ICAO

中国民用航空局
空中交通管理局
Air Traffic Management Bureau. CAAC

Transition of Shanghai ATM Automation System

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NanJing, 2018-11-22

1. Background

2. Challenges and Solutions

3. Conclusions and Suggestions

Background

NESACC

Three Fully Integrated Air Traffic Control Centres

BEIJING
- 18 En-Route Suites
- 5 Terminal Approach (TMA) Suites
- 6 Simulator Suites
- 1 Tower & 1 Remote Suite
- Software Support Facility (4 Suites)

SHANGHAI
- 22 En-Route Suites
- 4 Terminal Approach (TMA) Suites
- 6 Simulator Suites
- 2 Tower Suites

GUANGZHOU
- 24 En-Route Suites
- 6 Terminal Approach (TMA) Suites
- 6 Simulator Suites

- Total of 530 Computers
- 224 Operational & Technical Positions

NESACC Program

Contract: 2001.09

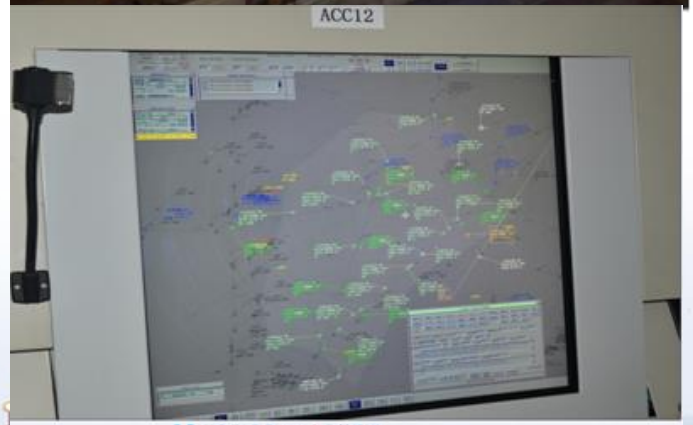
BeiJing ACC: 2004.12
Shanghai ACC: 2005.08
GuangZhou ACC: 2005.11

TianJin(TCU of BeJing): 2008.4
HeFei(TCU of ShangHai): 2008.1

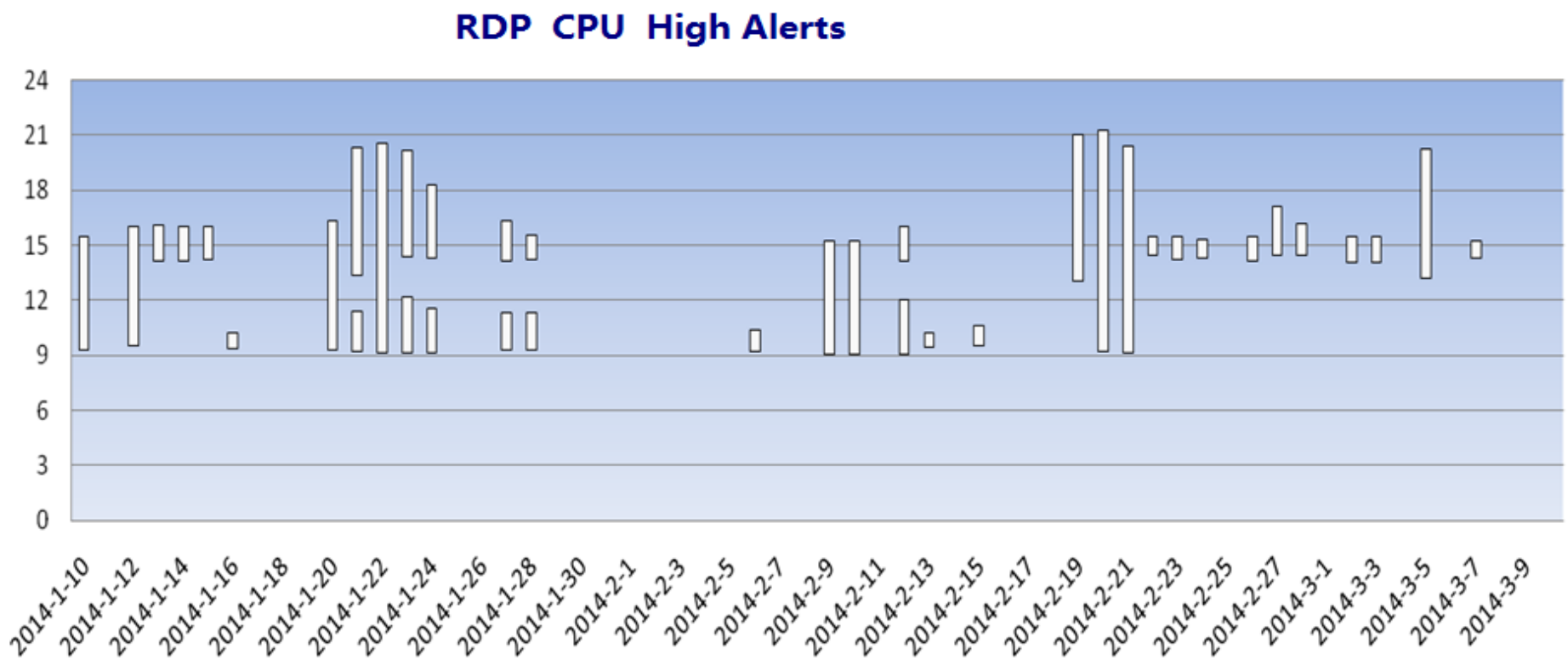
70%+ Air Traffic of China

1.2 Background--Why

- Rapid Air Traffic Growth
- Capacity and System Load
- New Operational Requirements
- Hardware Issues
- New Technologies
- ……



1.2 Background--Why



1.2 Background--What

NESACC EUROCAT-X Upgrade Program (NEUP)
2011.7.28

NESACC EUROCAT-X Hardware Upgrade Program (NEHUP)
2013.7.31

Purposes

1. Increased Capacity
2. New Requirements
3. New Technologies
4. New Hardware (>60%)

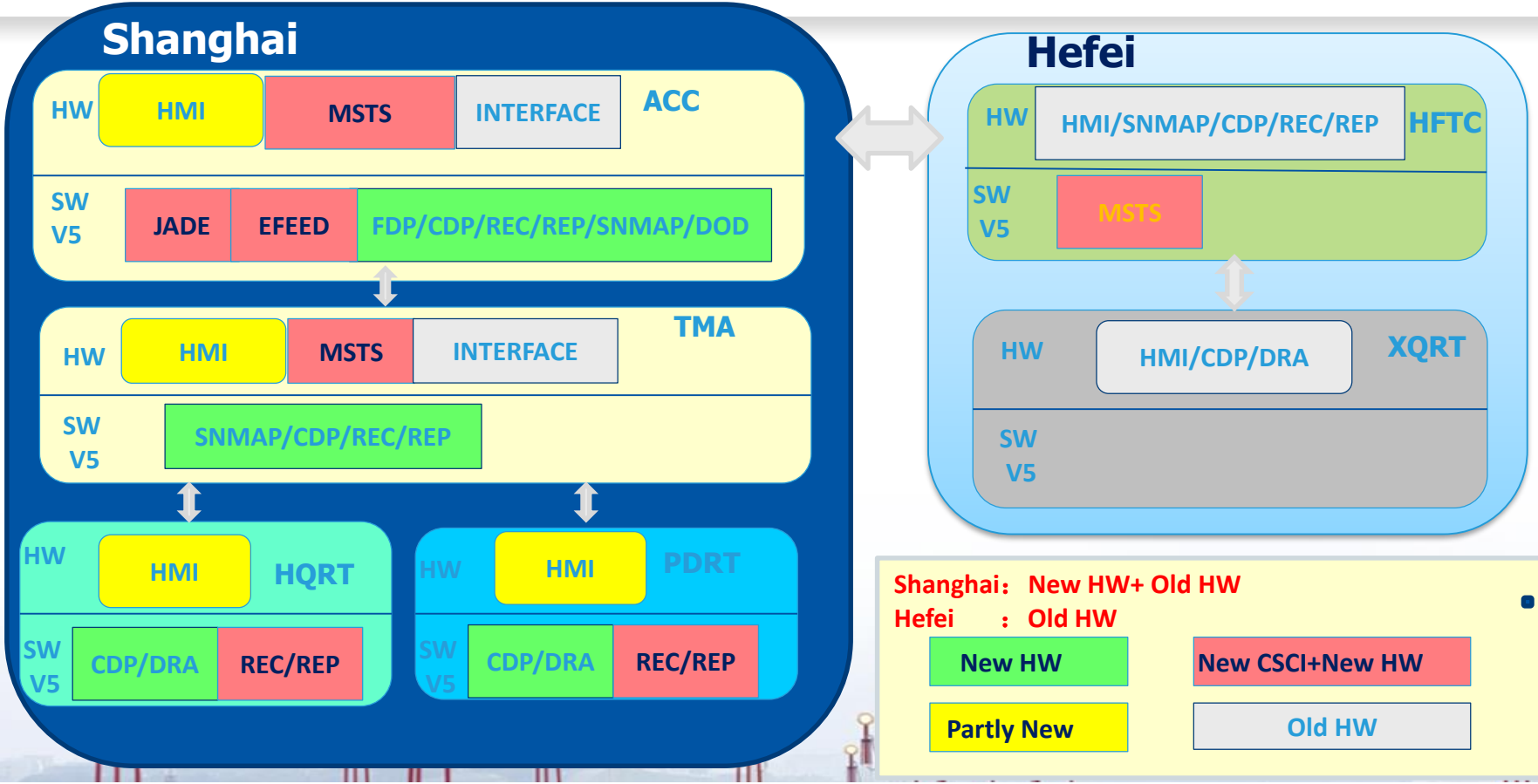
NEUP

1. The most advanced Eurocat-X Product version （V5）
2. Linux based architecture
3. New ECRs;
4. New interfaces and new CSCIs(MSTS, JADE, eFEED)

NEHUP

1. New hardware
   DS10-DL380 G8,HP Z420
   uline->pline
   Enterasys->Cisco
2. ICAO 2012 Doc. 4444

1.2 Background-How



1.3 Situation of Transition

Urgent

Reach maximum capacity (eg. RDP CPU load more than 70%)

No free position for new sector(119 HMIs of 120)

The transition must be done before the summer season (June)

Complex

Totally new software baseline + some new hardware + some old hardware

Transition at the same position

1.3 Situation of Transition

Difficult

- **2 Cities**
- **5 Sites**
- **5 Systems (The "new" , the old , backup system, HeFei "new" ,backup system)**
- **10+ Departments**
- **10+ related interfaces or systems（AIDC,CDM,SMR,EFS,BILL…）**

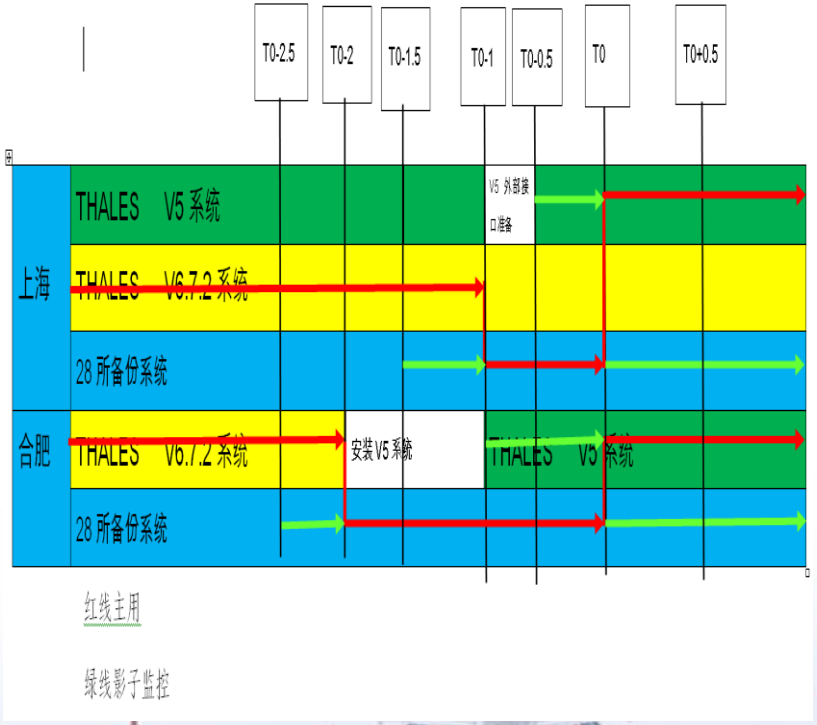
Risky

- **Uncertainty of the new software(126 +118 PCRs)**
- **Large scale system (12 partitions, 300+ servers,119 HMIs)**
- **5000+ flights per day (800 fights in rush time)**
- **Transition overnight, no Shadow (pseudo shadow)**
- **No referential experiences for similar projects**

1.4 Transition Period

- Preparation (2015.1.4 ~ D0)
- Transition (D0 ~ D0+7days)
- Stable Operation (D0+8 ~ D0+30days)

D0 Transition day



1.5 Prerequisite of Transition(D0)

Human (confidence)
Training: Controllers/Technicians
Evaluation: familiar with all changes

The new system(V5)
Sufficient testing
Stable and reliable

Other related systems
Sufficient testing
No impact on normal operation

Management preparation
New procedures and documents

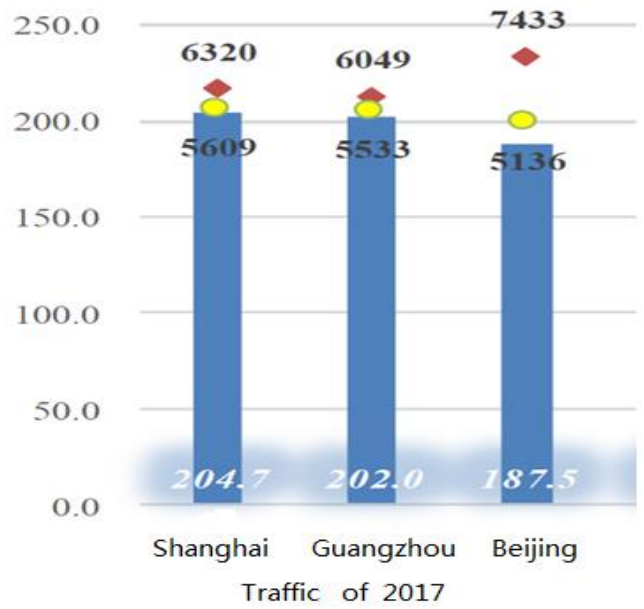
D0:
2015.6.2

1.6 After Transition

Shanghai+HeFei: 2015.6.2

Guangzhou: 2015.11

Beijing+TianJin: 2016.4



Traffic of 2017

1. Background

2. Challenges and Solutions

3. Conclusions and Suggestions

2 Challenges and Solutions

Challenge 1 : A slight move in one part may affect the situation as a whole.

- **The automation system is the key part of the whole ATM operation**
- **10+ related departments**
- **10+ related systems**
- **100+ major tasks**
- **500+ detailed procedures**

2 Challenges and Solutions

Challenge 1： A slight move in one part may affect the situation as a whole.

Solutions: pursuing delicacy management, focusing on details

- **Transition plan (11 revised versions, 20,000 + words)**
- **Work breakdown (schedule date for each task, responsibilities to each person)**
- **Standard phrases + predefined steps for all (precise + save time)**

2 Challenges and Solutions

Challenge 1： A slight move in one part may affect the situation as a whole.

4	自动化协调岗在 Thales V6.7.2 detach 4 路专线 AIDC 和 GRIB 链路；	技保中心
5	技术主任通知网络公司（20900） （通报用语：将 Thales V6.7.2 外接信号切换到 Thales V5） 请网络公司将 Thales V6.7.2 上的 GRIB，AIDC(上海到北京、广州、台北和青岛)信号切换到 Thales V5。请网络公司完成切换后与技保电话确认；	技保中心/网络公司
6	自动化协调岗在 Thales V5 attach 4 路专线 AIDC，GRIB 链路，并确认链路正常；	技保中心
7	技术主任通知转报(27921) （通报用语：开启老前置的模拟 AIDC 功能） 打开老前置上海与北京，广州，台北，青岛，济南 AIDC 协议的模拟 EST 开关。	技保中心/网络公司
8	技术主任通知气象中心(27560) （通报用语：重发 GRIB 数据） 技术主任通知气象中心(27560)重发 GRIB 数据，自动化协调岗在 V5 FDX	技保中心/气象中心

Every step is covered in the procedure checklist

2 Challenges and Solutions

Challenge 2 : Race against the clock

- **No shadow period before transition**
- **Must complete transition over one night**
- **No impact on normal operation of the next day(New system & other related systems)**

2 Challenges and Solutions

Challenge 2 : Race against the clock

Solutions:

- Detailed procedures, covered every step
- 6 rehearsals ,keep improving
- Redesign connection , switch among systems within second

make perfection more perfect

2 Challenges and Solutions

Challenge 2： Race against the clock

Solutions:

- Resort the whole procedures:
  - Steps must be done in order
  - Steps can be done in parallel
  - Steps can be done ahead
- Exact time of each step/command
- Reasonable rollback time

		Generate	Distribute
编译并发布上海离线数据	HQBY		(10S)
	HQRT		(10S)
	PDBY		(10S)
	PDRT		(10S)
	SHBY		(10S)
	SHER		(30S)
	SHTM		(45S)

注：Generate 时每个分区的.AIF、.ACF 文件会更新到现在时
DISTRIBUTE 时会自动生成 NEW_DATA 目录，HQRT、PDRT 只发 CDP 的 CENTRAL 目录

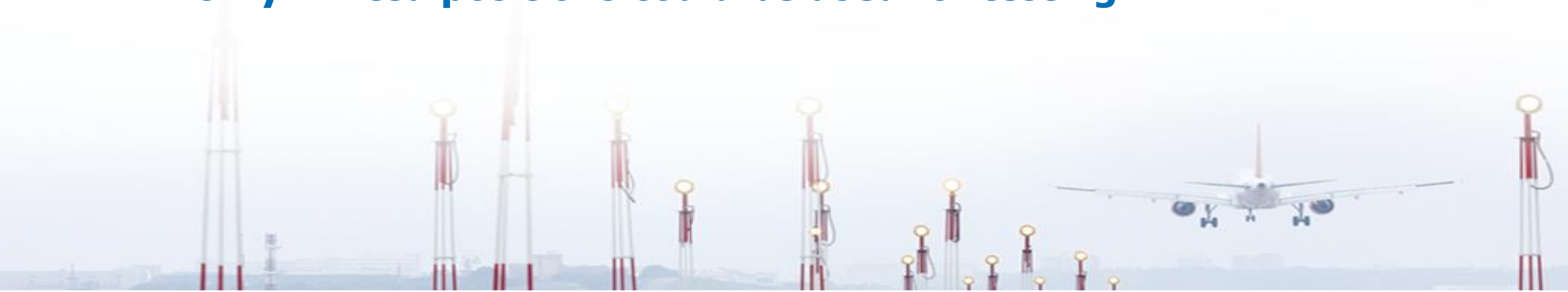
	check_central.sh	check_central_oper.sh	check_oper.sh

Transition time reduced from 9 to 2 hours

2 Challenges and Solutions

Challenge 3 : The "new" system must be stable and reliable enough to support the full scale operation

- **5000+ flights per day, 800+ system tracks at the same time**
- **5 new software versions**
- **118 new PCRs created after SAT**
- **Only limited positions could be used for testing**



2 Challenges and Solutions

Challenge 3 : The "new" system must be stable and reliable enough to support the full scale operation

Solutions:

- **Testing**, testing, testing, hundreds of test cases, test tools to simulate complicated environment
- **Problem by problem**, analyzation and evaluation
- Coordination ,**expert** dedicated on site efficient
- Rehearsals with **backup system**

Both systems must be reliable

2 Challenges and Solutions

Challenge 4 : Technicians and controllers needed to be confident

- More than 10% HMI differences
- New functionalities
- New CSCIs

2 Challenges and Solutions

Challenge 4 : Technicians and controllers needed to be confident

Solutions

- Set up some extra new positions besides the operational ones
- Prepare knowledge checklist
- Theoretical training + practical training
- testing and evaluating one by one, only qualified technicians and controllers could be on duty again

Knowledge + practice + skills = confidence

2 Challenges and Solutions

Challenge 5 : How to respond in case of system failure after transition?

- maintain the same operational level , especially in rush hours
- decision making plan , rollback?
- Limited "shadow", synchronization among systems

2 Challenges and Solutions

Challenge 5 : How to respond in case of system failure after transition?

Solutions

- contingency plan, scenarios , different level of failure in different partition result in different emergency response, improved after rehearsals
- develop special tools to synchronize information among systems
- Conference everyday (Wechat & internal network meeting etc.)
- Workaround to avoid triggering software bug

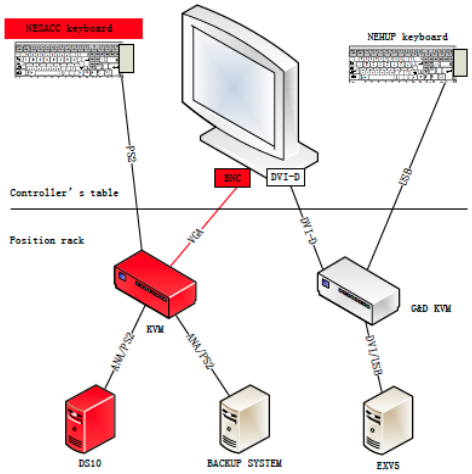
Well prepared plans reduce risk in emergency

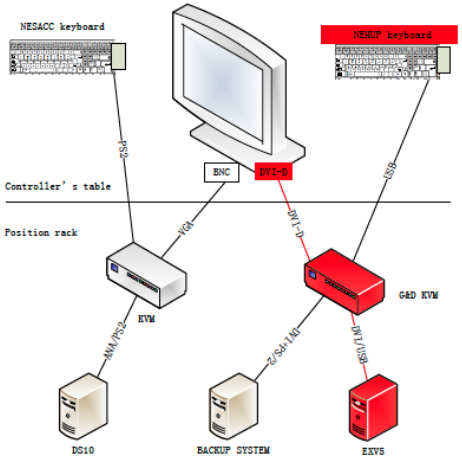
2 Challenges and Solutions

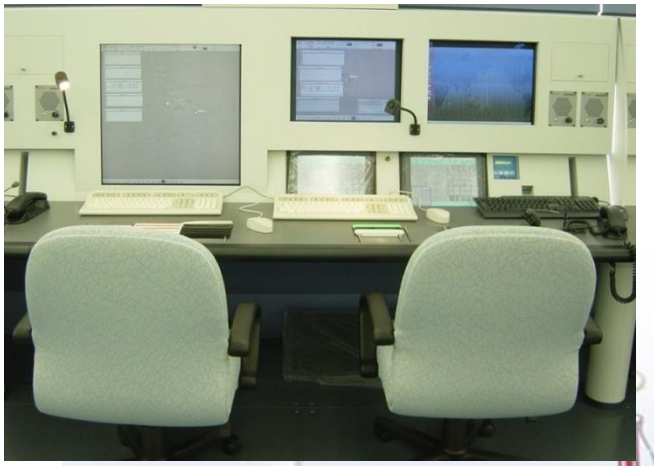
Challenge 5 : How to respond in case of system failure after transition?

Solutions

Switching plan among the 3 systems, switch within second







1. Background

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3. Conclusions and Suggestions

3 Conclusions and Suggestions

- Targeting date needs to be set , but can't be fixed. **Safety is the key factor.**
- Problems are not scary, the worst thing is we don't know what is the risk. There are more ways than problems. **Sufficient tests and rehearsals** are necessary. The more problems found ahead, the safer the future operation is.
- **Details** determine success or failure.(Checklist, standard phrases)

3 Conclusions and Suggestions

- **Confidence** of the technicians and controllers on site is very important. A man of skill is bold, can response calmly in emergency.

- Feasible **contingency plan** and reliable **backup system** are necessary in case of system failure.

Hope for the best, prepare for the worst

3 Conclusions and Suggestions

Suggestions

1. Avoid online transition, which is much more complicated and risky than real physical transition.

2. The scale of each ATC center/automation system needs to be controlled .Balance between efficiency and safety. Industry and CNS providers cooperate to define data exchange standard among ATC related systems.

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