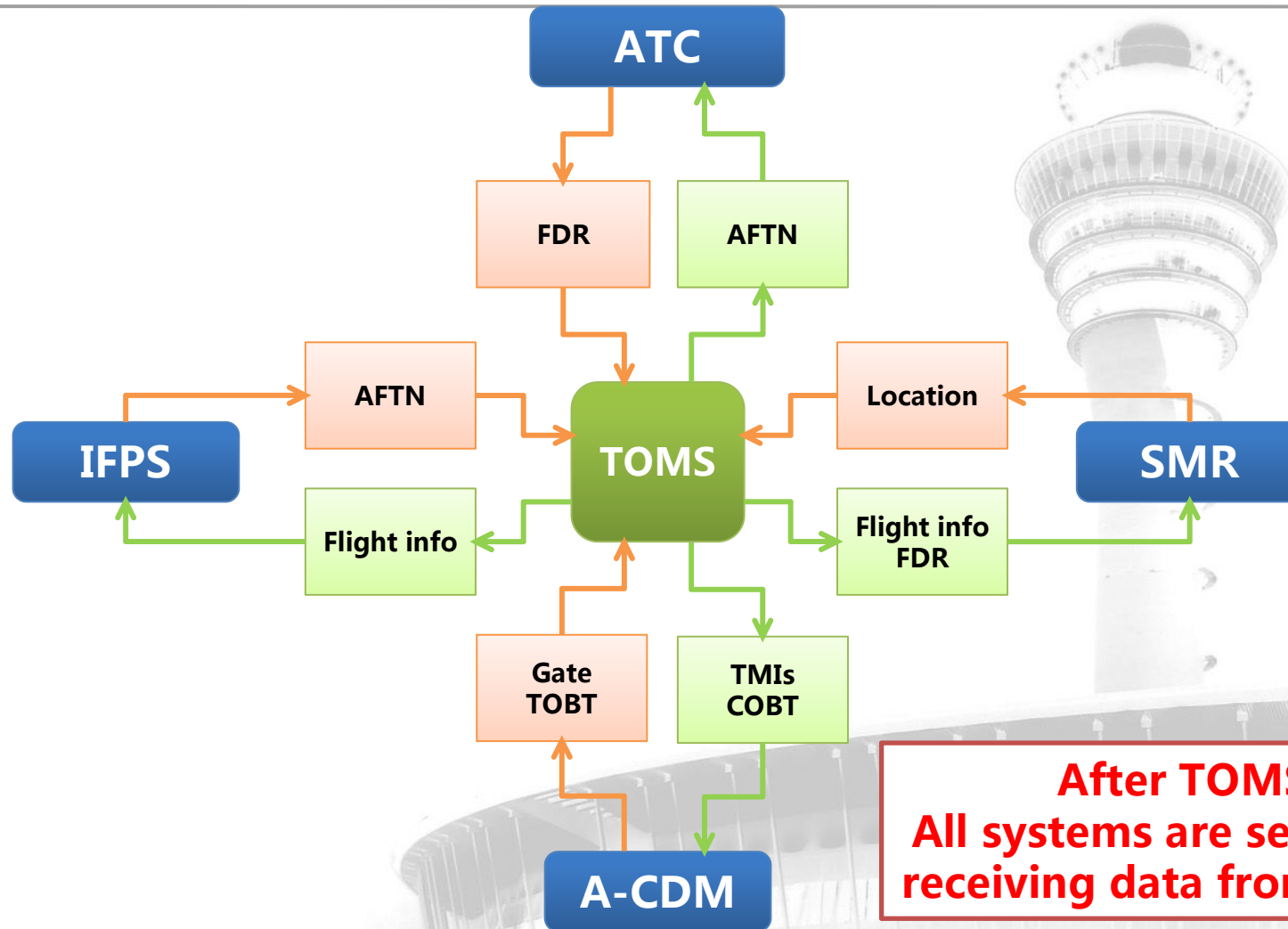
Data Integration & Exchange



Data Integration & Exchange



Data Integration & Exchange



D-ATIS

CSN3956 CLEARANCE DELIEVERY

ACID	ARR	MIS	ETD	RFL	STATE:	PRE
CSN3956	ZGSZ	W/Z	2225			
TYPE	REG	FPL ROUT				
A320	B6687			不具备RNAV能力		
ATIS	RUNWAY	SID	SELECT SID			
N	09	SK-01D	SK-01D			
INA	QNH	SSR	FREQUENCY	GATE		
900	1009	A 1267	119.15	1		

CLD By DCL CLEARANCE DELIEVERY CLOSE

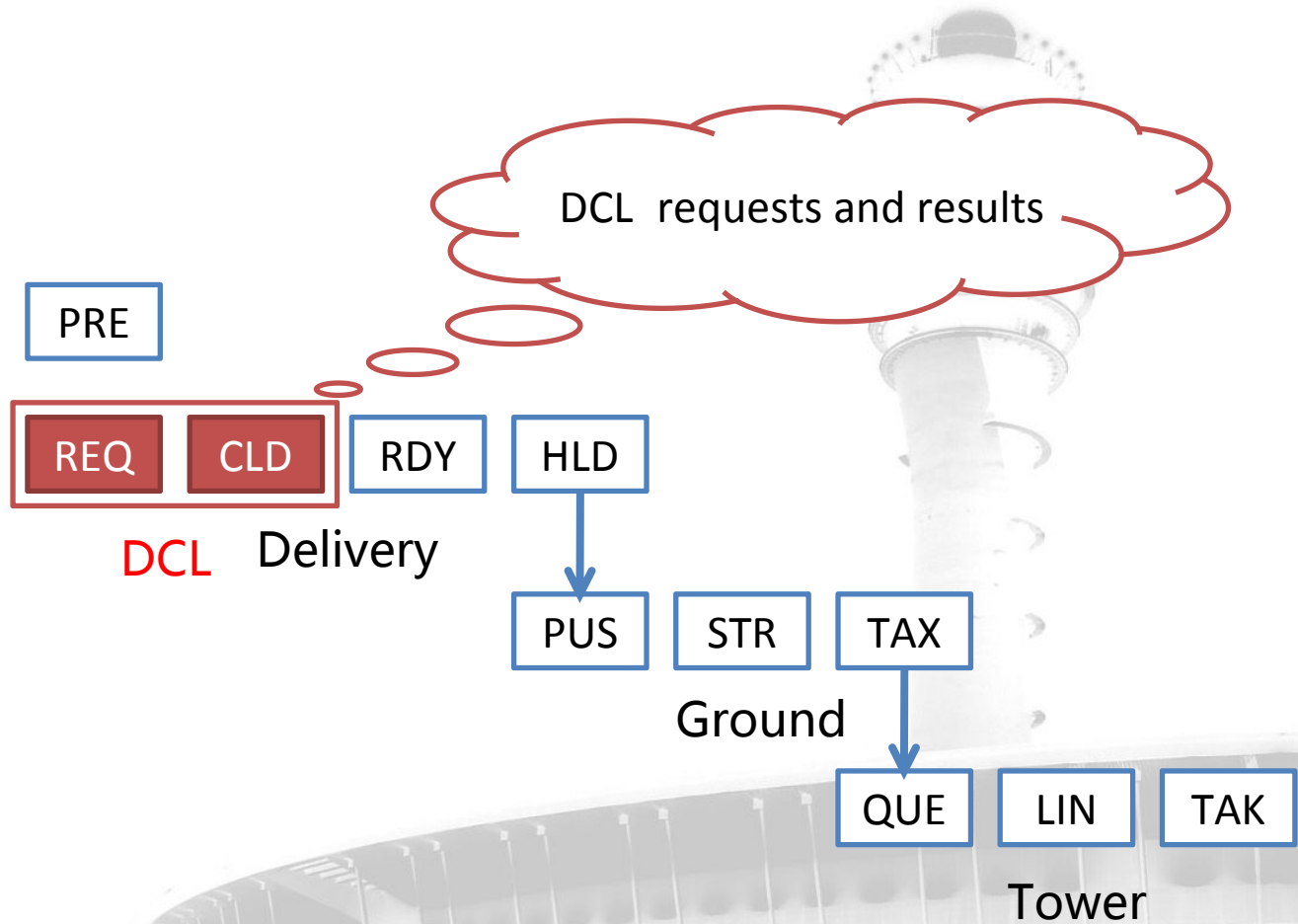
ATIS info



DCL



Pilot



Departure Management

The screenshot displays a flight departure management interface with several key components:

- 东跑道 (East Runway):**
 - 进港 (Arrivals):** A list of flights including ALK882, CCA1317, CSN3098, CCA1837, CCA8231, CSN3636, CSN3070, CSN351, and CSN3532, each with their respective flight numbers, destinations, and times.
 - 出港 (Departures):** A list of flights including CSZ9487, CSN3917, CSN3501, CQH8856, CSN3503, CSN6262, CSN3817, and CDG1170, with their destinations and times.
- 西跑道 (West Runway):**
 - 进港 (Arrivals):** A list of flights including CES5305, CSN3534, and CSN6785.
 - 出港 (Departures):** A list of flights including CSZ9649, CSN3331, CSC8734, CCA4350, CHH7785, CSN3135, GIA899, CSN363, CSN3380, CSZ9755, CSN3925, CES2609, CCA1392, and CSN3394.
- 算法设置 (Algorithm Settings):**
 - 算法选择:** 进港优先 (Arrival Priority).
 - 调试 (Debug):** 单步排序 (Step-by-step sorting), 全部排序 (Full sorting), 结束 (End).
 - 连续运行 (Continuous Operation):** 开始 (Start), 停止 (Stop).
 - 排序规则 (Sorting Rules):**
 - 东跑道 (East Runway):** 生效时间 (Effective Time), 可以起飞 (Can Take Off), 连续起飞 (Continuous Take Off), 可以降落 (Can Land), 连续降落 (Continuous Landing), 交叉起降 (Crossed Take and Land).
 - 西跑道 (West Runway):** Similar settings as the East Runway.
- Eurocat - 进港 (Eurocat - Arrivals):** A console window showing real-time status for various flights, including distances and Estimated Time of Arrival (ETA) for radar and flight deck (FDR).

Departure management subsystem generates sequence & shows the result in electronic flight strip



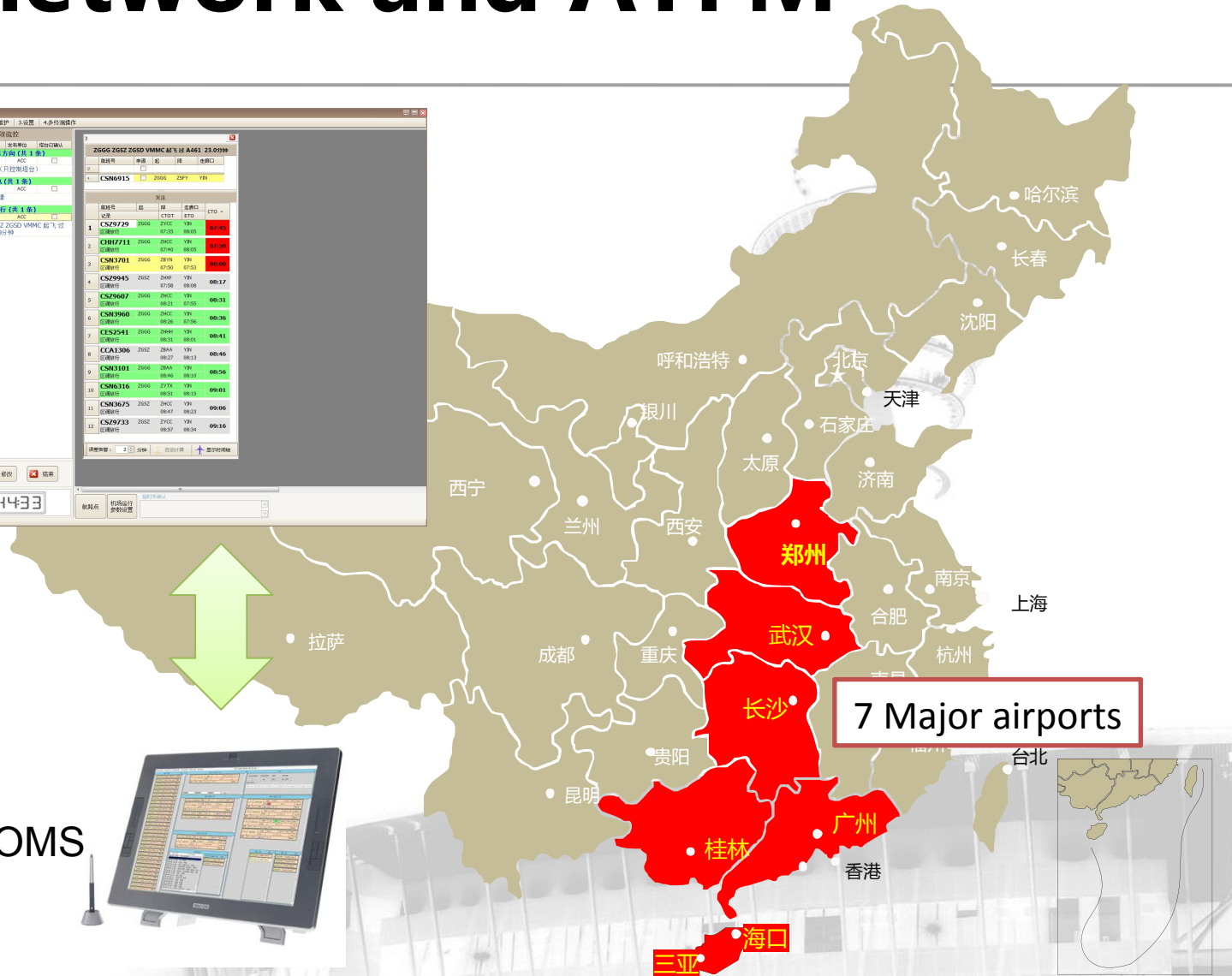
TOMS network and ATFM

Regional
ATFM
network

航班号	机型	起飞	落地	状态	CTOT	LTOT	CTD
ZGGG ZGGG VMHC 航班 A461 23.0919							
CSN6915	ZGGG	ZSPY	YWH				
CHH711	ZGGG	ZHCC	YWH	07:50			
CSN3701	ZGGG	ZHCC	YWH	07:50			
CSZ9945	ZGGG	ZHCC	YWH	07:50			
CSZ9607	ZGGG	ZHCC	YWH	08:17			
CSN3960	ZGGG	ZHCC	YWH	08:31			
CSZ2541	ZGGG	ZHCC	YWH	08:36			
CCA1306	ZGGG	ZHCC	YWH	08:41			
CSN3101	ZGGG	ZHCC	YWH	08:46			
CSN6316	ZGGG	ZHCC	YWH	08:50			
CSN3675	ZGGG	ZHCC	YWH	09:01			
CSZ9733	ZGGG	ZHCC	YWH	09:06			
				09:16			



Tower TOMS



7 Major airports

Thanks !

