Enterprise Core Systems Engineering Reference Manual: MTBF Mean Time Between Failures hours

PRODUCT IDENTIFICATION

Product Designation: TELCOVERGE ENTERPRISE SERIES 7600 (ES-7600) CORE ROUTING SYSTEM

Specification Reference: EN-7600-MTBF-R2.0

Document Type: Hardware Engineering Reference & Mean Time Between Failures (MTBF) Datasheet

The ES-7600 is a carrier-grade modular routing platform engineered for maximum service continuity. This document details the official Mean Time Between Failures (MTBF) parameters, system reliability architecture, and hardware lifecycle specifications as validated under Telcordia SR-332, Issue 4 methodology.



CORE INTERNAL TOPOLOGY & HARDWARE REDUNDANCY ARCHITECTURE

The ES-7600 achieves its industry-leading MTBF rating (mean time between failures hours) through a fully distributed, stateful failover design. The system eliminates all single points of failure (SPOF) across the data, control, and management planes.

FAILURE ISOLATION DOMAINS:

- Control Plane: 1+1 Redundant Route Processor Modules (RPM) with hitless Non-Stop Forwarding (NSF)

- Fabric Plane: 3+1 Redundant Switch Fabric Modules (SFM) enabling 100% fabric capacity upon single module failure

- Power System: N+1 (up to 6+1) Hot-swappable AC/DC rectifiers

- Cooling System: 5+1 Redundant Fan Tray with Variable Speed Control (dual

rotor redundancy per tray)

HARDWARE RELIABILITY ENGINEERING (HALT VALIDATION):

The platform is subjected to Highly Accelerated Life Testing (HALT) with thermal stress from -5°C to 70°C and vibration profiles exceeding GR-63-CORE. The calculated MTBF of the base chassis (excluding pluggable optics) is 2,450,000 hours under controlled data center conditions (40°C ambient).

SWITCHING SUBSYSTEM CAPABILITIES

FORWARDING ENGINE SILICON:

The ES-7600 utilizes a proprietary, non-blocking, cut-through switching ASIC (T-CORE Gen5) operating at 1.8 Tbps per fabric slice.

KEY HARDWARE ROUTING FEATURES:

- Feature 1: Hardware-based LPM (Longest Prefix Match) table for 2M IPv4 / 1M IPv6 routes
- Feature 2: Ingress/Egress ACL processing at line rate (no performance penalty)
- Feature 3: P4-programmable pipeline for custom telemetry and encapsulation
- Feature 4: Hardware timestamping for 1588v2 PTP and SyncE

OPERATIONAL ADVANTAGES (MTBF DRIVEN)

REDUCED SERVICE IMPACT:

With a demonstrated MTBF of 2.1 million hours (system fully populated), annual failure rate (AFR) is calculated at 0.0042, enabling five-nines (99.999%) availability in redundant configurations. Mean Time To Repair (MTTR) is 2 hours (hot-swappable modules + field-replaceable units).

LIFECYCLE ASSURANCE (MTBF):

The platform is qualified for a 15-year service life with continuous operation. Reliability Block Diagram (RBD) analysis confirms that under 1+1 redundancy, the probability of complete system failure due to independent hardware faults is less than 1e-9 per operational hour.

SPECIFICATION MATRIX

Parameter	**Specification**
System MTBF (Base Chassis, 40°C)	2,450,000 hours (Telcordia SR-332 Case III)
System MTBF (Fully Populated)	2,100,000 hours (2x RPM, 3x SFM, 8x Line Cards, 6x PSU)
Annual Failure Rate (AFR)	0.0042 (4.2 failures per 1000 units/year)

Mean Time To Repair (MTTR)	2 hours (field replaceable units, hot-swap)
Availability (1+1 Redundant)	99.999% (Five-nines, calculated from MTBF/MTTR)
Form Factor	4RU Modular Chassis (Height: 7.0 inches / 177.8 mm)
Switching Capacity (Max)	28.8 Tbps (non-blocking, full duplex)
Forwarding Rate	8.64 Bpps (64-byte packets)
Power Supply	6x slots, up to 3,000W AC/DC, Hot-swappable, N+1 Redundant
Operating Temperature	0°C to 45°C (Long term), -5°C to 55°C (Short term)
Relative Humidity	5% to 95% (non-condensing)

REGULATORY COMPLIANCE

SAFETY & EMI:

- IEC 62368-1:2018 (Audio/Video/ICT Safety)

- UL 60950-1 / CSA C22.2 No. 60950-1

- EN 55032:2015 Class A (Emissions)

- EN 55035:2017 (Immunity)

- FCC Part 15 Subpart B Class A

RELIABILITY STANDARDS:

- Telcordia GR-63-CORE (Physical Protection)

- Telcordia GR-3108-CORE (Environmental)

- Telcordia SR-332, Issue 4 (MTBF Calculation Methodology, Case III, 40°C, 60% confidence level)

ENVIRONMENTAL:

- RoHS 3 (Directive 2015/863/EU)

- WEEE (2012/19/EU)

- REACH Compliance (EC 1907/2006)

