



Your Extensible Software-Defined Radio

YesDR Technical Specification

YesDR TS 02.020

Version 1.0.0

Release 1

YesDR Base Station (YBS)

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1 Scope

This specification defines the YesDR Base Station (YBS).

YBS provides radio access, access-stratum security handling, NAS forwarding, PDU session establishment, and user-plane tunnel mapping between YUE and YCore.

YBS is functionally aligned with the 3GPP gNB defined in TS 23.501 but is simplified for research, teaching, and rapid prototyping.

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2 References

2.1 Normative

- YesDR TS 01.001: Overall Architecture
- YesDR TS 03.001: YesDR Access Control Protocol (YACP)
- YesDR TS 02.040: YesDR User Plane Function (YUPF)

2.2 Informative

- 3GPP TS 23.501
- 3GPP TS 38.401

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3 Abbreviations

Term	Description
YBS	YesDR Base Station
YUE	YesDR User Equipment
YAMF	YesDR Access Management Function
YUPF	YesDR User Plane Function
YACP	YesDR Access Control Protocol
NAS	Non-Access Stratum
TEID	Tunnel Endpoint Identifier
PDU	Packet Data Unit

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4 Functional Overview

YBS performs the following major functions:

- UE registration and identity handling
- NAS message forwarding between YUE and YAMF
- Access-stratum security setup
- PDU session establishment and management
- GTP-U tunnel mapping and forwarding
- PHY modulation and transmission coordination

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5 YBS Architecture

5.1 Control Plane Module

Handles YACP messages, UE context management, and interaction with YAMF.

5.2 NAS Relay Module

Encapsulates and forwards NAS messages between YUE and YCore without modification.

5.3 Security Module

Derives access-stratum keys (KgNB, K_RRC, K_UP) and validates UE security capabilities.

5.4 Session Management Module

Maintains PDU session state, TEID allocation, and UPF tunnel parameters.

5.5 User Plane Module

Maps downlink and uplink packets using TEID-based lookup tables and forwards traffic accordingly.

5.6 PHY Interface Module

Interfaces with the PHY processing chain, including modulation, coding, and SDR transmission.

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6 UE Context Management

YBS SHALL maintain a UE context identified by `gnb-ue-ngap-id`.

Each context SHALL contain:

- SUCI and/or GUTI
- Registration state
- Security keys
- Active PDU sessions
- TEID mappings

Contexts SHALL be updated dynamically based on YACP messages :contentReference[oaicite:1]index=1.

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7 Registration Procedure

The registration procedure follows these steps:

1. UE sends Initial Registration to YBS
2. YBS assigns gNB-UE-NGAP-ID
3. NAS Registration Request forwarded to YAMF
4. Security Mode Command handled
5. Registration Accept forwarded to UE

YBS SHALL NOT store AMF-assigned UE identifiers as primary keys :contentReference[oaicite:2]index=2.

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8 Security Procedures

YBS SHALL:

- Validate UE security capabilities
- Derive KgNB from Kamf
- Derive RRC and UP keys
- Protect access-stratum signaling

Security key derivation SHALL follow 3GPP-aligned KDF procedures.

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9 PDU Session Management

YBS SHALL support:

- PDU Session Setup
- TEID generation
- UPF tunnel parameter storage
- Session state synchronization

Each PDU session SHALL include:

- Local (DL) TEID
- UPF (UL) TEID
- UPF IP and port
- UE IP address

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10 User Plane Forwarding

Downlink packets SHALL be forwarded based on DL-TEID lookup tables.

Uplink packets SHALL be encapsulated using UPF-assigned TEID and forwarded to YUPF.

TEID mappings SHALL be dynamically updated upon session modification :contentReference[oaicite:3]index=3.

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11 Error Handling

YBS SHALL handle:

- Invalid NAS messages
- Session setup failures
- TEID conflicts
- SDR transmission errors

Errors SHALL be logged and SHALL NOT cause unexpected service interruption.

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12 Security Considerations

YBS SHALL:

- Avoid persistent storage of sensitive keys
- Restrict control-plane access
- Isolate UE contexts

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