

**2014
TECHNOLOGY
exchange**

OCTOBER 26-30



INDIANAPOLIS, IN

UHD (8K) Television Coverage of Large Sports Events in Brazil

Reliable International Media Transmission by Using Redundant
Transmission and FEC

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SPARKING NEXT

Introduction

Unique global joint project:

- Public viewing of 2014 FIFA World Cup Brazil
 - Transmit **8K Super Hi-Vision (SHV)** over **IP network**
 - Only fiber networks (not satellites)
 - Long distance transmission: **23,000km** from Rio de Janeiro to Tokyo
 - Connecting southern and northern hemispheres
 - Using various shared networks with different characteristics

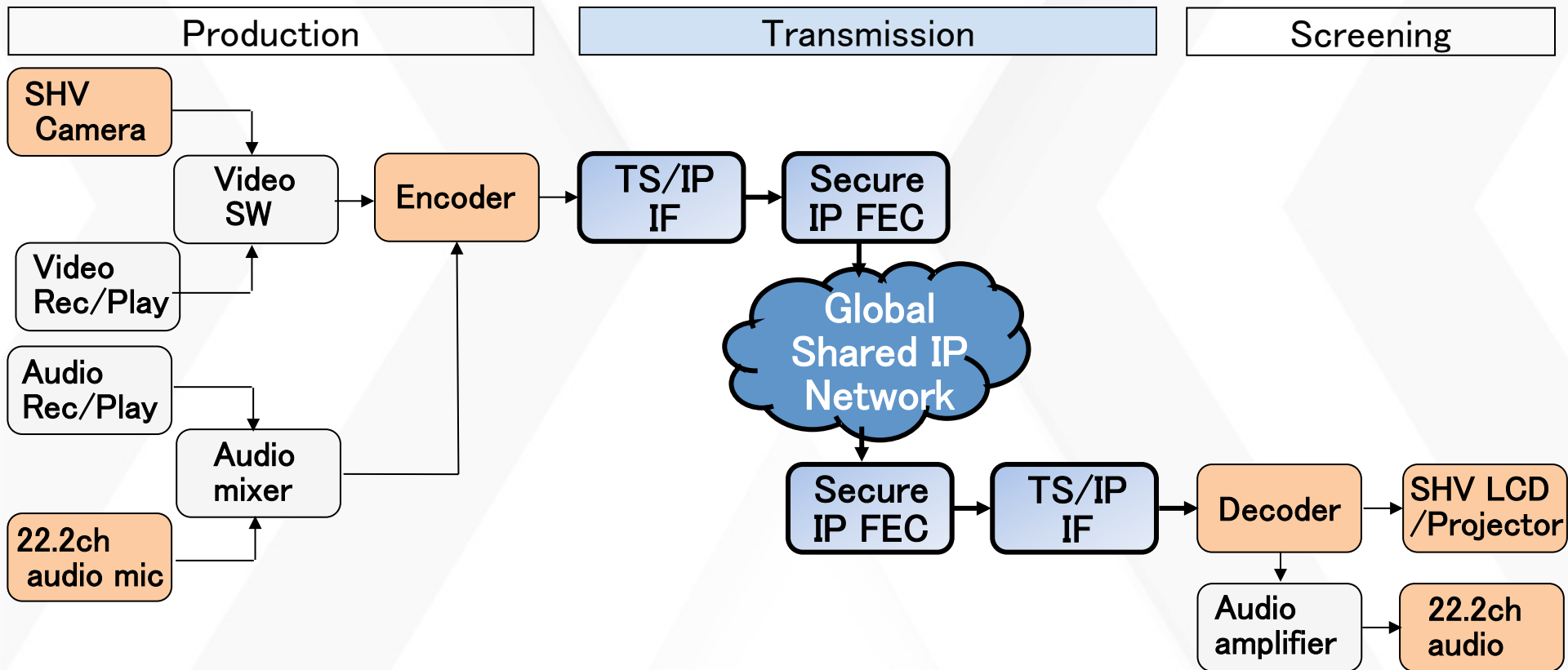
Challenge:

Transmitting live video over “Shared networks”

→ **How to secure the reliability of video transmission in real time?**

Overview of 8K PV System

- Compressed with NHK's H.264 encoder and multiplexed into 280Mbps MPEG Transport Stream (TS)
- Encrypted by **AES** and added **LDGM-FEC**
- Transmitted as **300-Mbps** UDP/IP real-time video stream



Reliability of Transmission over the World Wide Network

Challenge:

How to secure reliability of multi-domain network **against IP packet loss**, where the system consists of many heterogeneous elements?

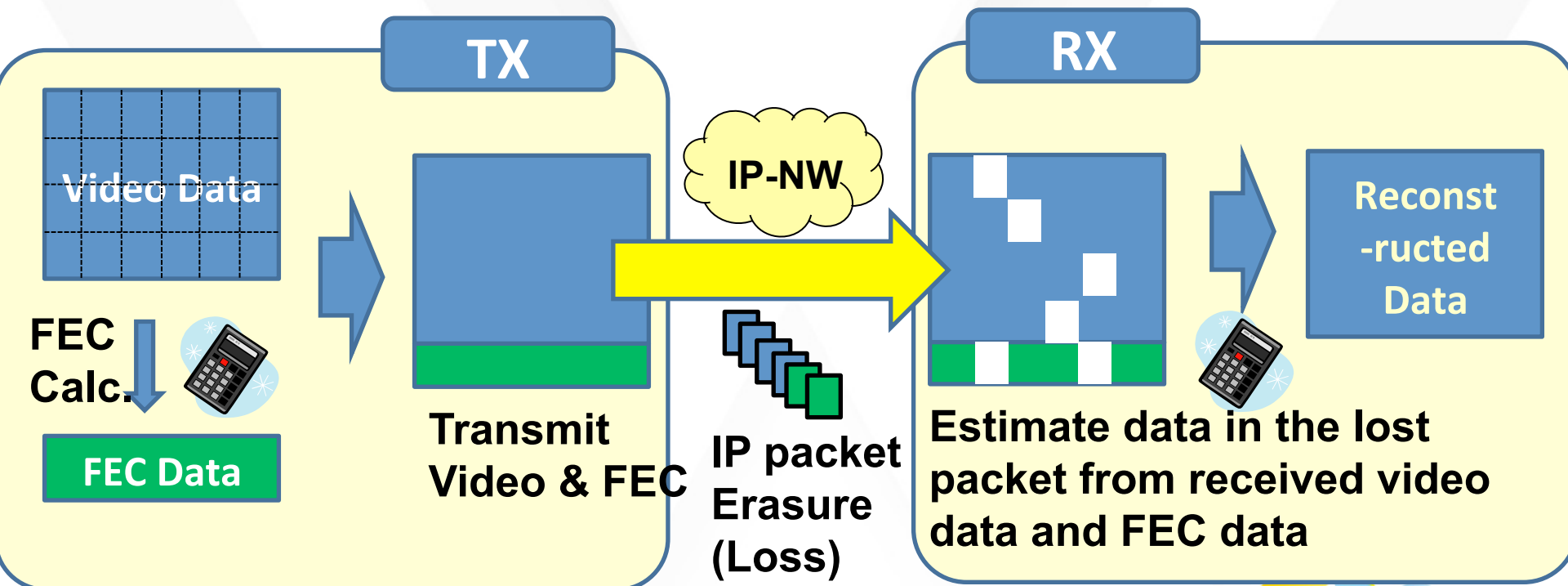
Approaches:

We applied the following both two methods

- **Forward error correction** (FEC) mechanisms at application level
- **Redundant transmission**
 - If FEC could NOT recover lost packets

Basics of Forward Error Correction

- Calculate redundant(FEC) data from video data to transmit.
- Reconstruct the lost data of video from the received data.
 - For example, the data with 10% loss can be rescued by adding 10% redundant data preliminarily.
 - Ideally we can this, but quite difficult in practice

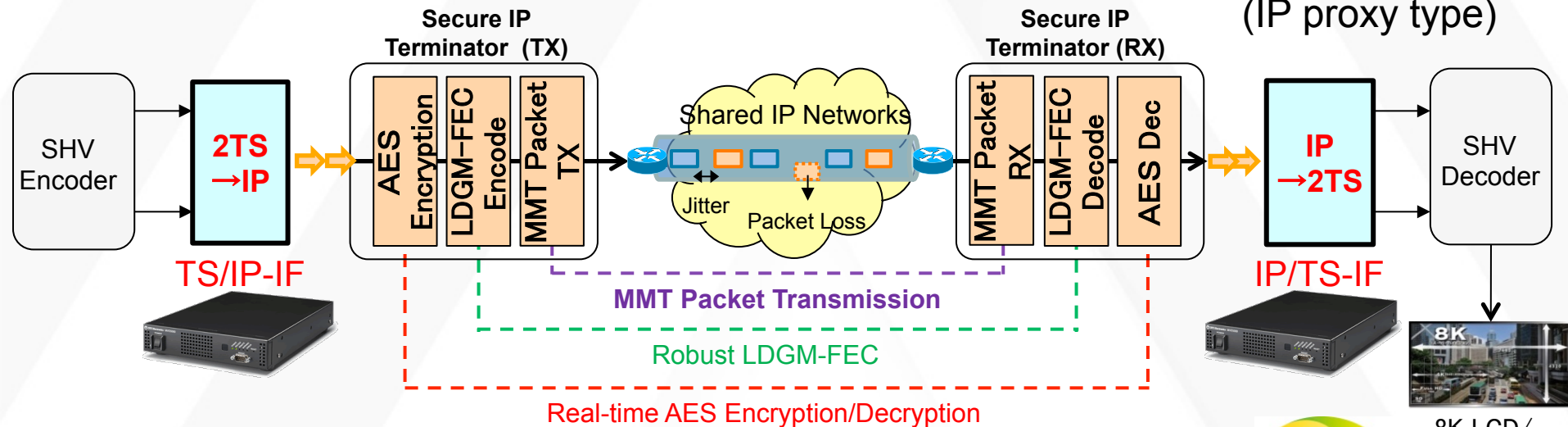


Software Implementation of FireFort LDGM-FEC

- PC/Linux box for 8K-PV
 - Large block size against long burst loss
 - Up to 150,000 blocks, 20% redundancy
 - Tolerance for loss of >20,000 packet sequence
 - AES128 encryption, MMT packet format
 - Proxy-type implementation
 - Just inserted into IP connection of CODECs.

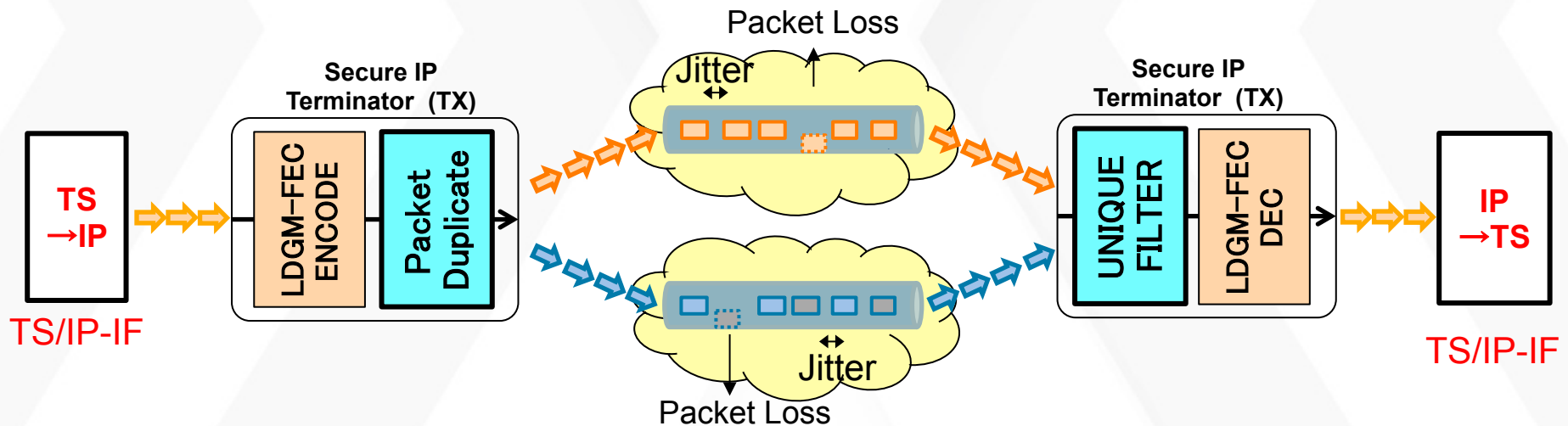


FEC-Terminator (IP proxy type)



Redundant Transmission

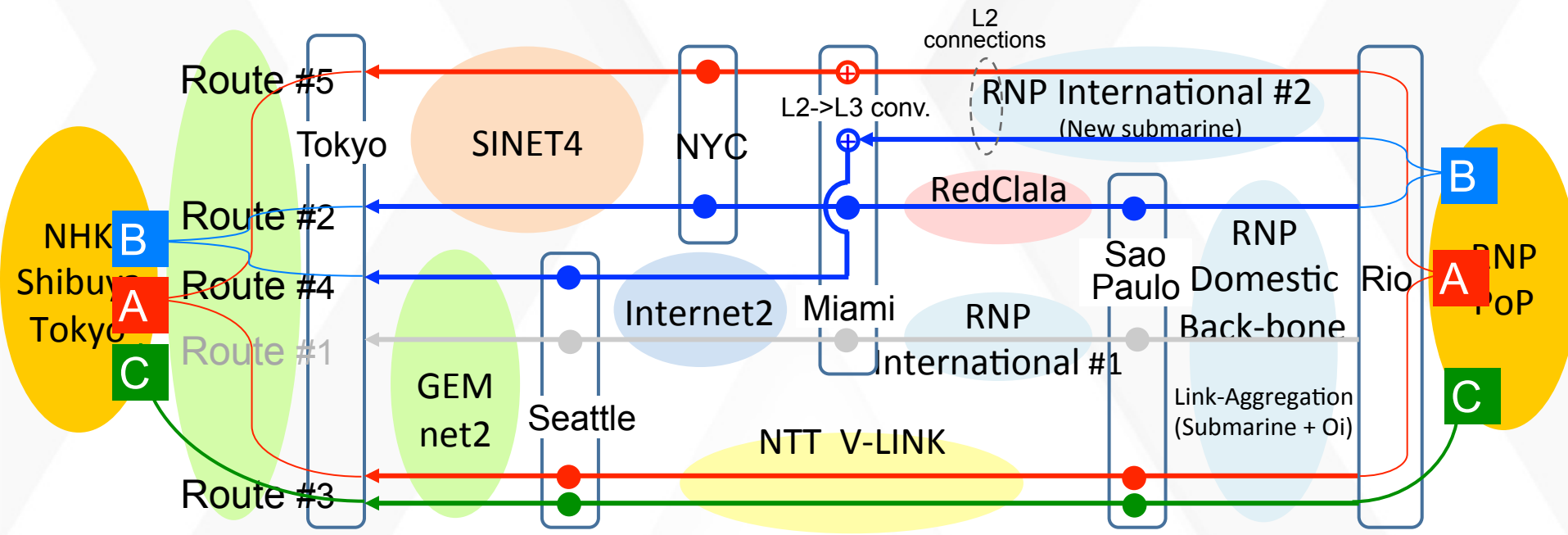
- Transmit two 8K-video streams with FEC to recover from unexpected **long-term burst loss** caused by:
 - **Long-time disruption** by unscheduled maintenance
 - **Malfunction**, and **power outage** of network links and nodes
 - **Fiber cutoff**



International Network Diagram

Three transmission systems use the multi-path/single-path NW connections

- **FEC System A (Route #3 + #5)** : Full-duplication of Networks & Nodes
- **FEC System B (Route #2 + #4)** : Full-dup. of NWs, but common in Miami-node
- **FEC System C (Route #3 only)** : Backup.



Summary

- Succeeded in 8K PV of 2014 World Cup Brazil
 - Keys to success:
 - Collaboration of **R&E network organizations**
 - **High reliable IP transmission technology** for shared networks
- High reliable IP transmission technology based on:
 - High-efficiency **LDGM-FEC**
 - **Redundant transmission** with FEC
- Configuration for redundant transmission
 - Designing multi-path network connections

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