

Telindus Dynamic Routing Engine (TDRE)

Detailed datasheet

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Features and Benefits

- Uniform feature set for Telindus routers product range
- Uniform set of maintenance and management tools
- All features are standard included
- Including VPN and QoS functionality
- Free upgrades

Introduction

Available on the complete range of Telindus routing devices, the Telindus Dynamic Routing Engine (TDRE) software is a feature-rich operating system that provides a common IP fabric, functionality and maintenance interface across your network. The TDRE guarantees a common feature set across the different product lines and a uniform support by maintenance and management tools. OneAccess operates a policy of free upgrades and includes all functionality in a standard package.

This document describes all features in the TDRE 12.0 release. At the end of this document, one may find the list of new features per TDRE release. As some features are hardware dependent, at the end of this document one may find also a table with the hardware dependent feature set.

TDRE products

The following products are based on the TDRE:

- 1021 Router
- 1030 Router series
- 1061 Router
- 1221 ADSL Router
- 1421 SHDSL Router
- 1422 SHDSL Router
- 1423 SHDSL Router
- 1431 SHDSL CPE
- 2400 Access Concentrator Series
- Crocus Router 10M modular interface

Features

PPP encapsulation

- Encapsulation compliant with RFC 1661, 1662
- LCP (Link Control Protocol)
- IPCP (IP Control Protocol, RFC 1332), including Cisco's subnetmask extension
- BCP (Bridge Control Protocol, RFC 2878)
- CCP (Compression Control Protocol, RFC 1962) with support for the Predictor compression algorithm (RFC 1978)
- CHAP authentication with MD5 hashing (RFC 1994), unidirectional or bi-directional authentication
- MS-CHAP1 (RFC 2433) and MS-CHAP2 (RFC 2759) CHAP authentication protocol extensions
- PAP (PPP Authentication Protocols, RFC 1334), unidirectional or bi-directional authentication
- Multilink PPP (RFC 1990) on devices with more than one interface of the same type

- The MLPPP bundle name or the MAC address can be exchanged
- PPP fragmentation (RFC 1990): enable to fixed size 200 bytes or disable
- Multi-class PPP (RFC 2686)
- Bandwidth Allocation Protocol (BAP) (RFC 2125) for ISDN interfaces

Frame Relay encapsulation

- Encapsulation compliant with RFCs 1490, 2427
- The equipment supports up to 200 DLCIs on a device
- CIR (Committed Information Rate) configurable per DLCI
- EIR (Excess Information Rate) configurable per DLCI
- Inverse ARP over Frame-Relay for automatic gateway configuration
- Different types of LMI (Local Management Interface):
 - revision 1 LMI
 - ANSI T1.617 D
 - ITU-T Q933 Annex A
 - FRF 1.2
- Frame-relay fragmentation (FRF 12)
- Multi-link Frame-Relay (FRF 16.1)

ATM encapsulation

- Higher layer protocols:
 - Classical IP according to RFC 2225 (formerly RFC 1577)
 - Ethernet or IP according to RFC 2684 (formerly RFC 1483)
 - PPPoA (PPP over ATM) according to RFC 2364
 - PPPoE (PPP over Ethernet) according to RFC 2516, 2684
 - auto PPP (in routing mode): an automatic selection is made between PPPoA and PPPoE
- Multiprotocol encapsulation using
 - LLC (Logical Link Control)
 - VC (Virtual Connection) multiplexing
- Reverse ARP for automatic IP address resolution
- Configuration of PCR (Peak Cell Rate) per PVC
- Service categories UBR, CBR, VBR-rt and VBR-nrt. The availability of CBR, VBR-rt and VBR-nrt service categories is hardware dependent.
- ATM cell format ITU-T I.311, I.321, I.361, I.432
- ATM forum UNI 3.1/4.0 PVCs
- ATM forum ILMI 3.1/4.0
- OAM F4 / F5 loop back response (ITU-T I.610)
- OAM F4 / F5 end-to-end loop back generation (ITU-T I.610)
- OAM F5 end-to-end RDI response
- OAM F4 /F5 segment and end-to-end CC (Continuity Check) (Telindus 1431 only)
- OAM F4/F5 segment and end-to-end PM (Performance Monitoring)
- ATM IMA over E1 links (ATM Forum af-phy-0086.001 and ITU-T G.761) (on TIM 6E1 interface)

Other WAN encapsulations

- HDLC encapsulation in bridging mode (not interoperable with Cisco HDLC encapsulation)
- Error test encapsulation for end-to-end error tests over TDM networks between Telindus devices.

Interface characteristics

The definition of an “interface” entirely depends on the configuration of the unit and can correspond to the following:

- A physical interface, e.g. an Ethernet interface, a serial interface ,..
- A Frame-Relay DLCI
- An ATM PVC
- An L2TP Tunnel
- A VLAN

Logical interfaces behave similarly as physical interfaces, except that they don't send interface alarms. One can define up to 255 interfaces on a device.

Physical interface characteristics include:

- Configurable output queue length
- Configurable MRU (Maximum Receive Unit) on HDLC, PPP and Frame Relay interfaces up to a maximum value of 1650 bytes
- Fixed MRU of 2048 bytes on Ethernet interfaces

Dial-up interfaces

- Applicable to ISDN-BRI, ISDN-PRI, PSTN and AUX interfaces
- Dial-up pools if multiple dial-up interfaces are available
- Profiles for dial parameters:
 - Idle timeout and fast idle timeout
 - Number of packets buffered during call set-up
 - Interval between successive calls
 - Call timeout
 - Maximum outgoing call time over a 24 hours period
 - Restriction on time frame within which outgoing calls are possible
 - Maximum number of simultaneous ISDN channels for Multilink PPP
- Minimum number of ISDN channels to keep free for incoming calls
- PPP and Multilink PPP encapsulation for routed IP traffic
- Bandwidth Allocation Protocol (BAP) (RFC 2125) for ISDN interfaces
- Call filtering on incoming and / or outgoing calls, local and remote telephone number
- Channelised E1 interfaces can be used as an ISDN PRI interface (up to 30 simultaneous ISDN calls)
- ISDN callback for dial-out in compliance with the PPP LCP callback extension of RFC 1570. Operations 0, 1 and 3 are supported.
- Leased line operation on ISDN BRI interfaces (aka Standard Festverbindung (SFV))

- ISDN BRI internal and external loopback tests

IP Address assignment and auto-provisioning

- BOOTP/DHCP server (RFC 2131, RFC 2132) with static or dynamic address assignment
- IP address ranges in the DHCP server are configurable per interface
- If no gateway is configured in the DHCP server, the router gives its own address.
- DHCP relay agent (RFC 2131, RFC 2132)
- DNS proxy
- Local DNS server
- Static IP address assignment
- Static ARP entries
- Automatic IP assignment through BootP client (RFC 951)
- Automatic IP assignment through DHCP client (RFC 2131, RFC 2132)
- DHCP client requests can be blocked from being transmitted on the LAN and from bridge groups
- Automatic IP assignment through PPP IPCP
- Possible assignment of secondary IP address on LAN interface
- Automatic IP gateway assignment through Inverse ARP (RFC 2390, in Frame-Relay and ATM)
- Numbered or unnumbered mode on WAN interfaces
- Automatic configuration file upload through DHCP client
- Automatic default route assignment on remotely learned IP address in PPP
- For deployment of many devices in a network, a pre-configuration file can be installed on the device's file system with the minimal configuration to connect to the servers for the auto-provisioning. A reset button allows returning to the pre-configuration (hardware dependent).

IP routing

The equipment complies with the router requirements as stated in RFC 1812 and supports the routing of standard IP packets (RFC 791) between the different interfaces on the equipment according to following routing protocols:

Static routing

Routing is based on static routing entries in the routing table. Alternate routing is possible through the use of different preferences for different routes to the same destination.

Policy based static routing

Normal routing is based on the destination IP address. Policy based routing offers the possibility to define different routing entries based on additional higher layer information. Traffic is routed to a certain interface or gateway based on one or more of the following parameters:

- Source and destination IP address range
- Type Of Service (TOS) value range (8 bits in the IP header, also called DSCP bits)
- IP protocol (examples are any (0), ICMP (1), IGMP (2), TCP (6), UDP (17))
- Source and destination port range for UDP / TCP packets

RIP

- RIP1 compliant with RFC 1058
- RIP2 compliant with RFC 2453
- Split horizon and selective router updates per interface
- Broadcasting of selective RIP updates limited to information on specific network subnets
- RIP2 authentication with MD5 hashing or clear text
- Triggered RIP for ISDN interfaces

OSPF

- Compliant with RFC 2328 (OSPF version 2)
- Import of statically configured routes including the default route
- Route summarization and route suppression through range definitions on areas
- Encryption through simple password or MD5 encryption chains
- OSPF NSSA (RFC 3101)

BGP4

- Border Gateway Protocol version 4 (RFC 1771)

VRRP

- Virtual Router Redundancy Protocol in accordance with RFC 3768
- Critical interfaces list: whenever at least one critical interface is down, the router behaves for VRRP as if it were powered down.

ICMP

ICMP messages (RFC 792) are used to inform the originator of the packets about anomalies:

- “TTL exceeded” messages
- “destination unreachable” messages (configurable)

Multicasting and broadcasting

The TDRE equipment support the handling of broadcasts and multicasts and include the following related functionalities:

- IGMPv2 (Internet Group Management protocol, RFC 2236), as the standard for IP multicasting
- IGMP proxy function
- Enabling or disabling the forwarding of directed broadcasts on an interface
- Setting of helper address for broadcasts, in order to replace the general broadcast address by the address of specific host(s) in the network

IP MTU

- The IP MTU can be configured on the WAN and LAN interfaces (between 500 and 1650 bytes)

IP filtering and firewall

- Filtering of outgoing traffic on all interfaces based on extended access lists
- Filtering of incoming traffic on all interfaces based on extended access lists

- Filtering on incoming traffic on the IP protocol stack based on an extended access list
- IP extended access lists filter on the following parameters:
 - Source and destination IP address range
 - Type Of Service (TOS) value range (8 bits in the IP header, also called DSCP bits)
 - IP protocol (examples are any (0), ICMP (1), IGMP (2), TCP (6), UDP (17))
 - Source and destination port range for UDP / TCP packets
- Stateful inspection firewall with 3 zones (Internet, Corporate, DMZ) and Self (IP protocol stack)
- Outbound and inbound policies based on
 - Source and destination IP address range
 - Application (IP protocol and port range)
- PAT can be applied per outbound / inbound policy
- Outbound and inbound policies for the IP protocol stack
- Protection against attacks including Denial of Service attacks (DoS): SYN flooding, Source routing, winNuke, FTP bounce, IP unaligned timestamp, MIME flood, Sequence number prediction, Sequence number out of range, ICMP error messages
- Firewall status and performance values
- Firewall logging with different priorities
 - Configurable per policy
 - Thresholds per attack type

Bridging and VLANs

Bridging

- Spanning tree protocol (IEEE 802.1D). The spanning tree protocol allows having multiple paths between two sites, building redundancy in the connection.
- Bridging may be enabled or disabled for each of the available interfaces on the router and may be combined with IP routing on the same interface.
- Filtering of packets on source MAC-address on outgoing traffic
- 10.000 MAC addresses cache
- Self-learning bridge may be disabled to operate it as a repeater
- Maximum size of Ethernet frames depends on the device, but is guaranteed at least 1650 bytes
- VLAN support (802.1Q)
- Multiple bridge groups: a bridge group is a collection of interfaces that are connected through bridging. These interfaces may be physical or logical interfaces. In case a bridge-group is connected to a logical Ethernet VLAN interface, it is possible to forward or strip-off the VLAN ID (untagging) before sending the Ethernet packets to the other interfaces of the bridge group.
- Within a bridge group, an IP address can be defined for management purposes. Also secondary IP addresses can be configured.
- MAC address configurable per bridge group
- Between different bridge-groups in the equipment, routing may be enabled.
- Multiple VLANs may be defined in the interface within a bridge group towards the IP router.
- IP TOS to 802.1P COS mapping and COS to TOS mapping are available on the LAN interface and the data sent between a bridge group and the IP router in order to maintain priority information when changing from IP to VLAN or vice versa.
- Up to 250 VLANs per LAN interface

- On the LAN interfaces and in bridge groups, MIB2 performance counters are available per VLAN

VLAN switching

- A bridge-group can also be configured as a “VLAN switch” In this case a mapping is done between a VLAN ID on one interface and a VLAN ID on another interface. For this purpose, a VLAN switching table is used. This table can also be used for “tagging” or “untagging” VLAN tags and for changing the 802.1P priority tags.
- In VLAN switching mode, Q in Q as defined in IEEE 802.1ad is available.
- No practical limit on the number of VLANs in VLAN switching mode
- VLAN switching performance table
- VLAN switching mode can be combined with bridging mode for packets on the same interface.

Filtering

- Filtering of outgoing bridged traffic on all interfaces based on access lists
- Bridge access lists filter on source MAC addresses
- Advanced access lists. The filtering is based on source and destination MAC address ranges, the layer 3 protocol field, the number of TCP SYN packets per minute and VLAN tag and priority bits. This advanced filtering can be configured per interface both in inbound and outbound directions.
- Limit broadcasts in a bridge group selectively by interface. A proxy ARP cache avoids losing ARP requests.

Network address translation (NAT and PAT)

- Compliant with RFC 3022
- NAT mode for one-to-one private to public IP address translation
- PAT mode for many-to-one private to public IP address translation (also called port mapping, single address NAT or NAPT)
- NAT/PAT configurable on any interface (the interface with the public address(es))
- Up to 5 NAT/PAT interfaces
- List of UDP/TCP port numbers that should not be translated
- Reverse NAT or Port Forwarding (List of incoming UDP/TCP port numbers destined for a server)
- Easy NAT: CPE learns official IP address via PPP
- Application Layer Gateway (ALG) Support including:
 - General: FTP, ICMP (Echo, Echo response, Destination unreachable, time exceed & source quench), SQLNet
 - Microsoft Games
 - Video / Streaming applications: RTSP, QuickTime, Real Player (Real Audio / Real Video), H.323 (ASN1 PER encoding and decoding included), NetMeeting , Intel Video Phone, CuseeMe 5.0, SIP Audio
 - Communication: Internet Chat, IRC – MIRC, AOL Instant Messenger, AOL enhanced chat, ICQ2000b, Net2Phone, Microsoft Messenger
- Security Related: PPTP, IPSec ESP (IPSec client from internal network), IKE, L2TP

Tunneling and VPNs

PPPoE

- A PPPoE server is available on the LAN interfaces and in the bridge groups. Up to 100 PPPoE sessions can be terminated.
- PPPoE clients can be set-up on the LAN interface

L2TP tunneling

The Layer 2 Tunneling Protocol emulates a point-to-point connection over an IP network.

- Compliant with RFC 2661
- Available on WAN and LAN interfaces
- Tunnel authentication
- Available for IP and bridged PDUs
- Static and dynamic tunnels. Dynamic tunnels are set-up only if data is to be sent.
- One L2TP tunnel between each pair of IP addresses
- One PPP session per L2TP tunnel
- L2TP tunnels can be set up from an interface running NAT/PAT
- L2TP backup tunnels
- RIP snapshot routing on L2TP tunnels

GRE tunneling

- Generic Routing Encapsulation (GRE) (RFC 1701-1702)

IPSec security

- Compliant with RFCs 2401 and succeeding
- L2TP transport mode (RFC 3193)
- IPSec tunnel mode or Native IPSec (RFC2406)
- ESP (Encapsulation Security Payload), allowing authentication of the sender and encryption of the data (RFC 2406)
- DES (56 bits; RFC 2405), 3DES (3 * 56 bits; RFC 2451) and NULL (RFC 2410) encryption. The availability of the different encryptions may be hardware dependent. See table at the end of this document.
- HMAC (Keyed-Hashing for Message Authentication) based on MD5 (RFC 2403) and SHA-1 (RFC 2404) for integrity and authentication
- Manual SAs (Security Association)
- IKE preshared SAs
- IKE certificate SAs; certificates manually installed or installed via Simple Certificate Enrollment Protocol (SCEP)
- Key management protocol framework compliant with
 - RFC 2408 "Internet Security Association and Key Management Protocol"
 - RFC 2407 "IP Security Domain of Interpretation for ISAKMP"
 - RFC 2409 "Internet Key Exchange" (IKE)
- NAT Traversal (NAT-T) in compliance with RFC 3947 and 3948

Note: On the standard equipment, the software handles the IPSEC encryption. As this is a processor-consuming task, the forwarding performance of the equipment decreases. Therefore, some equipment is also available in a version with a hardware accelerator chip. This chip takes care of the encryption / decryption, unburdening the software of this task.

Quality of Service (QoS)

Traffic classes

The Quality of Service mechanism is based on total of 7 forwarding queues per interface. Queues are numbered 1 to 7 with 1 the lowest priority and 7 the highest. Six of them are for user data, while the last one is a system queue:

Queue	Queue type	Description
1 – 5	configurable queue	Standard queues
6	low delay queue	This queue is always addressed between every user configurable queue and should be used by delay sensitive traffic.
7	system queue	This queue is filled with link monitoring messages etc. and has priority over all other queues.

IP traffic classification and policing

The classification and policing of the traffic between the different queues occurs through an IP Traffic Policy. The following traffic policies are defined:

Traffic shaping

Based on a variety of TCP/IP protocol parameters, a complete customised policy may be set. The elements that define how the traffic is forwarded to a certain priority queue are the following:

- Source and destination IP address range
- Type Of Service (TOS) value range (8 bits in the IP header, also called DSCP bits)
- IP protocol (examples are any (0), ICMP (1), IGMP (2), TCP (6), UDP (17))
- Source and destination port range for UDP / TCP packets

During traffic classification, the TOS/DSCP value may be remarked as well. The maximum queue length in packets (before packets are dropped) is configurable.

Performance information is available on classified traffic: number of discards and usage of each line in the traffic-shaping table

TosDiffServ

The data is redirected to the queues based on *DiffServ* (RFCs 2474, 2475) regarding class and drop precedence. This means that, depending on their Type Of Service (TOS) field, some packets are moved to other queues and/or dropped sooner than other packets in case the queue is full.

The highest 3 bits of the TOS field are mapped as follows:

Bit values	correspond with
000 up to 100	queues 1 up to 5, respectively
101 and higher	the low delay queue

The next 2 bits define the drop precedence:

Bit values	packets are dropped if
00 and 01	the queue length exceeds a configurable maxLength1
10	the queue length exceeds a configurable maxLength2
11	the queue length exceeds a configurable maxLength3

TosMapped

This simple and flexible policy allows classifying the traffic based on a user-defined range of the TOS field into one of the queues. The maximum queue length in packets (before packets are dropped) is configurable.

Bridge traffic classification

In case of VLAN tagged Ethernet traffic, the 802.1P tag can be used to map the traffic to any of the priority queues described above.

Traffic shaping and policing

Per queue, a committed information rate (cir) is configurable. Per queue the bandwidth is measured over a period of time. Traffic that exceeds the cir value is no longer serviced conform the selected priority policy but is queued until there are no other queues with traffic below their cir value. If the maximum queue length is meanwhile reached, additional packets are dropped. This is also called Committed Access Rate (CAR).

Priority scheduling

The way that the *configurable queues* are transmitting data can be selected according to different algorithms. It is also called Priority Queuing (PQ). Each queue has a quatum and a weight parameter. The quatum defines how many data are taken from the queue each time. The quatum is

expressed in bytes or packets. The weight parameter defines the relative number of times this queue is emptied. Following algorithms are implemented:

- FIFO (first in first out): no separate priority queues are in use
- Round Robin: the configurable queues all have equal weight
- Absolute Priority: the queues have no weight nor a quatum. A lower priority queue is emptied only if all higher priority queues are empty.
- Weighted Fair Queuing: weights are configurable per configurable queue. If the traffic classification is based on DSCP (tosDiffServ) bits, this is commonly called WFQ. If the traffic classification is using traffic shaping, this is commonly called Class Based Weighted Fair Queuing (CBWFQ).
- Low delay Weighted Fair Queuing: weights are configurable per configurable queue. Data in the low delay queue is always emptied prior to any data in the user configurable queues. This is commonly called Low Latency Queuing (LLC).

Access Security

The equipment is password protected for access through the different maintenance and management tools. For each router one can define a variety of users, where each user can be given a customised access-right to the equipment. The access-right is based on a combination of following elements:

- Read-access: read all parameters except security parameters
- Write-access: write all parameters except security parameters
- Security-access: read and change security parameters
- Filesystem-access: access to the file system (configuration, firmware files...)

The unit also features a Radius client (RFC 2865), that can be used for authentication, authorisation and accounting (AAA) of network maintenance sessions, or for PPP sessions initiated by remote devices.

Per interface one can enable/disable all access to the device for traffic coming from this interface. Overall access with specific management tools can be prohibited (telnet – HTTP, SNMP, TFTP, FTP).

All accesses (successful and failed logins) are logged.

Maintenance and Management tools

The equipment is supported by a wide set of local and remote maintenance and management tools. These tools include:

- TMA (Telindus Maintenance Application): A free graphical maintenance application delivered with the equipment. It can be used to access the device through a local serial connection or through an IP connection (UDP port 1728).
- TMA CLI: stand-alone command line console software
- TMA for HP OpenView: management integration in HP Openview NNM
- TMA Element Management: stand-alone Element Management

- Local console: a standard VT100 connection with command line or interactive menu-driven user interface
- TELNET server with command line or interactive menu-driven user interface (RFC 854)
- TELNET client from the console port and from within another telnet session.
- HTTP interactive menu-driven web user interface (RFC 2616)
- HTTP interface available on ports 80 and 8080
- Customisable JAVA based web interface
- 5 simultaneous TMA, TMA CLI, local console, telnet and HTTP sessions
- PING (RFC 792) request and reply with extended options
- Traceroute command with extended options
- TFTP configuration and software download (RFC 1350)
- FTP configuration and software download (RFC 414)
- TML: Telindus Memory Loader for the download of configuration or software through the serial console port
- SNMP version 1 (RFC 1157)
- SNMP version 2 (RFCs 3416-3418). The release of SNMPv2 involves SNMP private MIB files that are different from the ones before TDRE 12.0. Both versions may co-exist in a network.
- SNMP version 3 (RFCs 3413-3415) (without the use of a RADIUS server)
- SNMP MIB2 (RFC 1213), private MIB
- SNMP traps (RFC 1215)
- SYSLOG event logging generation (RFC 3164)
- Simple Network Time Protocol (SNTP) (RFC 2030)
- IP loop back address
- The absolute performance counters can be cleared overall or per object
- Dual software image allows secure firmware upgrades
- Mode to automatically boot up from the most recent stored software version
- Compressed software image allows fast transfer and compact storage in Flash memory

Features history

New features in TDRE 11.0

PPP encapsulation

- MS-CHAP1 (RFC 2433) and MS-CHAP2 (RFC 2759) CHAP authentication protocol extensions
- Multi-class PPP (RFC 2686)
- Bandwidth Allocation Protocol (BAP) (RFC 2125) for ISDN interfaces

Frame Relay encapsulation

- Frame-relay fragmentation (FRF 12)
- Multi-link Frame-Relay (FRF 16.1)
- Improved algorithm for the CIR/EIR calculation
- The total number of DLCIs on a device is increased from 40 to 200

ATM encapsulation

- OAM F4 /F5 segment and end-to-end CC (Continuity Cells) (Telindus 1431 only)

Other WAN encapsulations

- Error test encapsulation for end-to-end error tests over TDM networks between Telindus devices
- Leased line operation on ISDN BRI interfaces (aka Standard Festverbindung (SFV))

Interface characteristics

- Configurable MRU (Maximum Receive Unit) on HDLC, PPP and Frame Relay interfaces up to a maximum value of 1650 bytes (default 1560 bytes)

Routing

- Policy based routing can also be used on interfaces with NAT and/or PAT
- Triggered RIP for ISDN interfaces
- OSPF routing protocol
- The IP MTU can be configured on the WAN and LAN interfaces (between 500 and 1650 bytes)

IP filtering and firewall

- Filtering of incoming traffic on all interfaces based on extended access lists
- Filtering on incoming traffic on the IP protocol stack based on an extended access list

Bridging and VLANs

- MAC address configurable per bridge group
- IP TOS to 802.1P COS mapping and COS to TOS mapping are available on the LAN interface to maintain priority information when changing from IP to VLAN or vice versa.
- In VLAN switching mode, Q in Q as defined in IEEE 802.1ad is available.
- Limit broadcasts in a bridge group selectively by interface. A proxy ARP cache avoids losing ARP requests.

Network Address translation (NAT and PAT)

- Up to 5 NAT/PAT interfaces

Tunneling and VPNs

- L2TP tunnels can be set up from an interface running NAT/PAT

Quality of Service

- Per queue, a committed information rate (cir) is configurable. Per queue the bandwidth is measured over a period of time. Traffic that exceeds the cir value is no longer serviced conform the selected priority policy but is queued until there are no other queues with traffic below their cir value. If the maximum queue length is meanwhile reached, additional packets are dropped.

New features in TDRE 11.1

ATM encapsulation

- In routing mode, auto PPP is available on ATM PVCs: an automatic selection is made between PPPoA and PPPoE.

IP Address assignment and auto-provisioning

- DNS proxy:
 - If the router has a static DNS server address is configured or it has received a DNS server address via a DHCP request (as a DHCP client), the router uses that address in DHCP replies (as a DHCP server).
 - If the router has not yet a DNS server address, it uses its own address as a DNS server address in DHCP replies with a short lease time.
- The router relays DNS requests to configured or learned DNS servers.
- DHCP client requests can be blocked from being transmitted on the LAN and from bridge groups.

Bridging and VLANs

- Multiple VLANs may be defined in the interface within a bridge group towards the IP router.
- IP TOS to 802.1P COS mapping and COS to TOS mapping are available on the data sent between a bridge group and the IP router to maintain priority information when changing from IP to VLAN or vice versa.

Tunneling and VPNs

- A PPPoE server is available on the LAN interfaces and in the bridge groups. Up to 100 PPPoE sessions can be terminated. This feature is only available on Telindus 1061 Router and Telindus 2400 Series.

Quality of Service

- Performance information is available on routed traffic shaped data: number of discards and usage of each line in the traffic-shaping table.

Maintenance and management tools

- Customisable JAVA based web interface

New features in TDRE 11.2

Routing

- The OSPF status information has been extended with
 - the received netmask in the network LSAs table, the summary LSA table and the external LSA table
 - the imported type in the table of external routes
- Default metrics can be configured for importing RIP and static routes into OSPF.
- The import of external routes into OSPF can be filtered.
- Virtual Router Redundancy Protocol in accordance with RFC 3768
- Critical interfaces list: whenever at least one critical interface is down, the router behaves for VRRP as if it were powered down.

Bridging and VLANs

- Secondary IP addresses can be configured on the bridge group

- On the LAN interfaces and in bridge groups, MIB2 performance counters are available per VLAN

New features in TDRE 11.3

Dial-up interfaces

- Channelised E1 interfaces can also be used as an ISDN PRI interface. On this interface up to 30 simultaneous ISDN calls can be terminated and / or initiated.
- ISDN callback for dial-out is available in compliance with the PPP LCP callback extension as defined in RFC 1570. Operations 0, 1 and 3 are supported.

IP Address assignment and auto-provisioning

- IP address ranges in the DHCP server are configurable per interface
- The DHCP server collects the DNS names of all DHCP clients and acts as a local DNS server for these names

Bridging and VLANs

- VLAN switching performance table
- The number of entries in the VLAN table on the LAN interface or bridge group is no longer restricted to 25. The total number of interfaces however remains restricted to a maximum 255.
- VLAN switching mode can be combined with bridging mode for packets on the same interface.

Maintenance and management tools

- The WEB interface is also available on port 8080: this allows connecting the web interface in case a NAT service is defined at port 80.

Tunneling and VPNs

- L2TP tunnel discard: allows resetting the main tunnel and closing the routes to the main tunnel when the tunnel is no more available. This ensures that the routes over the tunnel are down instead of spoofing.
- RIP snapshot routing possible on L2TP tunnels

New features in TDRE 11.4

IP filtering and firewall

- Firewall with 3 zones (Internet, Corporate, DMZ) and Self (IP protocol stack)
- Outbound and inbound policies based on
 - Source and destination IP address range
 - Application (IP protocol and port range)
- PAT can be applied per outbound / inbound policy
- Outbound and inbound policies for the IP protocol stack
- Protection again attacks: SYN flooding, Source routing, winNuke, FTP bounce, IP unaligned timestamp, MIME flood, Sequence number prediction, Sequence number out of range, URL filtering, ICMP error messages
- Firewall status and performance values

- Firewall logging with different priorities
 - Configurable per policy
 - Thresholds per attack type

Network address translation (NAT and PAT)

- Application Layer Gateway (ALG) Support including:
 - General: FTP, ICMP (Echo, Echo response, Destination unreachable, time exceed & source quench), SQLNet
 - Microsoft Games
 - Video / Streaming applications: RTSP, QuickTime, Real Player (Real Audio / Real Video), H.323 (ASN1 PER encoding and decoding included), NetMeeting, Intel Video Phone, CuseeMe 5.0, SIP Audio
 - Communication: Internet Chat, IRC – MIRC, AOL Instant Messenger, AOL enhanced chat, ICQ2000b, Net2Phone, Microsoft Messenger
 - Security Related: PPTP, IPsec ESP (IPsec client from internal network), IKE, L2TP

Tunneling and VPNs

- IPsec Key management protocol framework compliant with
 - RFC 2408 “Internet Security Association and Key Management Protocol”
 - RFC 2407 “IP Security Domain of Interpretation for ISAKMP”
 - RFC 2409 “Internet Key Exchange” (IKE)
- IKE with preshared Sas

New features in TDRE 11.5

ATM encapsulation

- Service categories VBR-rt and VBR-nrt. The availability of VBR-rt and VBR-nrt service categories is hardware dependent.

IP Address assignment and auto-provisioning

- For deployment of many devices in a network, a pre-configuration file can be installed on the device's file system with the minimal configuration to connect to the servers for the auto-provisioning. A reset button allows to return to the pre-configuration (hardware dependent).

IP routing

- OSPF NSSA (RFC 3101)
- Default route import into OSPF

PPP

- The MLPPP bundle name or the MAC address can be exchanged
- Fragmentation can be disabled in MLPPP

Dial-up interfaces

- The AUX port can be used as a dial-out interface (to connect e.g. a PSTN modem)
- ISDN BRI internal and external loopback tests

Tunneling and VPNs

- IKE with certificate Sas on devices with TDRE 11.4 features
- Certificates manually installed or installed via Simple Certificate Enrollment Protocol (SCEP) on devices with TDRE 11.4 features
- NAT Traversal (NAT-T) in compliance with RFC 3947 and 3948. NAT-T is an add-on to the IKE and Ipsec protocols that make them work when going through NAT.

Access security

- Access logging (successful and failed logins)

Maintenance and Management tools

- Traceroute command with options like DSN name resolution, source IP address, packet length, TOS value and timeouts
- FTP supports Windows XP SP2
- The absolute performance counters can be cleared overall or per object

New features in TDRE 12.0

Kernel

- The Operating System has been adapted with an improved buffer management. This has an impact on the overall performance and in particular with some software modules like the firewall.
- There is a common driver for all physical interfaces.
- The use of general RAM memory and of Dual Port RAM memory has been optimised.

ATM encapsulation

- ATM OAM F4/F5 segment and end-to-end PM (Performance Monitoring)

Interfaces

- The status attributes ifDropLevelExceeded and QLenght have been added on the LAN interfaces.
- There is an additional configuration attribute to enable/disable automatic retrain of the line interface if the layer 2 on the line interface becomes down (attribute layer2Check).
- Timed statistics (2h, 24h, 7d) are now available per port on an Ethernet switch.

Dial-up interfaces

- The no-traffic timer is now separate for the incoming and outgoing traffic on ISDN & PSTN connections. This corrects backup issues where the backup link remains open due to data traffic flowing in a single direction on the main and the backup link.

IP address assignment and auto-provisioning

- Static ARP entries

IP routing

- Border Gateway Protocol version 4 (RFC 1771). It has been tested for 1000 prefixes and 10 simultaneous sessions to other routers.
- New RIP attribute clearNextHop; when this attribute is enabled, the nextHop parameter in an advertised RIP route is set to zero. The default value is disabled.
- Static routes that are reachable via an Ethernet interface can be configured without a gateway attribute. This simplifies configuration.
- Configuration attribute 'sendHostUnreachable' with options enable/disable added (default enabled)

Bridging and VLANs

- Advanced access lists in bridged mode. The filtering is based on source and destination MAC address ranges, the layer 3 protocol field, the number of TCP SYN packets per minute and VLAN tag and priority bits. This advanced filtering can be configured per interface both in inbound and outbound directions.

Network address translation (NAT and PAT)

- A flood ping over standard NAT is supported.

Tunneling and VPNs

- Generic Routing Encapsulation (GRE) (RFC 1701-1702)
- IPSec tunnel mode or Native IPSec (RFC2406)
- PPPoE clients can be set-up on the LAN interface

Maintenance and Management tools

- SNMP version 2. The release of SNMPv2 involves SNMP private MIB files that are different from the ones before TDRE 12.0. Both versions may co-exist in a network.
- SNMP version 3 (without the use of a RADIUS server)
- Wherever 2 hours and 24 hours statistics are available, also 7 days statistics are available now.
- TELNET client from the console port and from within another telnet session.

Product specific issues

TDRE versions per product

The table below indicates per product and per TDRE version whether these TDRE features are available in the latest firmware. When available, the latest firmware version matching this TDRE version is listed.

Feature	1021 Router	1030 Series	1061	1221	1421 1422 Crocus Router 10M Intf	1423	1431	2400 Series
TDRE 11.0	√	T2802/01700	T2410/00800	√	T2852/02400	√	T2855/01400	T2402/00800 T2403/00800 T2404/00800
TDRE 11.1	√	T2802/01900	T2410/01100	T2858/00400 T2861/00400	T2852/02600	√	T2855/01800	T2402/01400 T2403/01200 T2404/01200
TDRE 11.2	T2858/00500	T2802/02000	√	T2858/00500 T2861/00500	T2852/02700	√	√	√
TDRE 11.3	√	T2802/02300	T2410/01500	√	T2852/02900	√	√	T2402/01700 T2403/01500 T2404/01500
TDRE 11.4	T2858/00700	√		T2858/00700 T2861/00700		√		
TDRE 11.5	T2858/01400	T2802/02900	T2410/02000	T2858/01400 T2861/01400	T2852/03200	T2863/00700	T2855/02200	T2402/02000 T2403/02000 T2404/02000
TDRE 12.0	(1)(2)	(1)(2)		(1)(2)	(1)(2)	(1)(2)	(1)(2)	

- See the download center on the Telindus website <http://www.telindusproducts.com> to find the latest firmware version
- The current TDRE 12.0 versions are Early Deployment (ED) versions

WAN encapsulations

Products	1030	1030	1021 1030 1221 1423	1021 1030 1221 1423	1221	1030	1421	1221 1422 1423 ¹ 1431 2400	1061 2400	1061 2400	1061 2400	Cr Rtr 10M Intf
Interface type	G703	RS530	ISDN-BRI	ISDN- BRI LL	PSTN	AUX	DSL	DSL	TIM 6E1 ¹	TIM E3/T3 ¹	TIM STM1 ¹	Basic Unit interface
PPP	√	√	√	√	√	√	√		√ ²	√		√
Multilink PPP	√		√	√					√ ²			
Multi-class PPP	√			√			√		√			√
Frame Relay	√	√		√			√		√ ²	√		√
Multilink Frame Relay	√			√					√ ²			
HDLC	√	√		√			√					√
Error test	√	√		√			√					√
ATM	√ ³	√					√	√	√	√	√	
ATM IMA									√			

- The Telindus 1423 SHDSL 2ETH-4P HWA version supports additional WAN encapsulations like the Telindus 1421 Router.
- In PPP and Frame Relay modes, the E1 interfaces operate in framed mode, possibly in fractional E1
- Only ATM on the first E1 interface on the Telindus 1032, no ATM on the 1035

Other features

Feature	1021 Router	1030 Series	1061	1221	1421	1422	1423	1431	2400 Series	Crocus Router 10M Interface
Hardware accelerator (HWA)	√ ²	√ ¹		√ ²	√ ¹		√ ²			
DES encryption	√	√	√	√	√	√	√	√	√	√
3DES encryption	√	√		√	√	√	√			
Routing performance (pps)	100000	45000	175000	60000 100000 ³	40000	40000	60000 100000 ³	40000	175000	45000
Routing performance with IPSec 3DES encryption using HWA (pps)	26000	4200		26000	4000		26000			
Bridging performance (pps)	110000	36000	175000	75000 110000 ³	30000	30000	75000 110000 ³	30000	175000	36000
# Bridge groups	13	13	25	13	13	13	13	13	25	13
# IPSEC tunnels	25	10	25	25	10	10	25	10	25	10
# L2TP tunnels	25	10	25	25	10	10	25	10	25	10
# ATM PVCs	-	31	200	31	31	31	31	30 ⁴	200	
ATM CBR service category	-	-	√	√	-	-	√	√	√	-
ATM VBR-rt & VBR-nrt service	-	-	√	√	-	-	√	√	√	-
ATM OAM Performance Management (PM)	√	-	√	√	-	-	√	√	√	-
Statefull inspection firewall & application layer gateway	√	√	-	√	-	-	√	-	-	-
ISAKMP, IKE & IPSEC certificates	√	√	-	√	-	-	√	-	-	-
BGP4, GRE, native IPSEC	√	√	√	√	-	-	√	-	√	-
PPPoE client on the LAN	√	-	-	√	-	-	√	-	-	-
PPPoE server	-	-	√	-	-	-	-	-	√	-
Flash memory (M Byte)	8	16	64	8	8	8	8	8	16	8
RAM memory (MByte)	16	16 ⁵	256	16	8	8	16	8	32	8
Customisable JAVA web interface	√			√			√			
Reset button	√			√			√			

(1) Available on specific versions with indication 3DES

(2) Available on specific versions with indication HWA

(3) Highest value for versions with built-in hardware accelerator

TDRE

(4) This includes up to 12 routed/bridged PVCs and either (18 FRF.5/FRF.8 PVCs) or (18 ATM over E1 PVCs) or (5 CES PVCs + 1 low speed management PVC)

(5) 64MByte on the Telindus 1035

