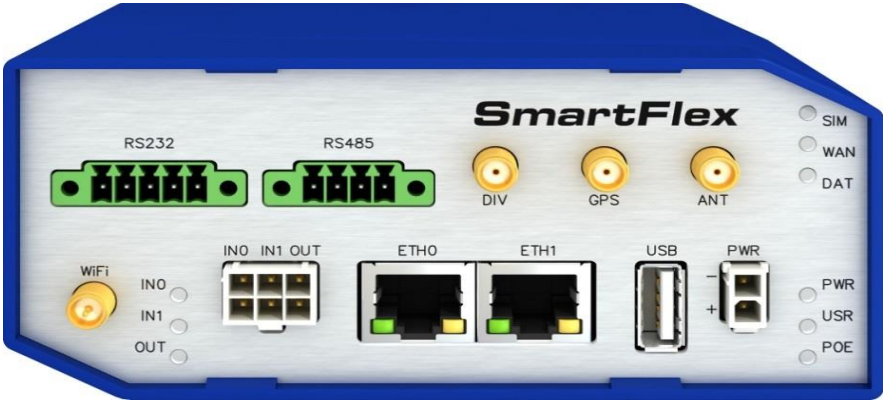




Router Features

APPLICATION NOTE



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1. Operating System

Linux-based operating system is tailored for Advantech cellular routers. It combines the simplicity of a web-based configuration with a flexibility of an open platform that allows the development of custom configuration scripts and Router Apps (User Modules). The functionality described in this chapter is supported by the latest router firmware.

LAN	
Ethernet	10 or 100 Mbps, half or full duplex IEEE 802.1X Authentication (client) with EAP-PEAP/MSCHAPv2 or EAP-TLS Bridged interfaces 802.1d Spanning Tree Protocol (configurable by a script only)
IPv4 IPv6	Multicast support IPv6 is not supported by routers of v2 platform.
DHCP Client	Configurable DHCP client
DHCP Server	Dynamic and static DHCP leases Configurable lease time IPv6 prefix delegation
DNS Forwarder	Support for the DNS Forwarder
DHCP Relay	Support for the DHCP Relay Agent
VLAN	Configurable by a script only

Connectivity	
Mobile WAN	GPRS, UMTS, or LTE with PAP and/or CHAP authentication Up to 2 SIM cards, possibly with a PIN number SIM switching based on connection failure, roaming status, data limit or Binary Input Dial number for GPRS or CSD Private APN Traffic limit monitoring with SMS warnings on limit exceedance Traffic history for past 60 days SIM lock and unlock
PPPoE client	Connection e.g. to an ADSL router PAP and/or CHAP authentication
Wi-Fi Access Point Wi-Fi Station	IEEE 802.11b+g+n (2.4 GHz) or IEEE 802.11a+n (5 GHz) WPA/WPA2/WPA3 authentication Pre-Shared Key (PSK) or an external RADIUS server (Enterprise) WEP, TKIP or AES encryption 40 MHz channel width option for 802.11n Wi-Fi Multimedia (WMM) Quality of Service (QoS) Accept or Deny list of client MAC addresses SSID isolation Client isolation Simultaneous operation of Wi-Fi Access Point and Wi-Fi Station modes for selected HW options Support for two SSIDs in AP mode (<i>multi SSID</i>)

Routing	
Static routes	Forward traffic to a specific destination via a given gateway and interface
Backup routes	Switch to one or more backup connections upon connectivity failure Backup via Mobile WAN, PPPoE, Wi-Fi Station or Ethernet Ability to use multiple WAN connections in parallel, optionally with load balancing based on defined weight
VRRP	v2 or v3 protocol Automated switch based on traffic monitoring and/or ping
Stateful Firewall	Allow or block incoming traffic from given sources Allow or block traffic forwarding between given sources and destinations Protection about most common DoS attacks Up to sixteen rules for both the incoming and forwarded packets
NAT	Access from public WAN to selected services Forwarding of input traffic to a specific IP address and port Forwarding of all remaining traffic to a default server Port Address Translation (PAT) Masquerading of outgoing packets NAT64
QoS	Configurable by a script only

VPN	
Cisco FlexVPN	Cisco's implementation of the IKEv2 standard featuring Can be enabled on the IPSec configuration page
IPsec	Policy-based or route-based VPN policy support IKEv1/IKEv2 protocol (RFC 7296) Certificate-chain based validation Dynamical IP address and interface update with IKEv2 MOBIKE (RFC 4555) Authenticated by a pre-shared secret, or RSA / ECDSA X.509 certificates Wide range of ciphers for payload protection, up to AES256/SHA512 Meets NIST recommended cryptographic strength beyond year 2030 Dead Peer Detection (RFC 3706) Perfect Forward Secrecy
OpenVPN	IPv4 or IPv6, UDP or TCP, client or server protocol Authentication via a pre-shared secret or a X.509 certificate
GRE Tunnels	Support for Multipoint tunnels (see the Router Apps called <i>Protocol NHRP</i>) Keyed tunnels (32-bit pre-shared secret) Support for multicast
L2TP client or server	Managed L2TP v1 (RFC 2661) Unmanaged L2TP v3 (Pseudowire) MTU and RTU configurable
PPTP client or server	PPTP Passthrough support MTU and RTU configurable
WireGuard	Up to four tunnel configurations

Services	
DynDNS client	Dynamic DNS Update API (dyn.com) Registers IPv4 and/or IPv6 address
NTP client NTP server	Connection towards up to 2 remote NTP servers NTPv3 protocol
SSH server SFTP server	For Admin users only
Telnet server	Remote console (the usage not recommended due to the security reasons)
FTP sever	File transfer for authenticated users (the usage not recommended due to the security reasons)
Expansion ports	Access to RS232/485/422 via UDP or TCP client/server Supports also USB to serial converters
External data storage	USB flash or SD card

Administration	
User authentication (PAM)	Based on local database, or based on remote RADIUS or TACACS+ server Admin and User roles Configurable password complexity enforcement Optional provisioning of remote users to the local database
Web / HTTP(S)	Secured using TLS 1.2 Brute force attack protection: IP is banned for 1 minute after 3 login fails
SNMP agent	SNMP v1/v2 or v3 Standard MIB for system information, network interfaces Custom MIB for mobile WAN connectivity, GPS and extension boards Remote control of Binary I/O Reporting via regular SNMP Traps
SMTP(S) client	Secured using SSL/TLS or STARTTLS Send e-mails from startup script
SMS	Notifications on significant events such as reboot or WAN outage Remote control, such as WAN (dis)connection or profile switch User-initiated SMS via AT command or TCP/serial
Custom Scripts	On startup On interface up/down
Statuses	Network, Mobile WAN, Wi-Fi, DHCP, IPsec, DynDNS
Logging	Limited local storage Export to defined syslog server, compliant with RFC 3164
One click report	Collection of a router configuration and all status information Used for troubleshooting by customer support

Configuration	
Profiles	Named configuration used for dynamic router reconfiguration. Up to four independent configuration profiles.
Backup and Restore	Of a router configuration, possibly including the defined users Stored in a password protected file
Automatic update	Firmware and/or router configuration Every 24 hours after reboot, at scheduled time Download from Web HTTP/FTP and/or USB flash drive
Upgrade rollback	When the router does not reboot after upgrade, the upgrade is reverted (not supported by routers of v2 platform).

2. Router Apps (User Modules)

The core functionality can be extended using one or more User Modules. Beyond the large set of modules we offer a Software Development Kit (SDK) so users can easily create their own modules.

Connectivity	
Band Select	Adjust the portfolio of frequency bands which router supports
Backup APN	Switch to a secondary APN if the primary fails
Ethernet Mirroring	Mirror traffic from one Ethernet interface to another
Modem Bonding	Bond connectivity of multiple routers to a single master
PPP Gateway	Provide internet access to older devices connected via a serial line only
Transparent mode	Transfer mobile WAN IP address is to connected device on ETH
Easy VPN client	Provides secure connection of LAN network behind our router with LAN network behind CISCO router.
WiFi SSID Switch	Automatically switch between up to four Wi-Fi Access Points
WiFi STA Relay	WiFi station transparent mode (interface in client mode bridged to ETH)
802.1X Authenticator	Requires an external RADIUS server List of exempted MAC addresses
Layer 2 Firewall	Allow or deny traffic from a given MAC address
NAT	Source NAT (SNAT) and Destination NAT (DNAT)
URL Blocker	Block selected domain names (URLs)

Routing	
RIP RIPng	RIP v1 (RFC 1058) RIP v2 (RFC 2453) RIPng for IPv6 (RFC 2080) RIP-2 MD5 Authentication (RFC 2082)
OSPF	OSPF v2 (RFC 2328) OSPF v3 for IPv6 (RFC 2740) Opaque LSA Option (RFC 2370) Not-So-Stubby Area (NSSA) (RFC 3101) Stub Router Advertisement (RFC 3137)
IPSec-Tools	IPSec-Tools is used for IPsec configuration. This user module uses Racoon instead of OpenSwan.
IS-IS	IS-IS (ISO/IEC 10589, RFC 1195) IPv6 support (RFC 5308)
NHRP DMVPN	NHRP (RFC 2332)

BGP	BGP v4 (RFC 1771) Autonomous Systems (RFC 1965) Communities Attribute (RFC 1997) Capabilities Advertisement (RFC 2842) Multiprotocol Extensions (RFC 2858) Multiprotocol Extensions for IPv6 Inter-Domain Routing (RFC 2545) Route Reflection (RFC 2796)
PIM-SM	Revised PIM-SM protocol (RFC 4601) Bootstrap Router (BSR) Mechanism (RFC 5059)
OpenVPN custom config	Text-based configuration of OpenVPN tunnels
EasyVPN Client	Provides secure (encrypted) connection between two LAN networks.
Stunnel	Encrypted network tunnel

Services	
Captive Portal	Welcome / Ban page for Wi-Fi users Password based authentication Transfer rate limitations Disconnection after given time period or after reaching a data limit Status overview Submission of statistics to an external log server
GPS	Report GPS position via SNMP Forward raw NMEA output to an expansion port and/or remote sockets Synchronize local time
NetFlow/IPFIX	NetFlow v5, Netflow v9, or IPFIX protocol Deterministic, random or hash sampler Export to a remote Collector, or to a limited local Collector Intake flows from external Probes
NTRIP Client	Help to obtain extremely precise positions by using data from an RTK base station via Ntrip protocol
NTP client NTP server	NTPv4 protocol
File Uploader	Invoked periodically Downloads files from a given FTP source Uploads files to a given (S)FTP target Removes old files
Samba	Windows Share (samba) for the Router directory /var/data/samba
Send Report	Periodically sends System log and Report files to an e-mail and/or FTP

Administration	
Daily Reboot	Reboot the router at a given time
Sleep Mode	Configure the low-power mode at a specific time and/or binary status
Customer Logo	Custom image on the Web Admin pages
HTTPS Login Banner	Custom information banner ahead of the login form
Loopback	Creates a virtual interface for managing the router
Ethernet Port Detector	Sends SNMP Trap and/or SMS upon Ethernet cable disconnection

Pinger	Automatic line failing / line lost check When line lost, sends SNMP Trap, e-mail or SMS, restarts mobile connection or reboots the router
TCP SYN Keep-Alive	Check ability to setup a TCP connection with a given peer
Firmware Over-The-Air (FOTA)	Update firmware of the cellular module "over the air"
PduSMS	Send a SMS longer than the common 160 characters
CURL	A tool to transfer data (<i>command: curl</i>)
SCEP Client	Command line tool for certificate enrollment Protocol per draft-gutmann-scep-16
SSH Client	Secure Shell connection (<i>command: ssh</i>)
Ext4 Tools	Support for these commands: mke2fs, e2fsck, mount, umount
NMAP	A tool for network exploration and security auditing (<i>command: nmap</i>)
Midnight Commander	Visual file manager (<i>command: mc</i>)
Vim Editor	Highly configurable text editor (<i>command: vim</i>)
Web Terminal	Access to router's console via the web administration GUI

Protocol Conversion	
AT Modem Emulator	Converts AT commands to TCP/IP and vice versa HAYES compatible
Serial to network proxy (ser2net)	TCP/IP server to access a serial port Telnet control protocol (RFC 2217)
Serial2TCP	TCP/IP client to access a serial port from one or more servers
Packet Splitter	Splits TCP, UDP or RS232 data flow to multiple targets
WoLGateway	Listens on a specific UDP port and forwards traffic to a broadcast address
DF1-Ethernet	Converts DF1 serial protocol to AB CSPv4 and/or industrial EtherNet/IP
DNP3 Outstation	Provides data from Binary inputs, Analog inputs and Counters DNP routing table
IEC101-104	Converts IEC 60870-5-101 serial protocol to IEC 60870-5-104 IP protocol ASDU conversions
Suite HT of protocols	Forwards TCP/IP queries from an AMR system to a meter on a serial line
wM-BUS concentrator	Store messages received via wireless M-BUS to an XML file at a FTP
Operating Hours Counter	Resettable and non-resettable time counter for each binary input Value can be retrieved via MODBUS
Modbus logger	Logging traffic on a Modbus RTU device connected to the serial interface Store data to a remote FTP(S) server
Modbus to LwM2M	Works as Modbus/TCP master Interconnects Modbus/TCP devices with a LwM2M device
Modbus to MQTT	Works as MQTT publisher/subscriber Interconnects Modbus/TCP devices with an MQTT broker
ALPHA-MODBUS	Converts data from Mitsubishi ALPHA2 to Modbus TCP
MODBUS-RTU2TCP	Converts Modbus RTU over serial line into Modbus TCP messages
MODBUS-RTUMAP	Maps RTU from more Modbus slaves to one Modbus TCP connection.
MODBUS-TCP2RTU	Converts Modbus TCP messages into Modbus RTU over serial line

Node-RED	
FTP Node	LIST, GET, PUT and DELETE files on a remote FTP server
GPSd Node	Retrieving data from a GPS Module via the GPSd Service Daemon
gzip Node	Compress/decompress tools
KNX Node	KNX device, KNX out and KNX in nodes
Modbus Node	Serial and TCP Modbus nodes
MQTT Node	MQTT Broker node
Splunk Node	Publish to Splunk's HTTP Event Collector

Integration	
Cumulocity	https://www.softwareag.cloud/site/product/cumulocity-iot.html
Docker	https://www.docker.com/
Eltima USB over Ethernet	https://www.eltima.com/products/usb-over-ethernet/
VPN Portal	https://icr.advantech.cz/products/software/webaccess-vpn
WebAccess/DMP	https://icr.advantech.cz/products/software/webaccess-dmp-gen2
Zabbix Agent	https://www.zabbix.com

Development	
Advantech SDK	https://icr.advantech.cz/devzone/advanced-usage-and-scripting
Azure IoT SDK Python	https://github.com/Azure/azure-iot-sdk-python
Python Python3	https://www.python.org/
Node.js	https://nodejs.org/en/
LUA	https://www.lua.org/
GDB (GNU Debugger)	https://www.gnu.org/software/gdb/

3. Commands

The table hereunder lists the most interesting commands which are available in the console environment of the Advantech routers. For the complete list and description see the *Commands and Scripts* application note available at:

<https://icr.advantech.cz/download/application-notes#commands-and-scripts>

List of the Most Important Commands	
curl	Tool to transfer data from or to a server. <i>Synopsis:</i> curl [options...] <url>
email	The program used for sending email. <i>Synopsis:</i> email -t <to> [-s <subject>] [-m <message>] [-a <attachment>] [-r <retries>]
fwupdate	The program used for router's firmware update. <i>Synopsis:</i> fwupdate [-i <filename> [-h] [-n]] [-f]
ifconfig	This command is used to configure a network interface. <i>Synopsis:</i> ifconfig [-a] <interface> [<option> ...]
io	Can be used to read binary inputs and to control binary outputs of the router. <i>Synopsis:</i> io [get <pin>] [set <pin> <value>]
ip	Display or configure a network interface. <i>Synopsis:</i> ip [<options>] <object> { <command> help }
iptables	Can be used as an administration tool for IP packets filtering and NAT. <i>Synopsis:</i> iptables [<options>]
led	Control the USB or PWR LED of the router. <i>Synopsis:</i> led [-p] [-u] <command>
lpm	Put the router into the low power mode and wake up on events specified by parameters (binary input or time interval). Router will wake up on the first event coming when more parameters specified. <i>Synopsis:</i> lpm [-b] [-i <interval>]
mount	This program used to mount a file system. <i>Synopsis:</i> mount [-a] [-o] [-r] [-t] [-w] <DEVICE> <NODE> [-o <option> , ...]
ping	Program for sending ICMP echo request to network host. <i>Synopsis:</i> ping [-c <count>] [-s <size>] [-I <interface>] [-q] <host>
ps	To view information related with the processes on a system. <i>Synopsis:</i> ps [options]
reboot	This program is used to reboot the router. <i>Synopsis:</i> reboot [-d <delay>] [-n <nosync>] [-f <force>]
report	This command can be used to list the router report from the command line. <i>Synopsis:</i> report [<options>]
restore	Program to restore configuration of the router from a file containing router's configuration. <i>Synopsis:</i> restore <filename>

route	Can be used to show and manipulate the IP routing table. <i>Synopsis:</i> route [- n] [- e] [- A] [add del delete]
slog	This command can be used to show system log (file /var/log/message). <i>Synopsis:</i> slog [-n <number>] [-f]
sms	The program used to send SMS message. <i>Synopsis:</i> sms <phone number> <text>
snmptrap	This program is used to sending SNMP trap. <i>Synopsis:</i> snmptrap [-c <community>] [-g <generic>] [-s <specific>] <hostname> [<oid> <type> <value>]
status	This program writes out the status of the router's interfaces or system. <i>Synopsis:</i> status [-hv][lan mobile module mwan ports sys wifiap wifista]
tcpdump	This program is used to dump traffic on a network. <i>Synopsis:</i> tcpdump [-AdDeflLnNOpqRStuUvxX] [-c <count>] [-C <file size>] [-E algo:secret] [-F <file>] [-i <interface>] [-r <file>] [-s <snaplen>] [-T type] [-w <file>] [-y <datalinktype>] [expression]
traceroute	This program can be used to track the route to a network host. <i>Synopsis:</i> traceroute[-FIldnrv][-f<1st_ttl>][-m<max_ttl>][-p<port#>][-q<nqueries>] [-s<src_addr>][-t<tos>][-w<wait>][-g<gateway>] [-i<iface>][-z<pausesecs>] host[data size]
umupdate	Can be used for adding or deleting of a user module from the command line. <i>Synopsis:</i> umupdate [-a <filename>][-d <name>]