PRP Protocol Application Scheme

Highly Reliable Data Transmission Solution
Defining the New Standard for Power System Monitoring

PRP Protocol: Principles & Power Monitoring Applications

High-Reliability Data Transmission · Zero-Switch Redundancy · Critical Infrastructure Protection

01. FUNDAMENTALS

- Definition & Core Standards
- Working Principle
- Networking Modes

02. CORE VALUES

- Zero Switching Time Redundancy
- High Availability Mechanism
- Critical Application Analysis

03. POWER MONITORING

- Challenges & Solutions
- PRP Architecture Design
- Core Benefit Summary

Core Goal: Establish a highly reliable power communication network with zero packet loss and zero downtime.

PART 01

Introduction to PRP Protocol Fundamentals

Parallel Redundancy Protocol (PRP) is a cutting-edge network protocol designed to achieve **zero-loss failover** and ultra-high availability at the Data Link Layer, ensuring uninterrupted communication for mission-critical systems.

High Availability
Continuous Data Flow

Zero-Loss Failover
Seamless Switching

Data Link Layer
OSI Layer 2 Tech

PRP Protocol Definition and Core Standard

Layer 2 Protocol

Parallel Redundancy Protocol (PRP)

A data link layer protocol achieving high availability by transmitting identical frames over two independent parallel networks (LAN A & B). If one path fails, the receiver switches seamlessly, realizing **"zero switching time"** and **"zero data loss"**.

IEC Standard

Core Standard: IEC 62439-3

Specifically designed for industrial automation networks to ensure high availability. Widely applied in critical mission fields like power systems, rail transit, and industrial control.

Mission-Critical Network Availability: Zero Loss, Zero Delay

PRP Protocol: Industrial-Grade High Availability Redundancy Mechanism

01 Frame Replication

The sending node duplicates the original data frame (C-Frame) into two identical frames, preparing for parallel transmission.

02 Parallel Transmission

The duplicated A/B frames are transmitted in parallel through two independent physical network ports to the LAN A and LAN B networks.

03 Reception & Discard

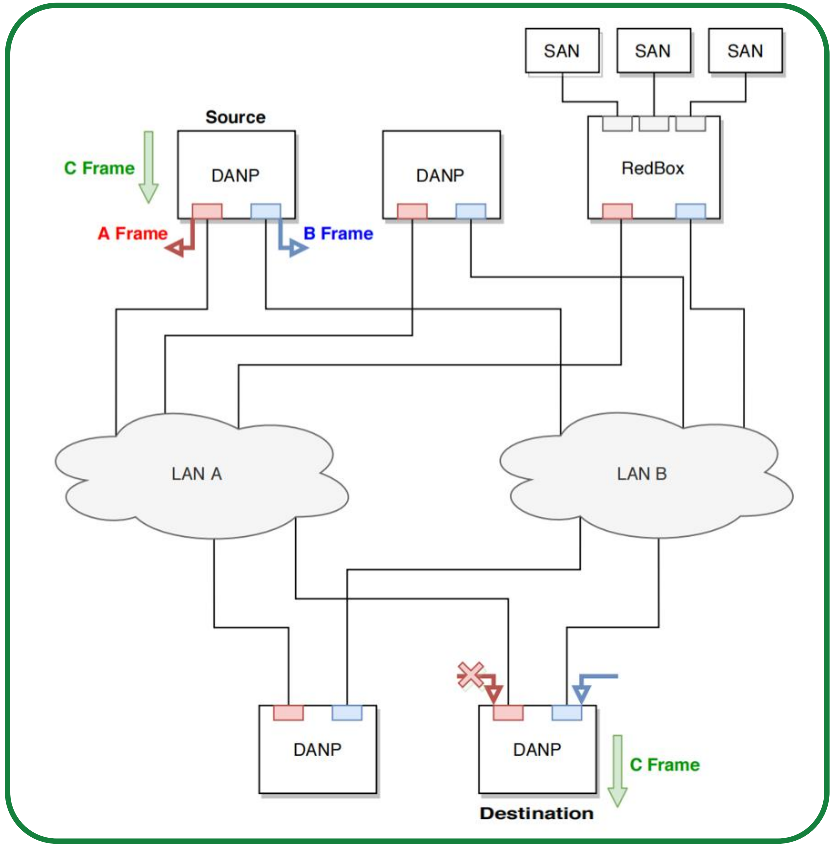
Identifies duplicates based on RCT trailer, processes the first-arrived valid frame, and automatically discards subsequent duplicates.

04 Fault Tolerance

If any network path fails, the receiving end can still receive data through the other normal link, achieving seamless communication redundancy.

Seamless Communication & Zero Downtime Guarantee

PRP Protocol: Working Principle & Key Components



PRP Protocol Networking Topology

Source DANP (Transmitter)

Duplicates data packets and sends them simultaneously to both networks.

LAN A / LAN B (Dual Networks)

Two physically isolated network paths providing redundant transmission channels.

Destination DANP (Receiver)

Receives dual streams, identifies and discards duplicate frames to ensure data integrity.

RedBox (Gateway)

Bridges non-PRP devices (Single Attachment Nodes) into the redundant PRP network.

Zero Interruption Fail Tolerance: Uninterrupted data delivery even if one network path fails.

PRP Networking Modes and Key Components

DANP (Doubly Attached Node)

• Core PRP device with dual interfaces
• Connects to both LAN A & LAN B
• e.g., Power quality monitors

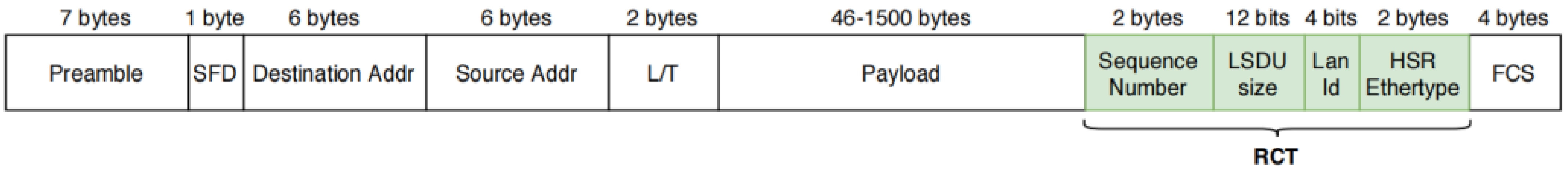
SAN (Singly Attached Node)

• Standard device (no PRP support)
• Connects to only one network
• Needs RedBox for redundancy

RedBox (Redundancy Box)

• Bridges SAN devices to PRP network
• Handles packet replication/removal
• Provides redundancy translation

PRP Frame Format: RCT Redundancy Control Trailer Analysis



LSDU Size (2B)

Indicates the original data length

Sequence Number (2B)

Critical for duplicate frame discard detection

LAN Id (1B)

Identifies source network (LAN A or LAN B)

HSR Ethertype (1B)

Fixed value identifier for frame type

Core Mechanism: The Sequence Number increments with each frame. Receivers discard duplicates by matching this number with the source address.

PART 02

Role and Application Value of PRP Protocol

Core Driver & Value Empowerment of Dual-Net Parallel System

High Reliability

Zero data loss, continuous transmission even in single network failure

Real-time Sync

Dual network parallel operation ensures zero-delay data updating

Data Integrity

Dual backup mechanism, 100% accurate data collection and storage

Core Value: Transition from millisecond outages to genuine seamless redundancy, guaranteeing continuous operation of critical services

PRP Protocol: Zero-Time Seamless Redundancy

Traditional Redundancy

(RSTP / MSTP)

- Mode: Active-Standby (One idle)
- Failover: Topology recalculation needed
- Recovery: 10ms ~ 1s+
- Risk: Data Loss / Interruption

⚠️ **High Risk of Interruption**

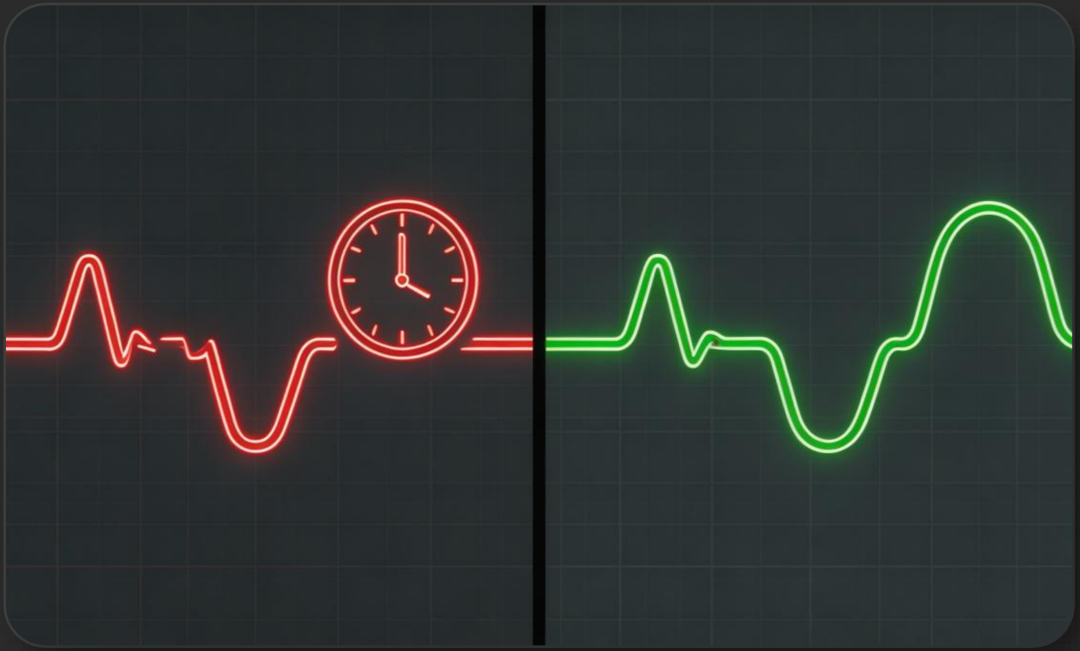
PRP Parallel Protocol

(Seamless Redundancy)

- Mode: Dual-Active (Both transmit)
- Failover: Ignore faulty frames instantly
- **Recovery: 0 ms (Zero Switching Time)**
- Key Benefit: Zero Loss / No Interruption

🚀 **Zero Loss · Zero Delay · Seamless**

Network Switching: Interruption vs. Seamless



Visual Comparison: Red (Disruption) vs Green (Seamless)

Traditional: Intermittent Loss

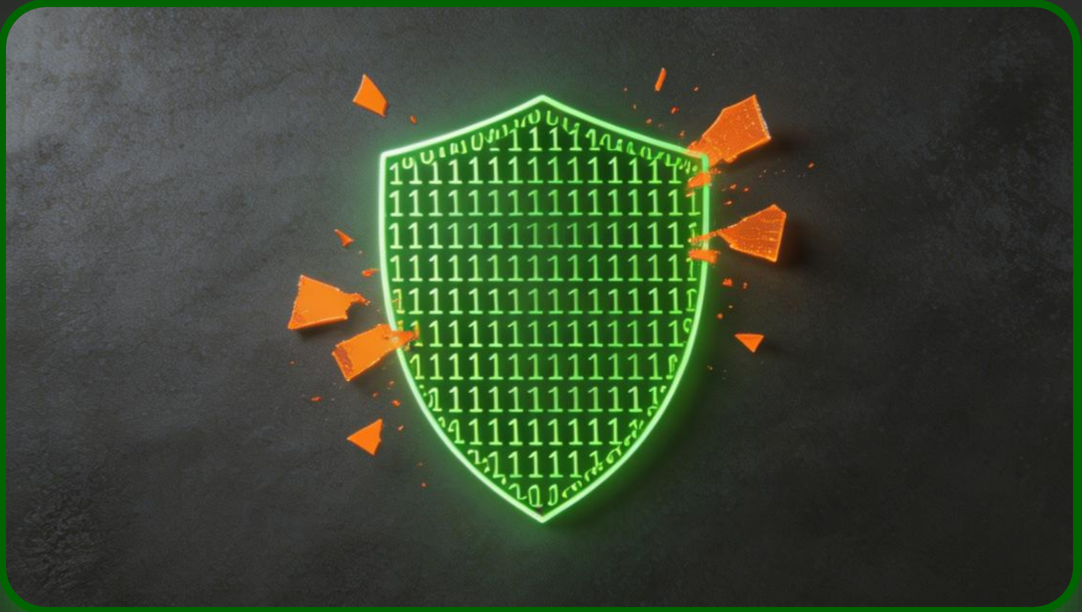
Inherent switching delays cause transient data loss, leading to analysis errors by missing critical moments.

PRP Network: Seamless

Dual-network parallel transmission ensures zero packet loss, providing maximum data integrity for monitoring.

Key Takeaway: PRP guarantees zero downtime for mission-critical monitoring systems.

Ensuring Data Integrity: PRP Technology Captures Critic



Zero-Packet-Loss Shield
100% Data Capture, 0% Compromise

PRP Zero-Packet-Loss Core Advantage

Uninterrupted Transmission
Even during network faults, millisecond-level transient data is uploaded to the master station without loss.

Reliable Governance Basis
Provides a 100% reliable foundation for fault analysis and power quality governance decisions.

Core Achievement: A qualitative leap from "data loss" to "zero packet loss".

Application Value 2: Enhancing System Reliability and Continuity

PRP Protocol: Dual-Network Parallel Operation

Like precision gears, ensuring stable data transmission

PRP Core Guarantee Capability

7x24h Uninterrupted Operation

Fault switching is transparent to upper-layer applications, ensuring the monitoring system runs without any downtime.

Ultimate Business Continuity

Greatly enhances system reliability, ensuring production safety and stable equipment operation even under network anomalies.

Business Zero-Interruption | System High Availability | Risk-Compliant

PRP Application Value: Simplified Management & Standard Compliance

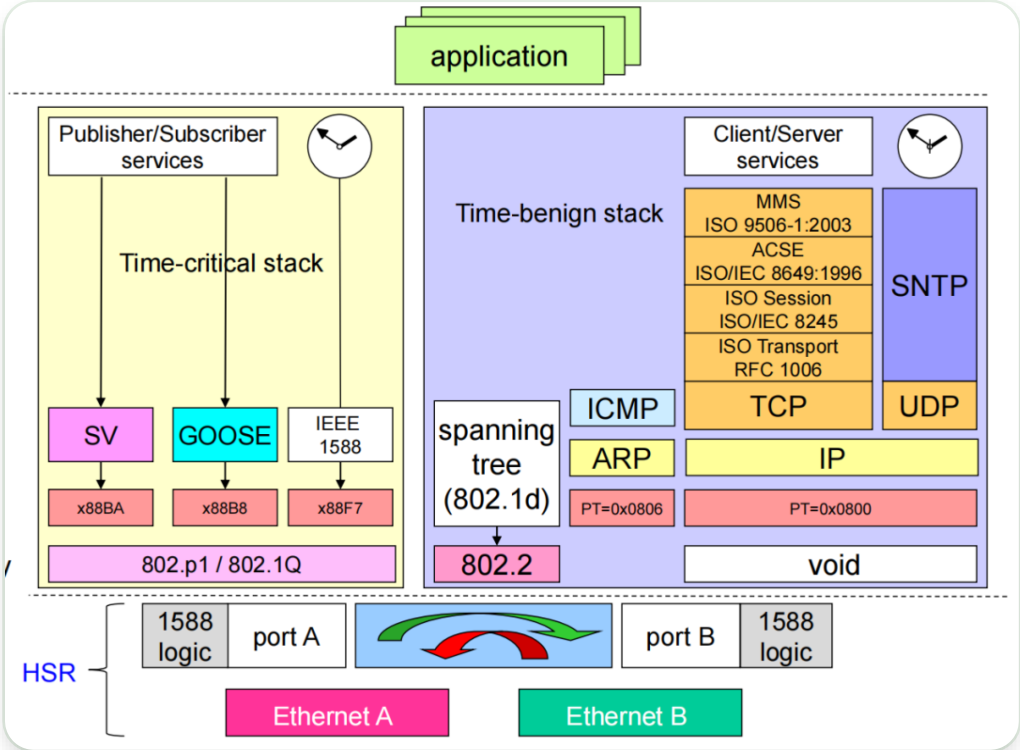


Diagram: IEC 61850 Protocol Stack & PRP Positioning

Simplified Management

- Transparent fault switching (no complex config)
- Uses standard Ethernet, cutting O&M costs

Industry Standard Ready

- Fully compatible with IEC 61850 process bus
- Aligns with mainstream industry trends

Best Practice for Smart Grid Networks

Conclusion: PRP is the Best Practice for Smart Grid & Critical Infrastructure Networks

PART 03

Application in Power Quality Monitoring Systems

Bridging theory and practice: Exploring PRP's role in grid stability, accuracy, and data integrity.

System Challenges

Current limitations & pain points

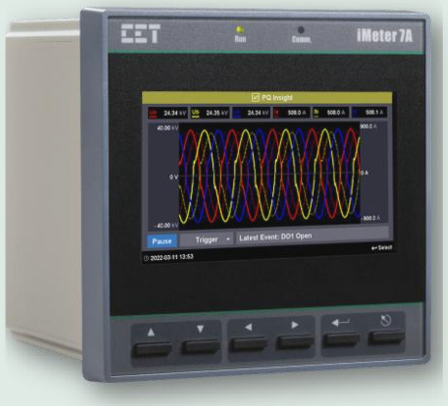
PRP Solution

Full-link dual-network monitoring

Core Benefits

Zero loss & ultra-high reliability

Application Background: Challenges in Power Quality Monitoring



iMeter 7A Power Quality Analyzer

Status & Challenges

Non-linear loads & distributed energy sources lead to increasingly complex power quality issues.

Steady-state Monitoring

Focus on harmonics, three-phase imbalance, voltage/frequency deviation, etc.

Transient Event Capture

Critical for detecting voltage sags, swells & short interruptions (extremely harmful to equipment).

Core: Real-time & Integrity

Data loss may lead to missed judgment of critical events.

PRP Solution: Building a Highly Reliable Monitoring Network

High Availability Data Center Infrastructure

01 Frontend Monitoring Layer

PRP-enabled DANP devices with dual ports connected to LAN A & B.

02 Network Transmission Layer

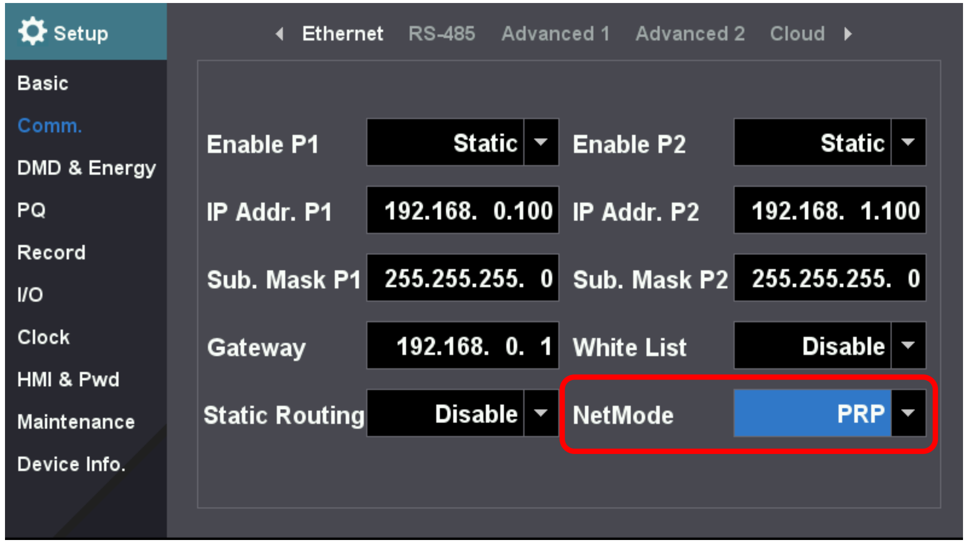
Dual-network parallel architecture (LAN A & B) for parallel transmission.

03 Master Station Layer

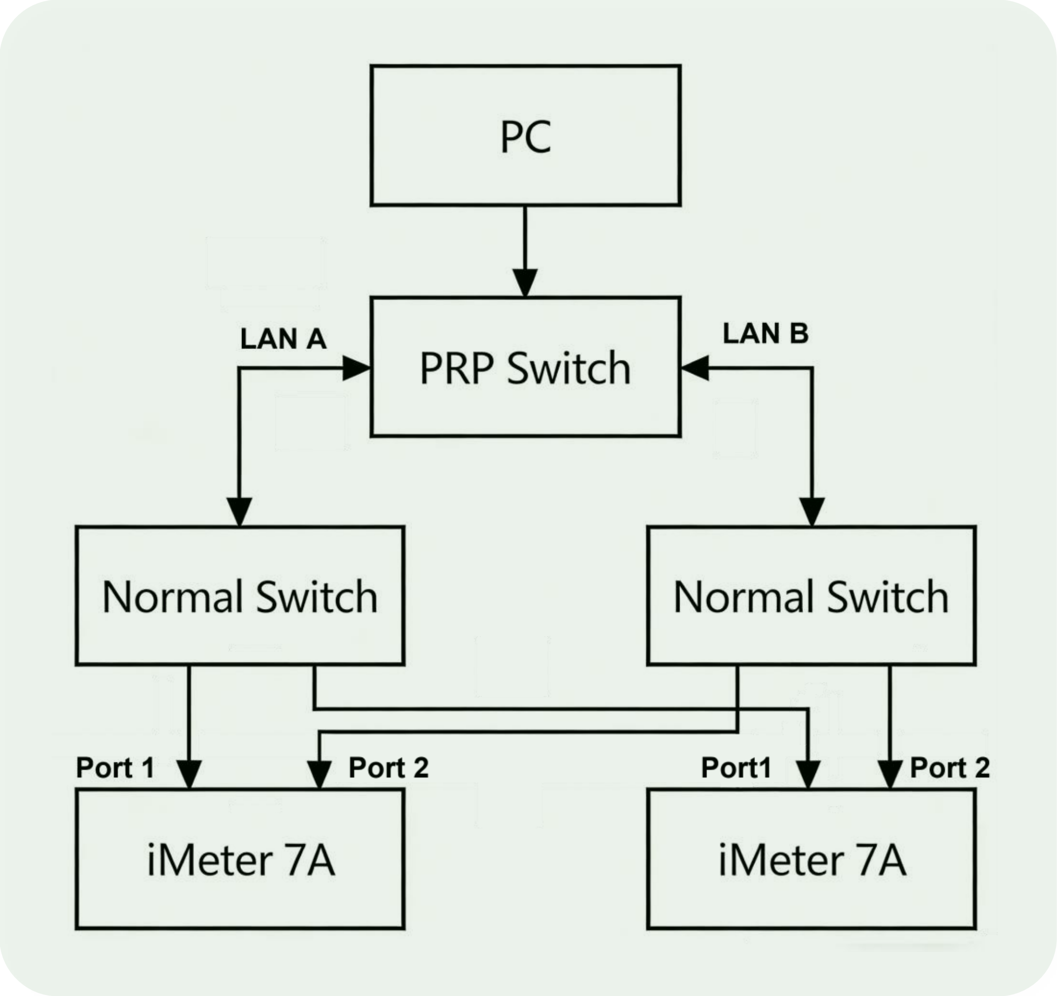
Dual-homed servers auto-discard duplicates to ensure data accuracy.

End-to-End Redundancy & Zero Data Loss

iMeter 7A PRP Settings & Network Topology



Setup > Comm. > Ethernet > NetMode > PRP



Thank You for Listening

Q & A SESSION

Your Questions & Suggestions Are Highly Appreciated