



移动通信网络设备的 高可用性平台设计

李程远



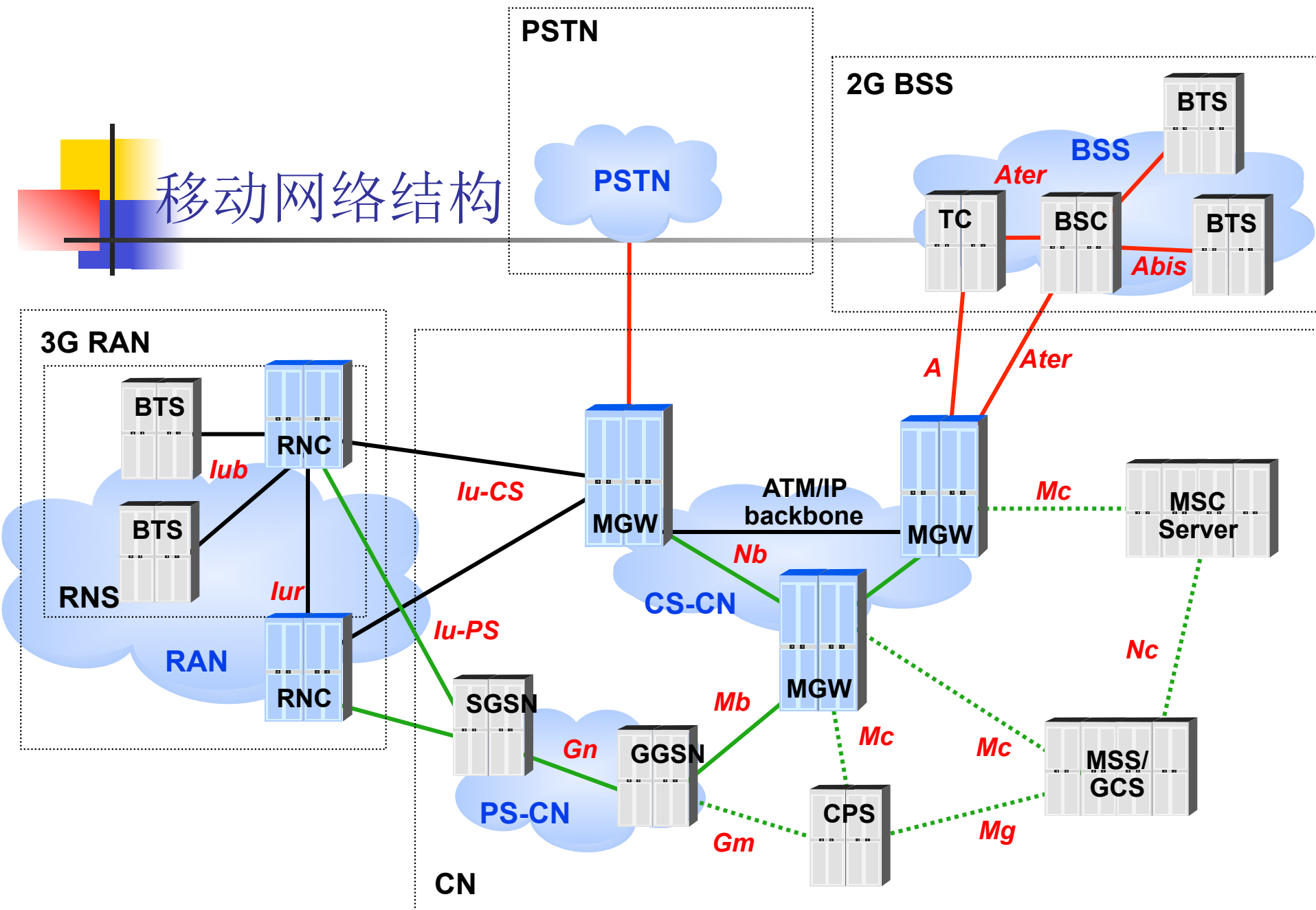
纲要

- 移动网络结构与网元设备
- 高可用性在移动网络设备中的含义
- 高可用性平台的设计
 - 系统冗余备份模型
 - 内部消息的冗余机制
 - 网络与传输
 - 存储系统
 - 过载保护与残留资源的清理
 - 系统升级

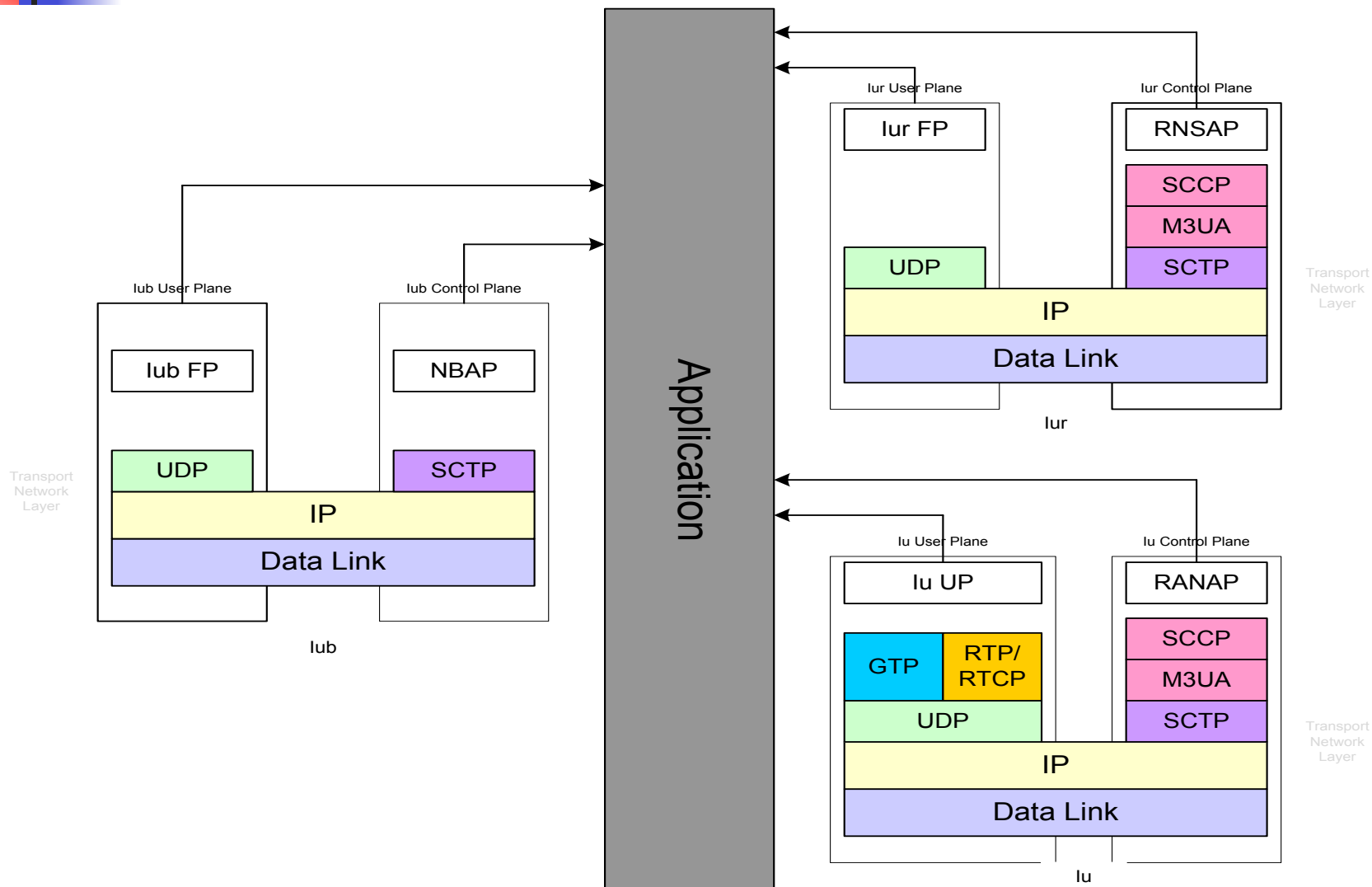
移动网络结构与网元设备



移动网络结构



3GPP 用户平面与控制平面的协议栈





相关术语解释

- **NE (Network Element, 网元)**

According to Telecommunications Act of 1996, the term `network element' means a facility or equipment used in the provision of a telecommunications service. Such term also includes features, functions, and capabilities that are provided by means of such facility or equipment, including subscriber numbers, databases, signaling systems, and information sufficient for billing and collection or used in the transmission, routing, or other provision of a telecommunications service.

- **UE (User Equipment, 用户设备)**

UE is any device used directly by an end-user to communicate. It can be a hand-held telephone, a laptop computer equipped with a mobile broadband adapter, or any other device

- **RAN (Radio Access Network, 无线接入网)**

Conceptually, it resides between a device such as a mobile phone, a computer, or any remotely controlled machine and provides connection with its core network (CN). RAN types: GRAN (GSM RAN), UTRAN (UMTS RAN).

- **CN (Core Network, 核心网)**

It is the central part of a telecommunication network that provides various services to customers who are connected by the access network. One of the main functions is to route telephone calls across the PSTN.



相关术语解释

- Interfaces

- Uu, The radio interface between the UE and the BTS.
- Iub, The interface between BTS and RNC.
- Iu, The interface connects RAN and CN
 - Iu-CS, Iu interface Circuit Switched
 - Iu-PS, Iu interface Packet Switched
- Iur, The interface between RNCs, for soft handover.

- User Plane (用户平面)

All information sent and received by the user, such as the coded voice in a voice call or the packets in an Internet connection, are transported via the User Plane.

- Control Plane (控制平面)

It's for all control signalling, includes the application protocol (e.g. RANAP in Iu, RNSAP in Iur and NBAP in Iub), and the signalling bearer for transporting the application protocol messages.

- Management Plane (管理平面)

The management plane carries the operations and administration traffic required for network management.

Network Element



Cabinet / rack

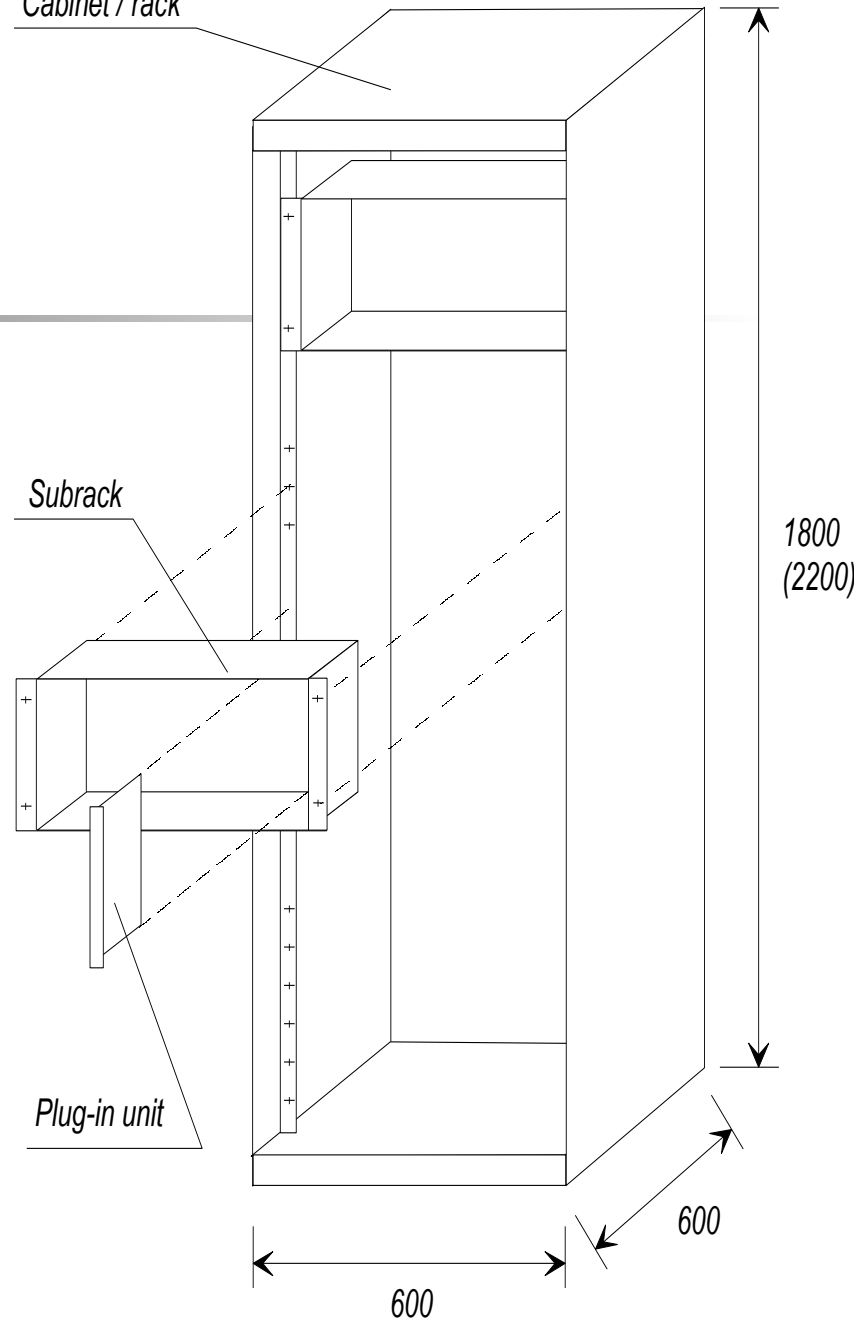
Subrack

Plug-in unit

1800
(2200)

600

600



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<http://www.picmg.org/v2internal/newinitiative.htm>

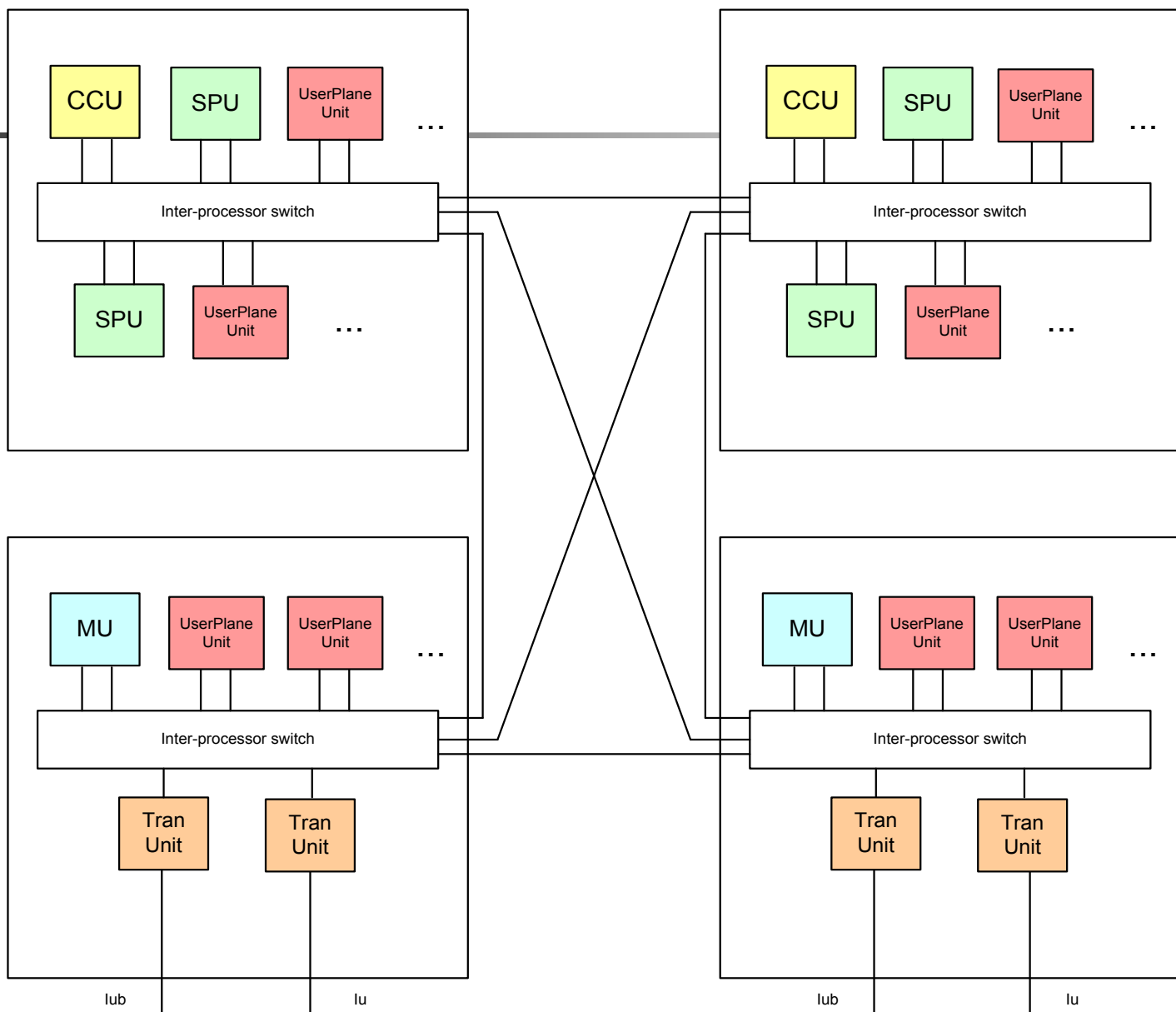


Figure 1

Rack-mount Box



一个网元中不同的功能模块



— User Plane Traffic

— Signaling Traffic

SPU (Linux Node)

RANAP

NBAP

IPC

UPU (DSP or SE Node)

RRC

RLC

MAC

FP

IU UP

IPC

IPC

SCCP

M3UA

SCTP

RTP

GTP

UDP

IP/IPSec

Tran Unit (Linux Node + HW Accelerate)

Iu

IPC

SCTP

UDP

IP/IPSec

Tran Unit (Linux Node + HW Accelerate)

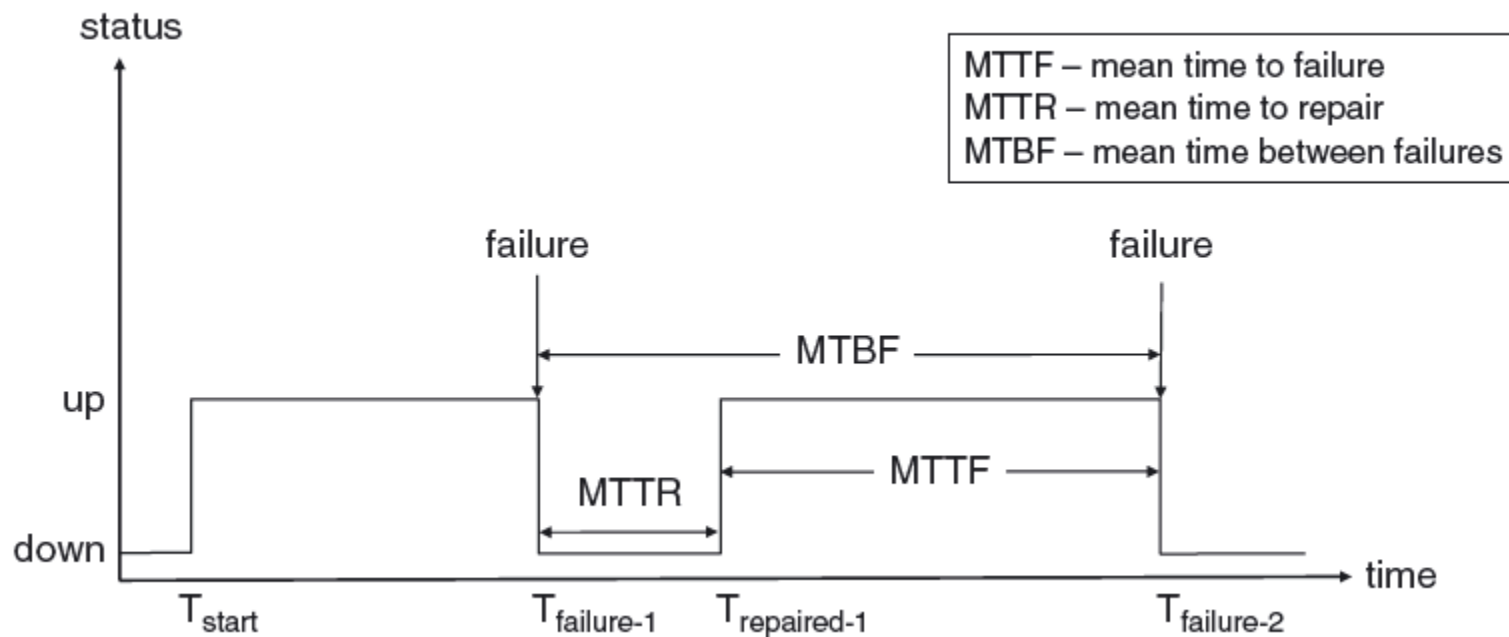
Iub



高可用性在移动网络设备中的含义

五个九的要求

- $MTTF/MTBF = MTTF/(MTTF + MTTR) = 99.999\%$
一年中停机时间最多**5分15秒**





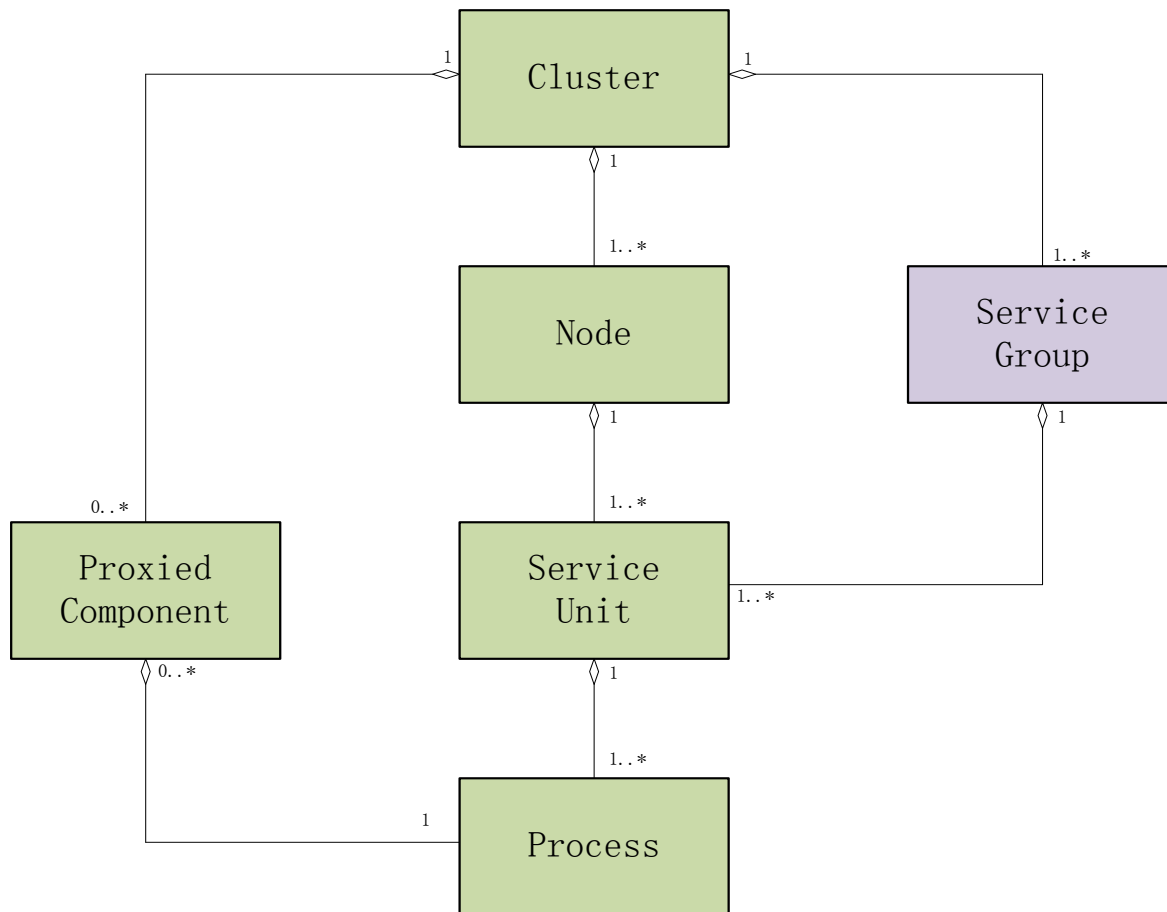
不同服务的可用性

- 用户平面
- 控制平面
- 管理平面



高可用性平台的设计

系统冗余备份模型





系统冗余备份模型

- SG(Service Group) Redundance Model
 - 2N
 - Active/Hot Standby.
 - N+M
 - Active/Cold Standby
 - N-Way Active
 - Active, Loadsharing
 - No Redundancy

State Model

(ITU-T X.731)

Administrative State

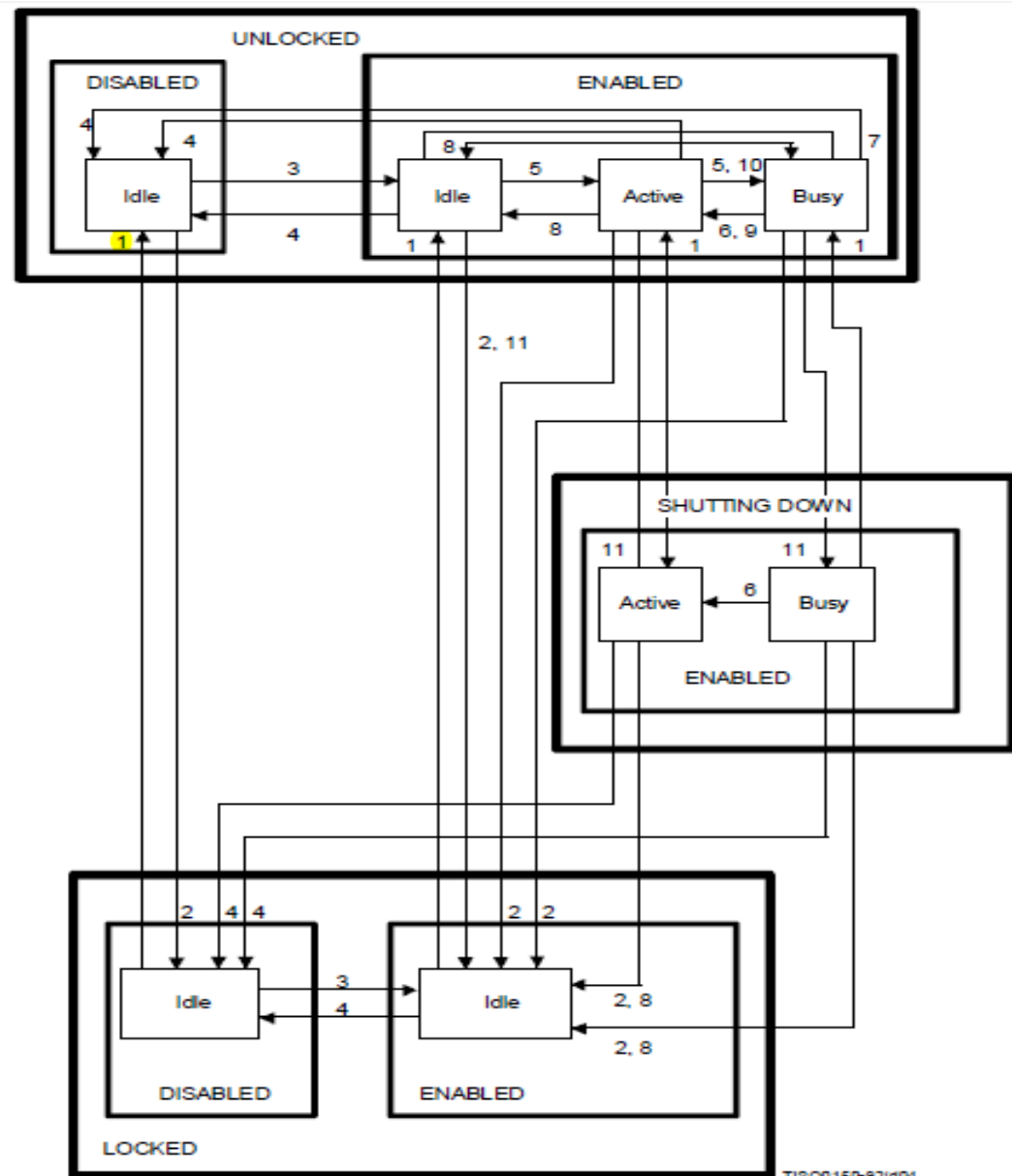
- Locked/Unlocked/
Shutting Down.

Operational State

- Enable/Disable

Usage State

- Idle/Active/Busy



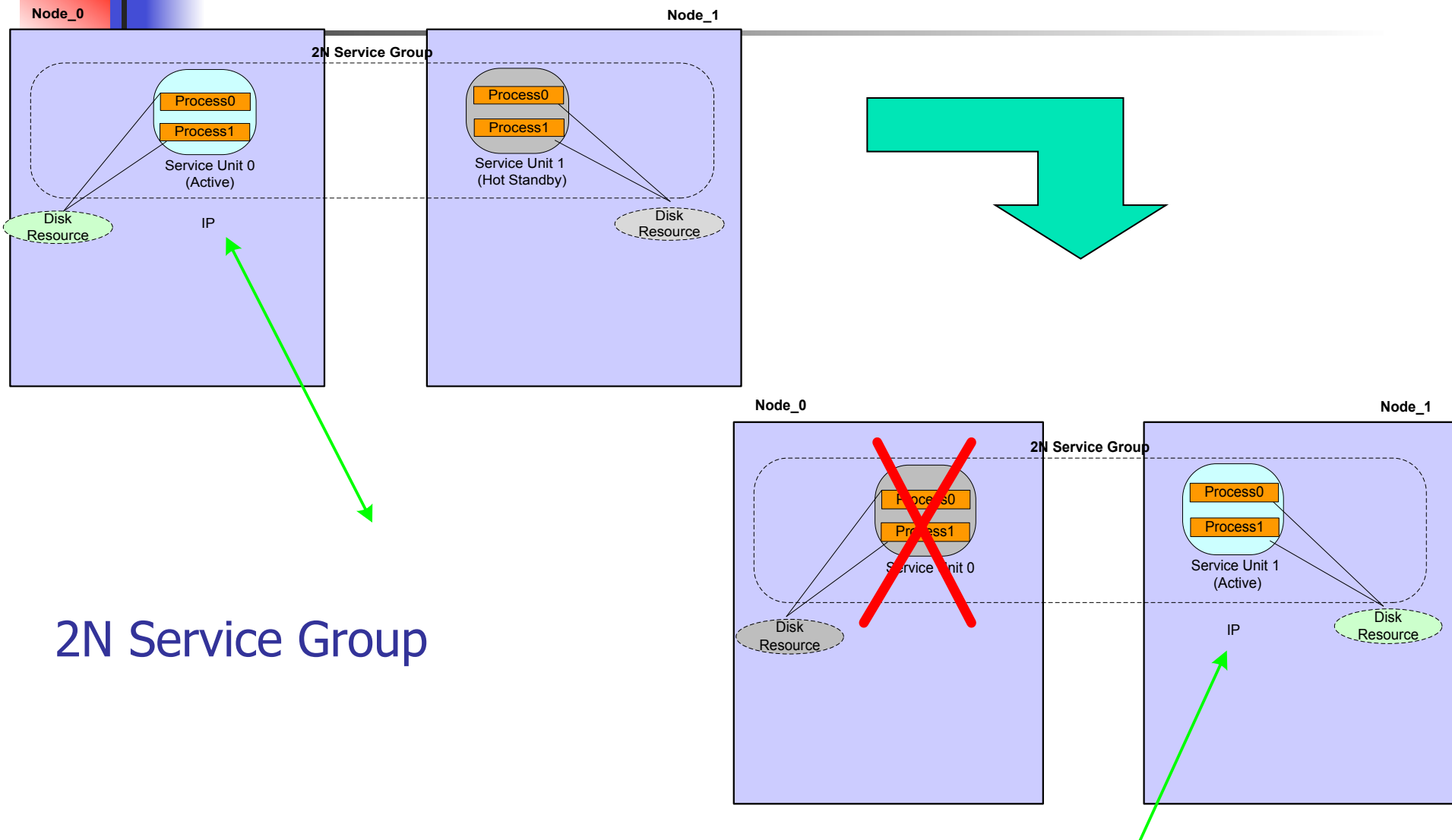
1 Unlock
2 Lock
3 Enable
4 Disable

5 New user
6 User quit
7 New user (nonsharable resource)
8 Last user quit

9 Capacity increase
10 Capacity decrease
11 Shut down

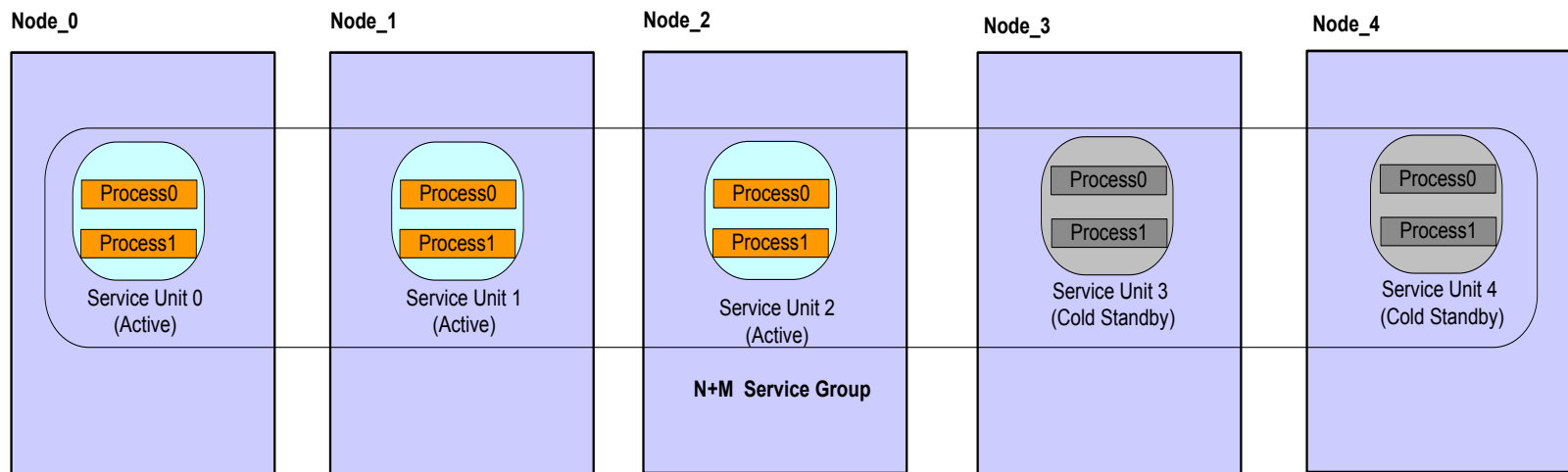
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系统冗余备份模型



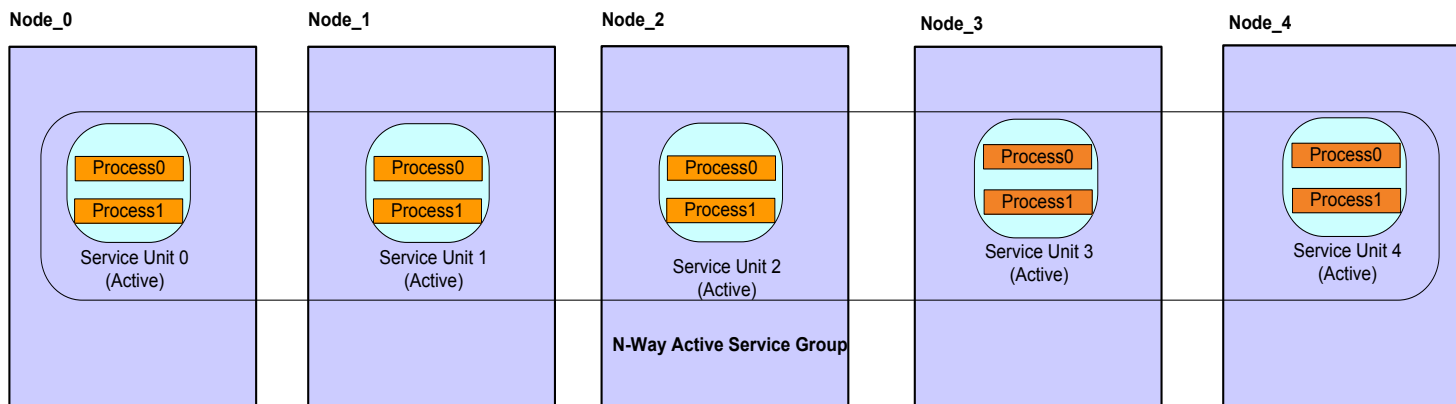
系统冗余备份模型

N+M Service Group



系统冗余备份模型

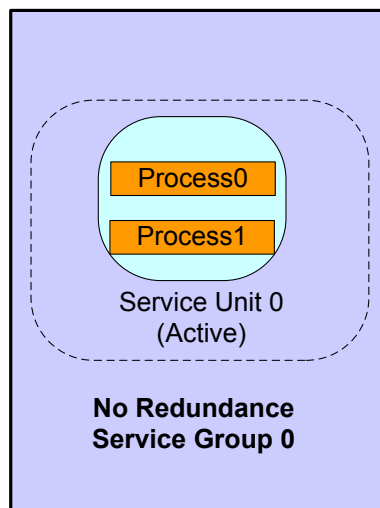
N-Way Active Service Group



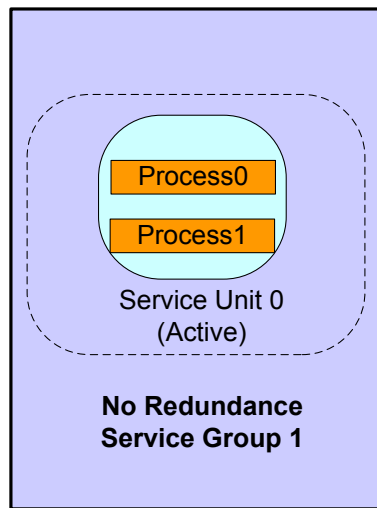
系统冗余备份模型

No Redundance Service Group

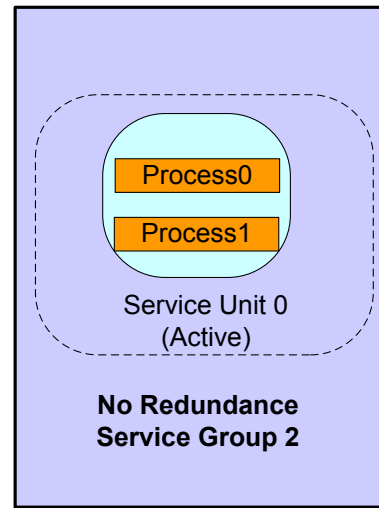
Node_0



Node_1



Node_2





系统冗余备份模型

- 不同服务使用不同的冗余模型
 - 2N
 - Management Unit, Transport Unit.
 - N+M
 - Signaling Processing Unit
 - N-Way Active
 - UE Specific Unit.
 - No Redundancy
 - User Plane Proxy

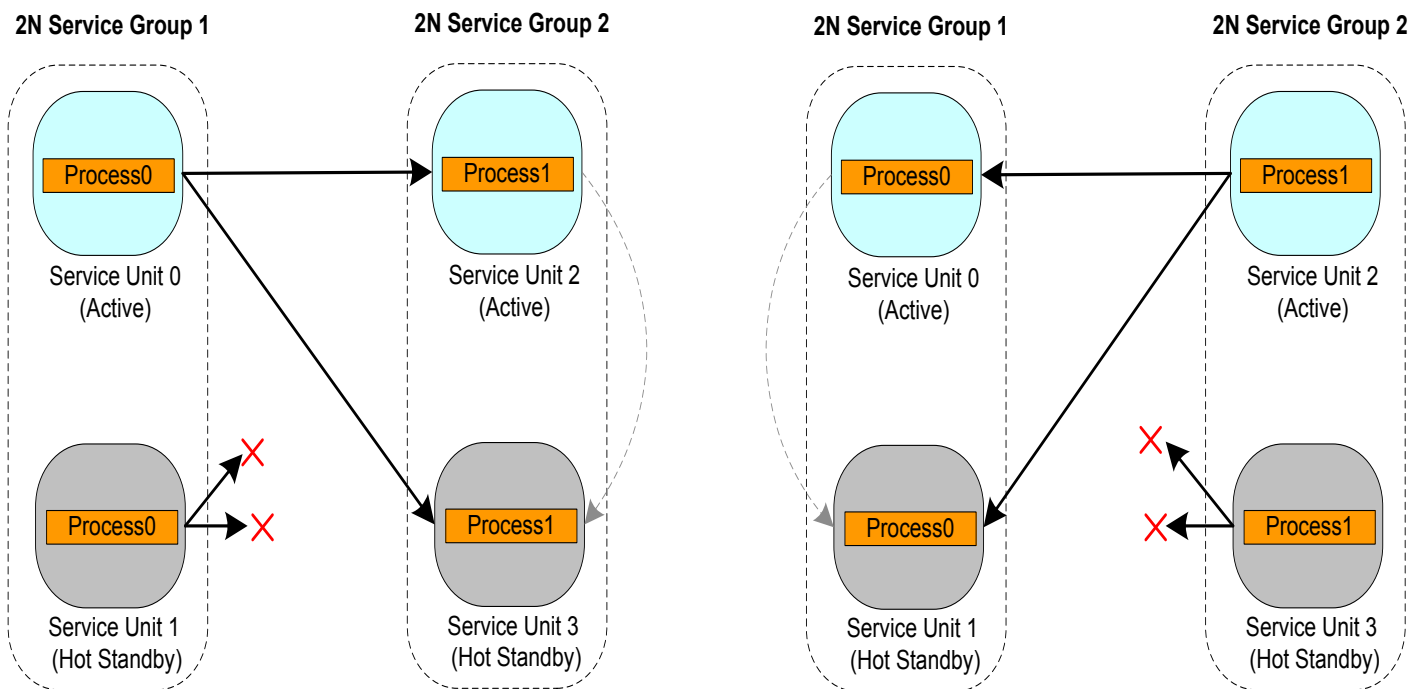


内部消息的冗余机制

- 内部消息的地址管理
 - 对于每个**Service Unit**, 同时有两个地址
 - 物理地址
 - 逻辑地址
 - 系统维护物理地址与逻辑地址的映射表
 - 当**Service Unit**状态发生变化时更新映射表

内部消息的冗余机制

■ 消息的输入同步





内部消息的冗余机制

- 模块的数据同步
 - 数据同步的时机
 - 2N Service Group
 - Standby Service Unit 重新启动的时候（通常是在switchover之后），从Active Service Unit中获取数据
 - N+M Service Group
 - 在control switchover时, Standby Service Unit 从Active Service Unit获取数据，然后standby -> Active.
 - 被侦测到失步
 - 数据同步的时间
 - 服务中断

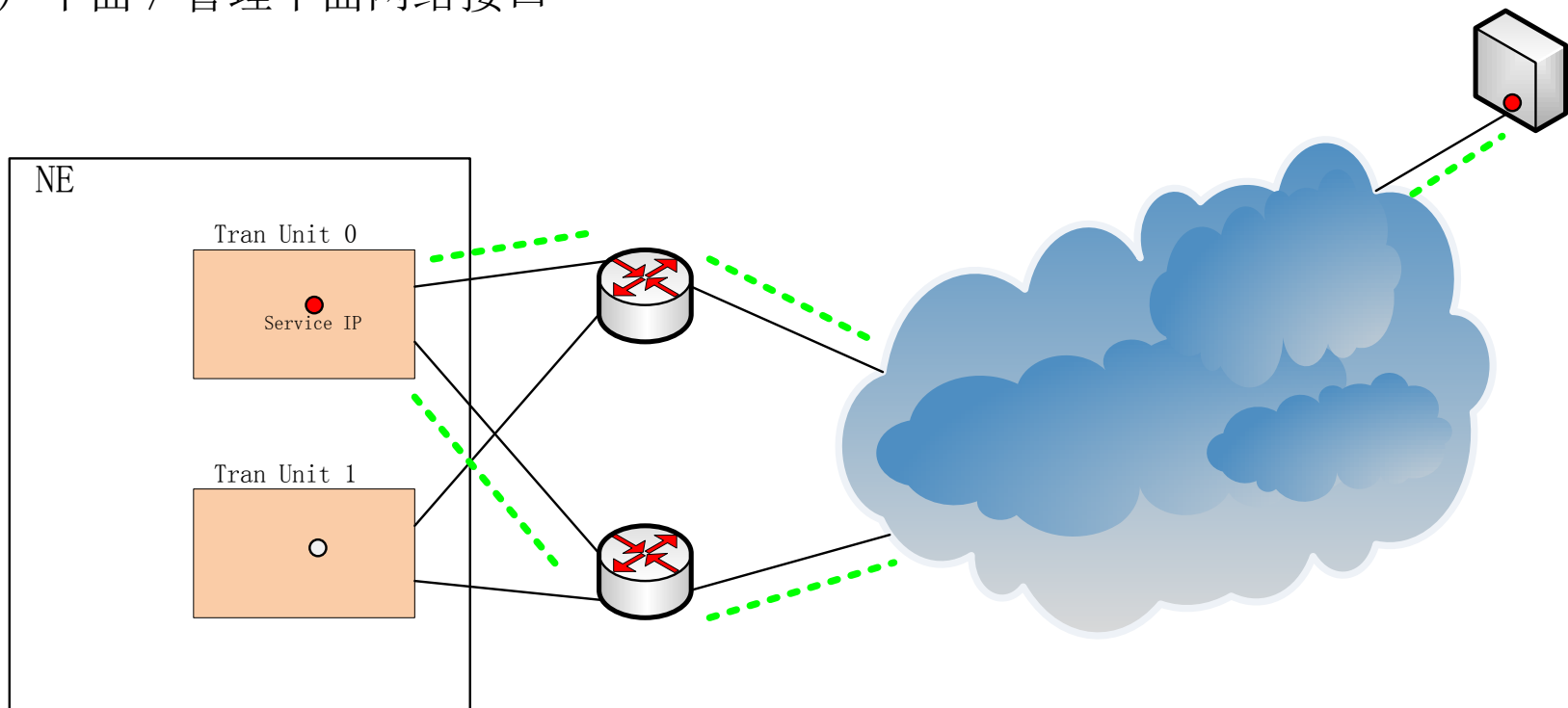


网络与传输

- 网络冗余规划
 - 网络接口的冗余
 - 用户平面 / 管理平面网络接口
 - 控制平面网络接口
 - 接口失效检测与切换
- QoS

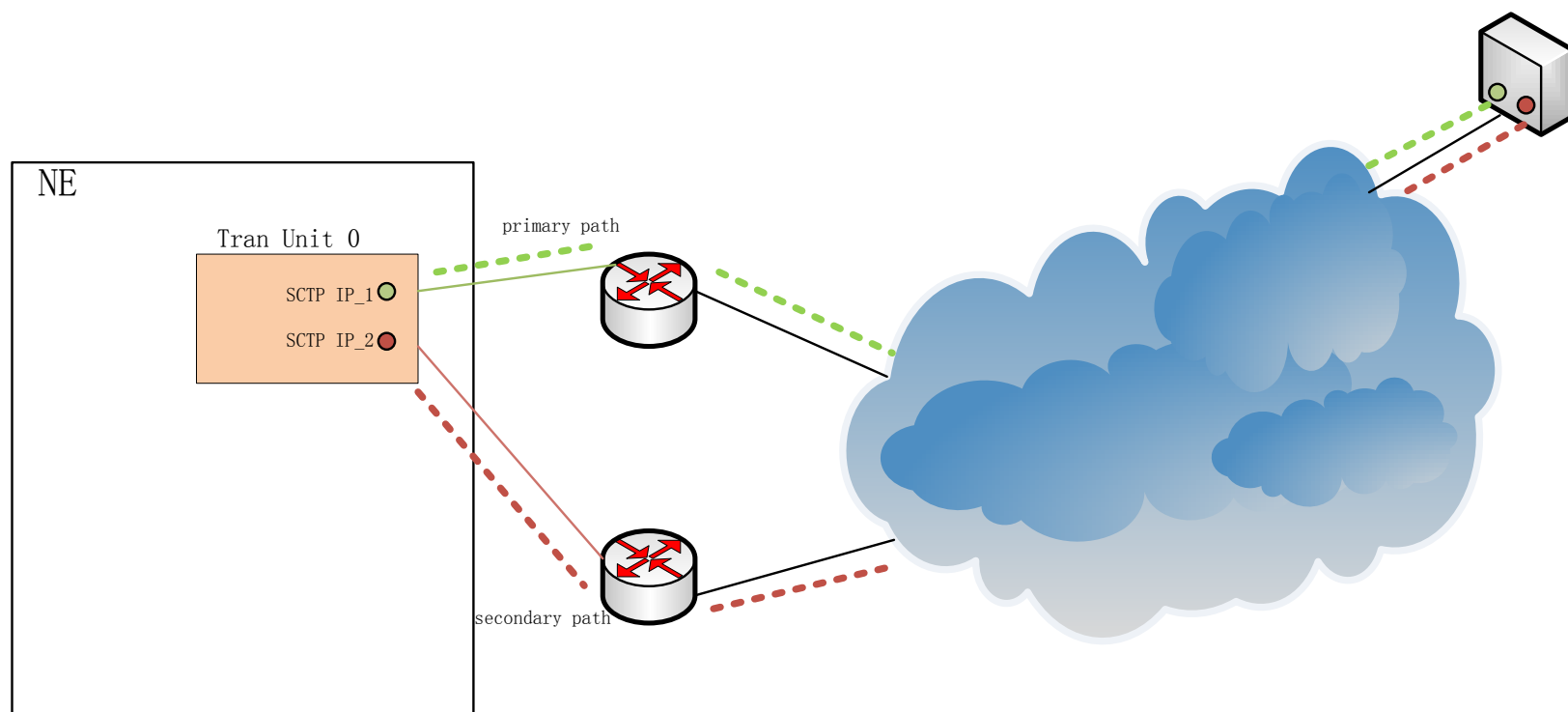
网络与传输

用户平面 / 管理平面网络接口



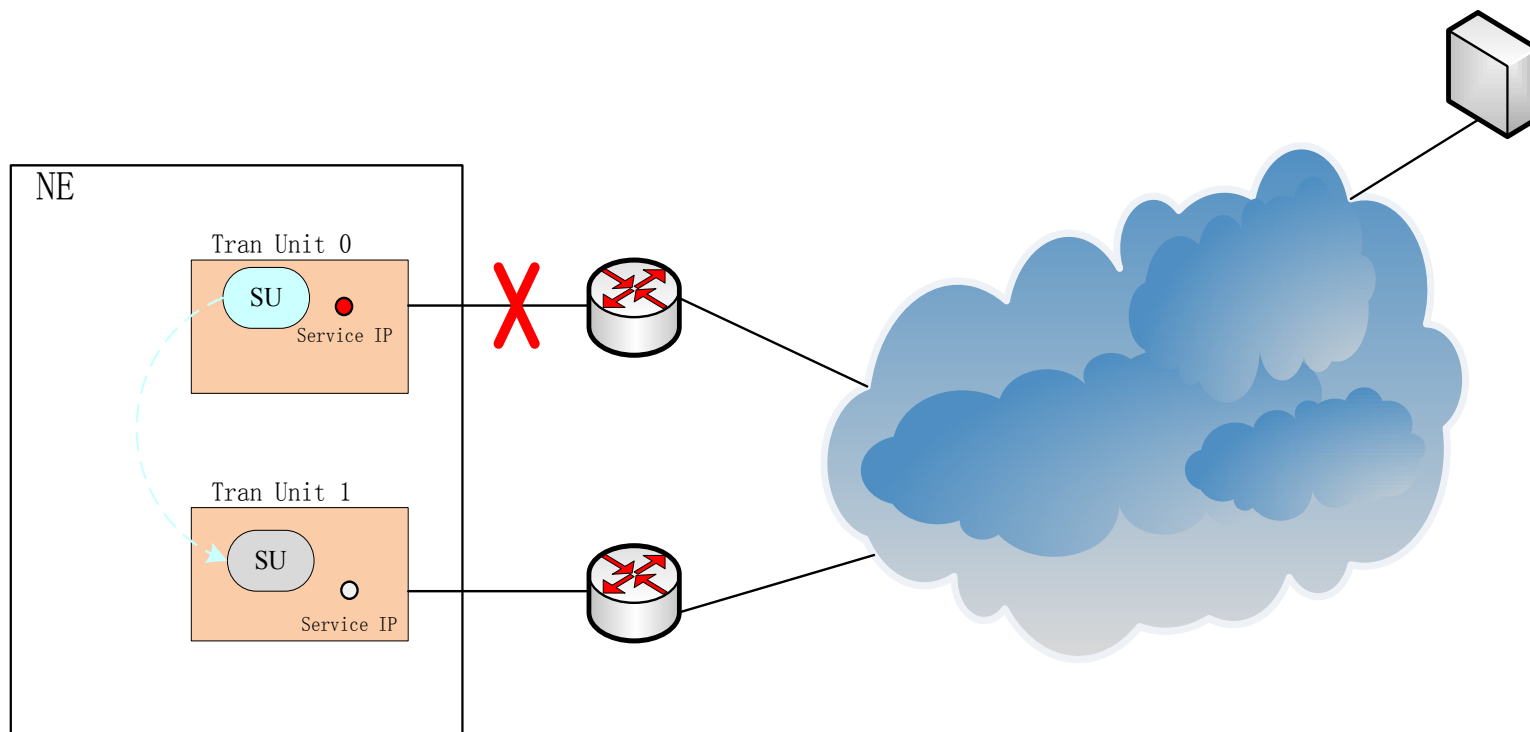
网络与传输

控制平面网络接口



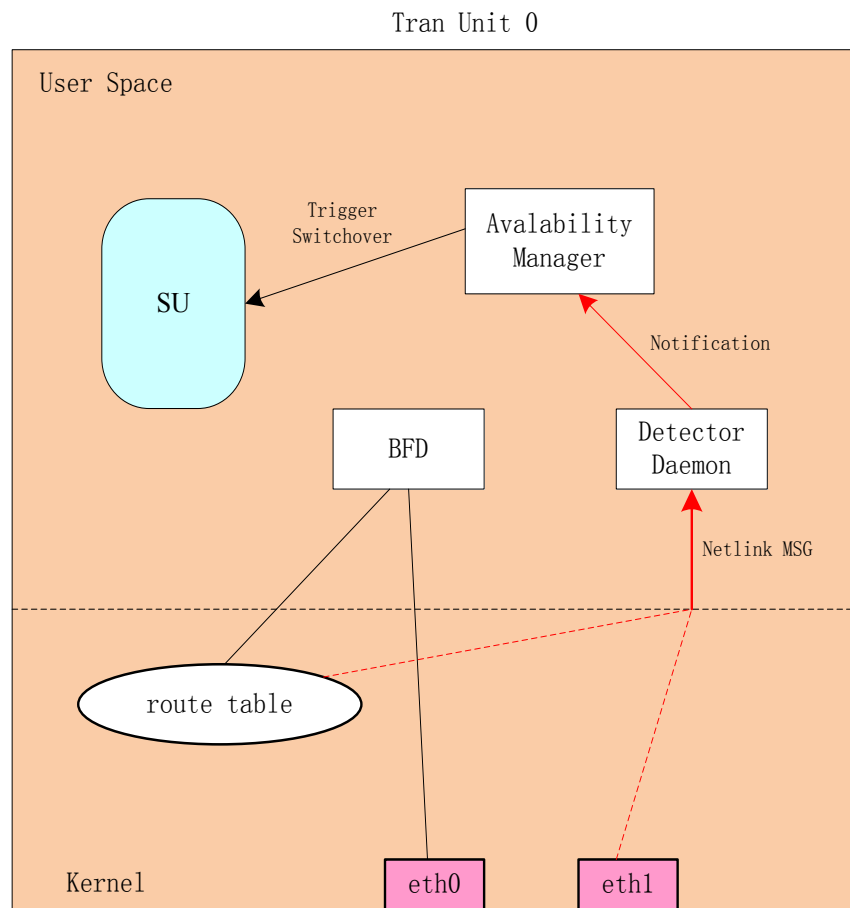
网络与传输

接口失效检测与切换



网络与传输

- 接口失效检测与切换
 - 接口状态?
 - 网关可达?





网络与传输

- QoS

- 确保高优先级的包先处理
- 入包队列的调度
- 硬件协处理器



存储系统

- 硬盘存储的同步
 - DRBD (Distributed Replicated Block Device)
 - DRBD 分区作为SG的资源，始终挂载在 Active SU 所在的Node.
- 数据库的同步
 - 例如，PostgreSQL synchronous replication. 数据在Active 和 Standby Node 之间同步。



过载保护与残留资源的清理

- 系统过载的原因
- 系统过载保护
 - 监控每个节点的CPU/Memory,
 - 超限拒绝新请求。
 - Traffic Ingress QoS
- 过载后的资源残留
 - 定时同步user/control/transport资源, 清理残留



系统升级

- 软件升级
 - 升级包的最小化
 - 配置数据的升级转化
 - 单次重起
- 硬件升级
 - 硬件冗余，
 - 控制切换/安全关机
 - 硬件替换单元



谢谢！
