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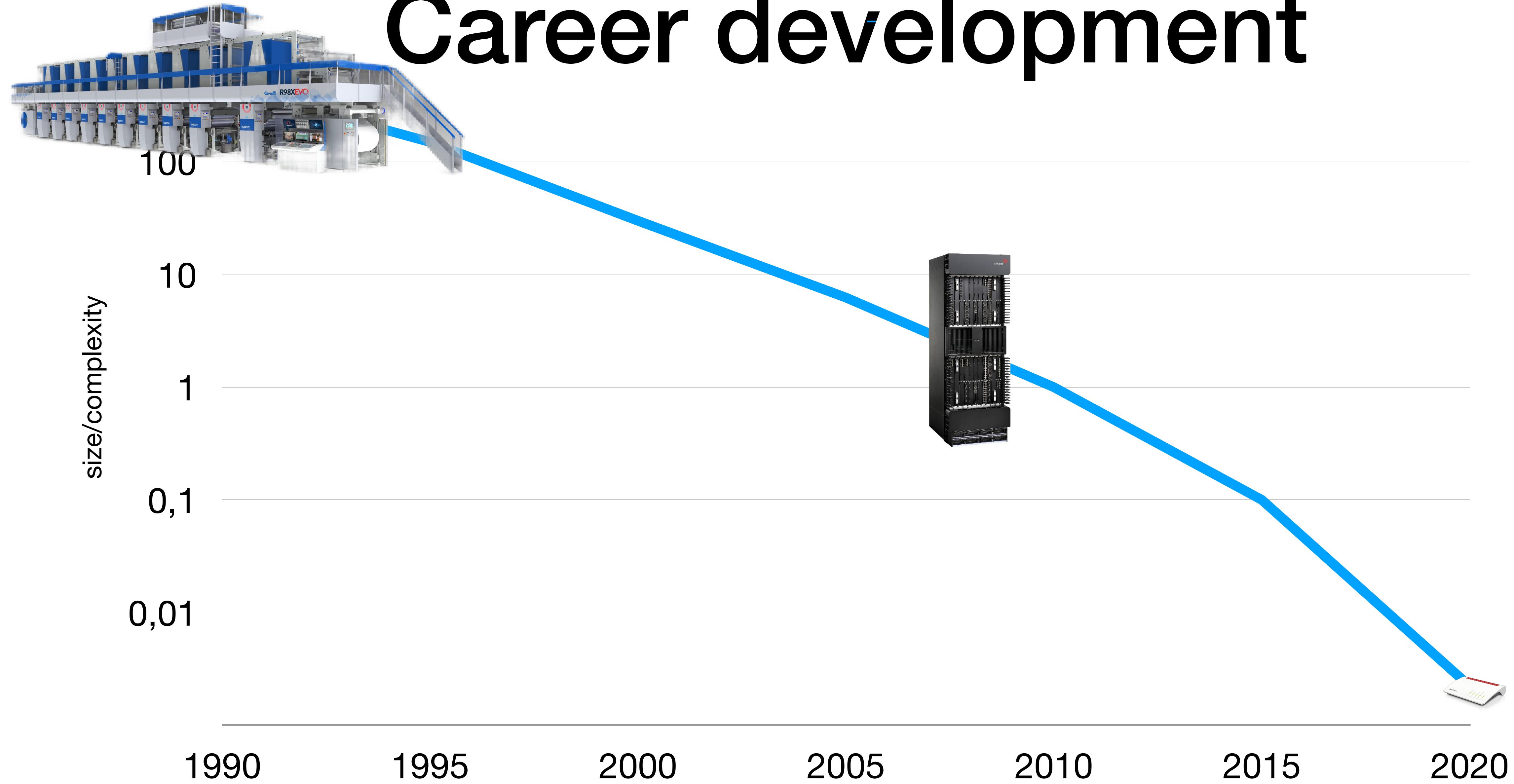
My Career Development



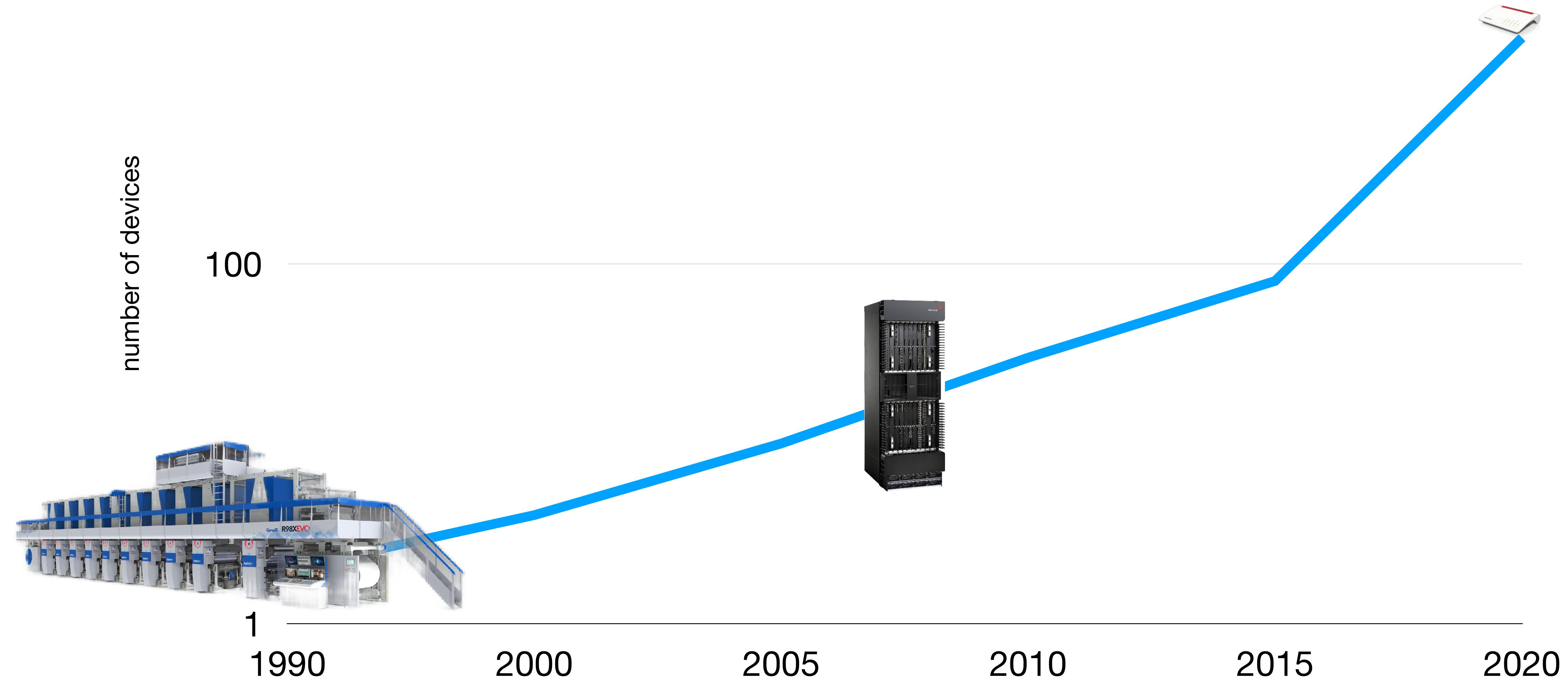




Career development



Less is More



**Manage and support
lots and lots of CPEs**

before ~ 1998



- Dial-in modems
- Typically purchased and managed by the subscribers themselves
- Hayes/AT command set

~ 1998 ... ~2004



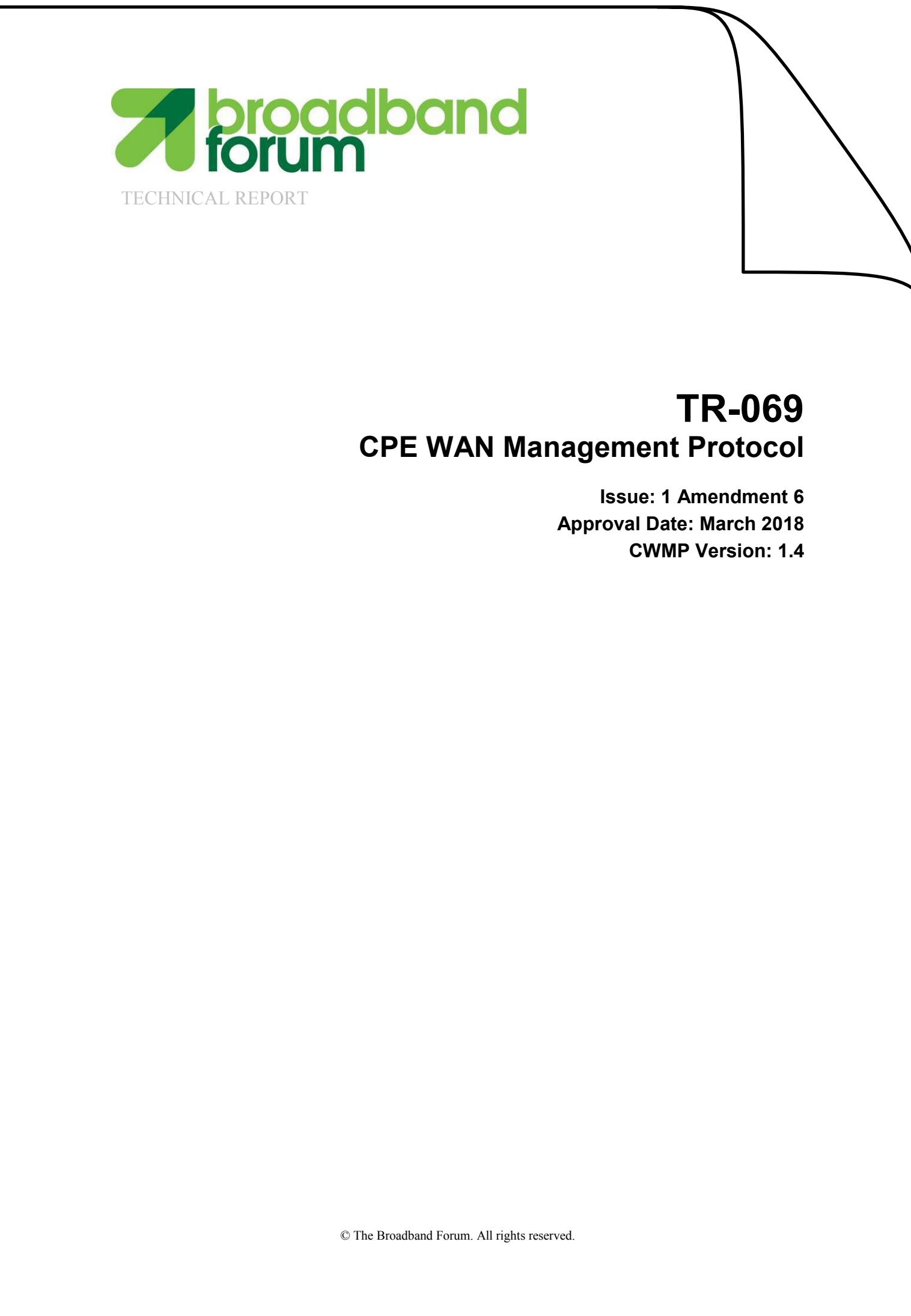
- ADSL and cable modems
- Provided by the ISPs
- Support requests on the CPEs
 - Engineers going on-site
 - Telnet, SSH, SNMP

~ 1998 ... 2004



- Vendor specific user interfaces and functionality
- Help desk / Call centers can't handle support requests
- Custom Scripting
 - CLI-scraping

2004



- Broadband forum
- Better way to manage CPEs
- Technical Report 069
- CPE WAN Management Protocol (CWMP)

TR-069



TECHNICAL REPORT

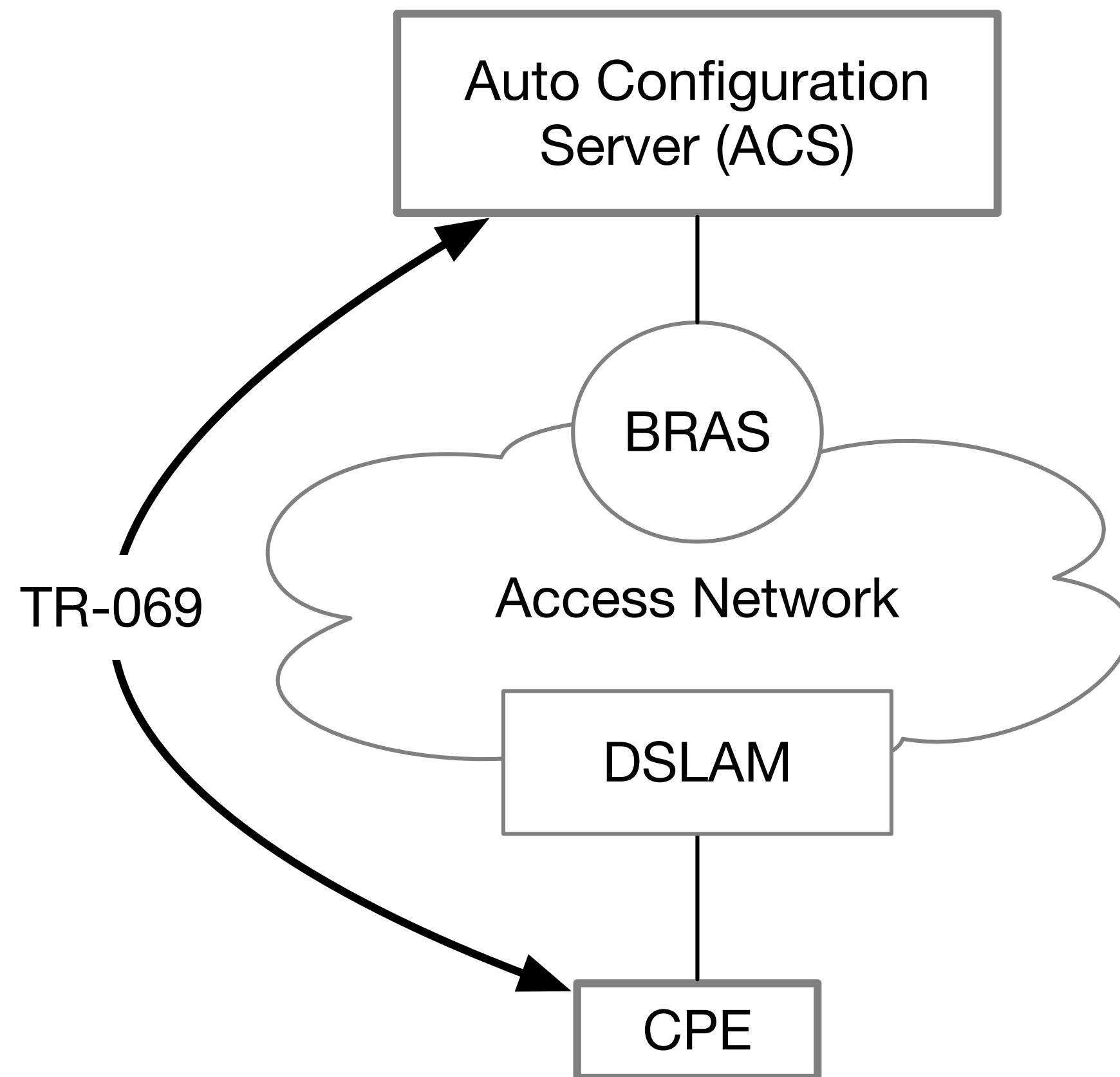
TR-069 CPE WAN Management Protocol

Issue: 1 Amendment 6
Approval Date: March 2018
CWMP Version: 1.4

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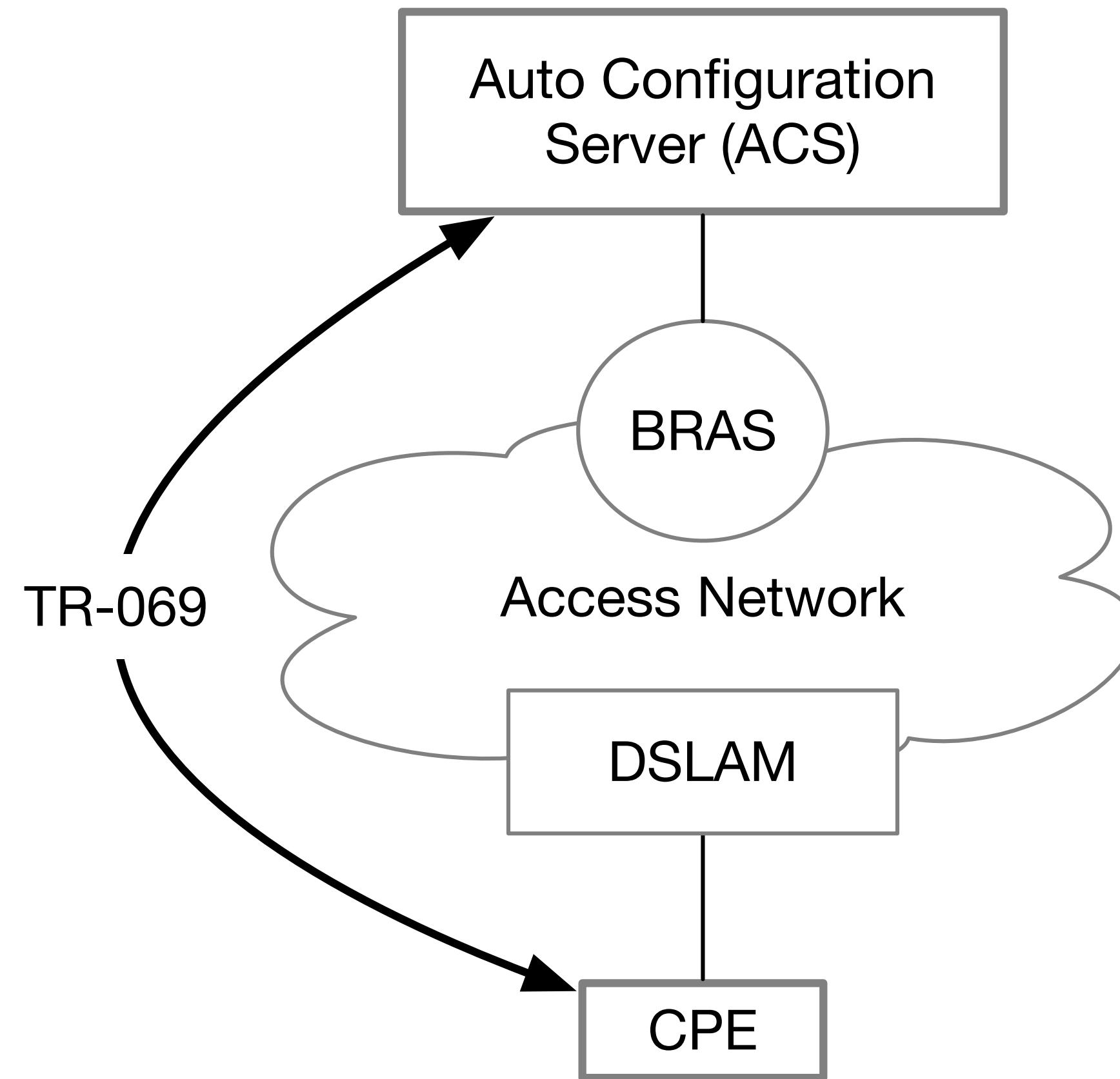
- Goals
- Auto-configuration and dynamic service provisioning
- Software/firmware image management
- Software module management
- Status and performance monitoring
- Diagnostics

TR-069 architecture



- Auto Configuration Server (ACS)
 - Element manager for CPEs
 - CPE WAN Management Protocol (CWMP)
 - Communication between the and CPEs and the ACS
 - Independent from the access network

ACS URL



- CPE gets the URL of the ACS via:
 - Build-in profile
 - DHCP
 - DISCOVER
 - Option 124 or 60
 - OFFER
 - Option 43 or 124
 - DHCPv6
 - Vendor Class Option 16

Data - DeviceInfo

- InternetGatewayDevice
- InternetGatewayDevice.DeviceInfo
- InternetGatewayDevice.DeviceInfo.AdditionalSoftwareVersion
 - "AVM TR069 16.01.01,AVM TR064 12.02.11" (string, read-only)
- InternetGatewayDevice.DeviceInfo.Description
 - "FRITZ!Box 7590 BETA Labor 154.07.19-79768" (string, read-only)

Data - Wi-Fi

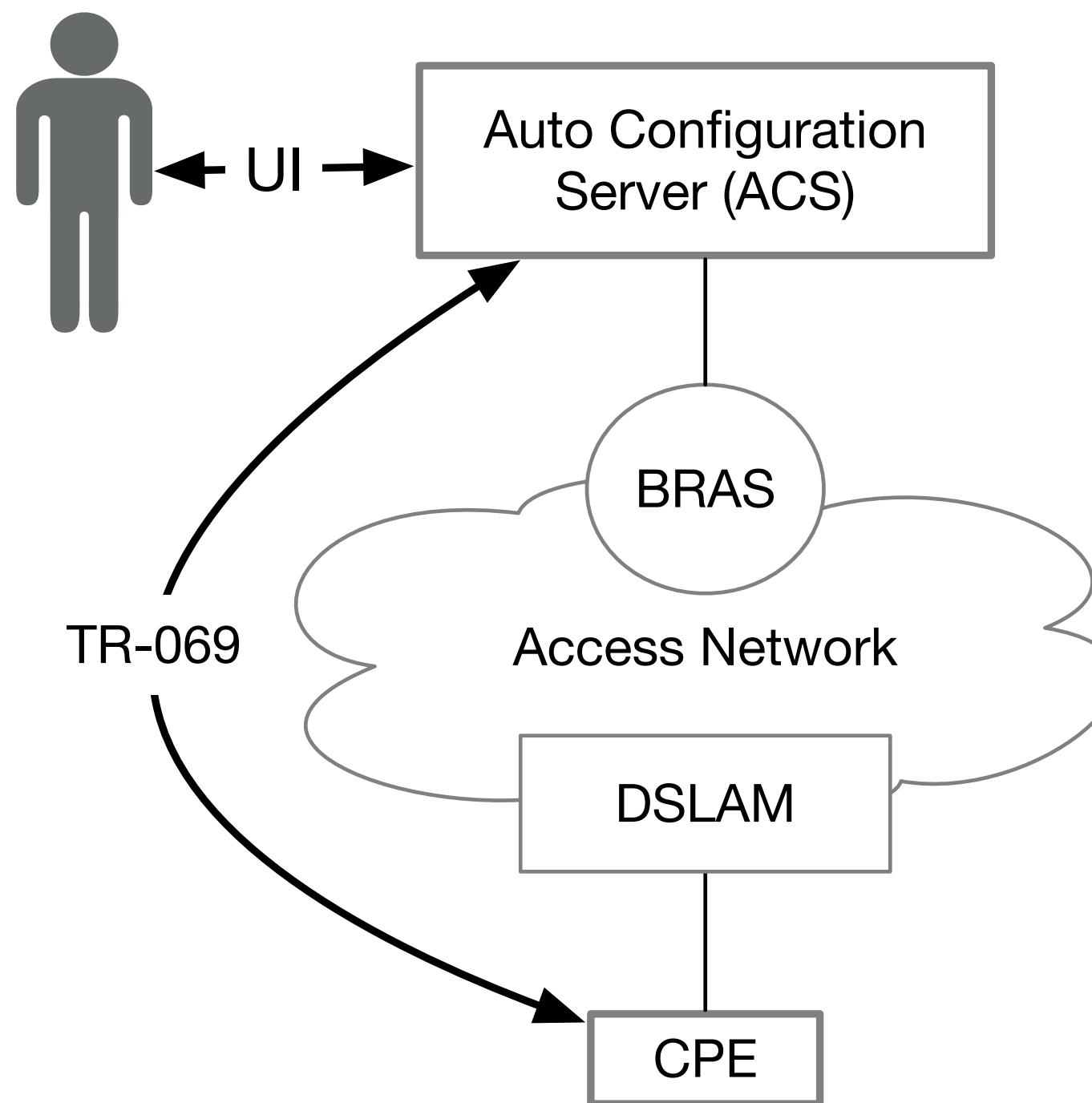
- InternetGatewayDevice.LANDevice.1.WLANConfiguration.1.RadioEnabled
 - true (boolean, read-write)
- InternetGatewayDevice.LANDevice.1.WLANConfiguration.1.SSID
 - "Pretty Fly For A Wi-Fi" (string, read-write)
- InternetGatewayDevice.LANDevice.1.WLANConfiguration.2.RadioEnabled
 - true (boolean, read-write)
- InternetGatewayDevice.LANDevice.1.WLANConfiguration.2.SSID
 - "Pretty Fly For A Wi-Fi 5GHz" (string, read-write)

Data - WAN / DNS

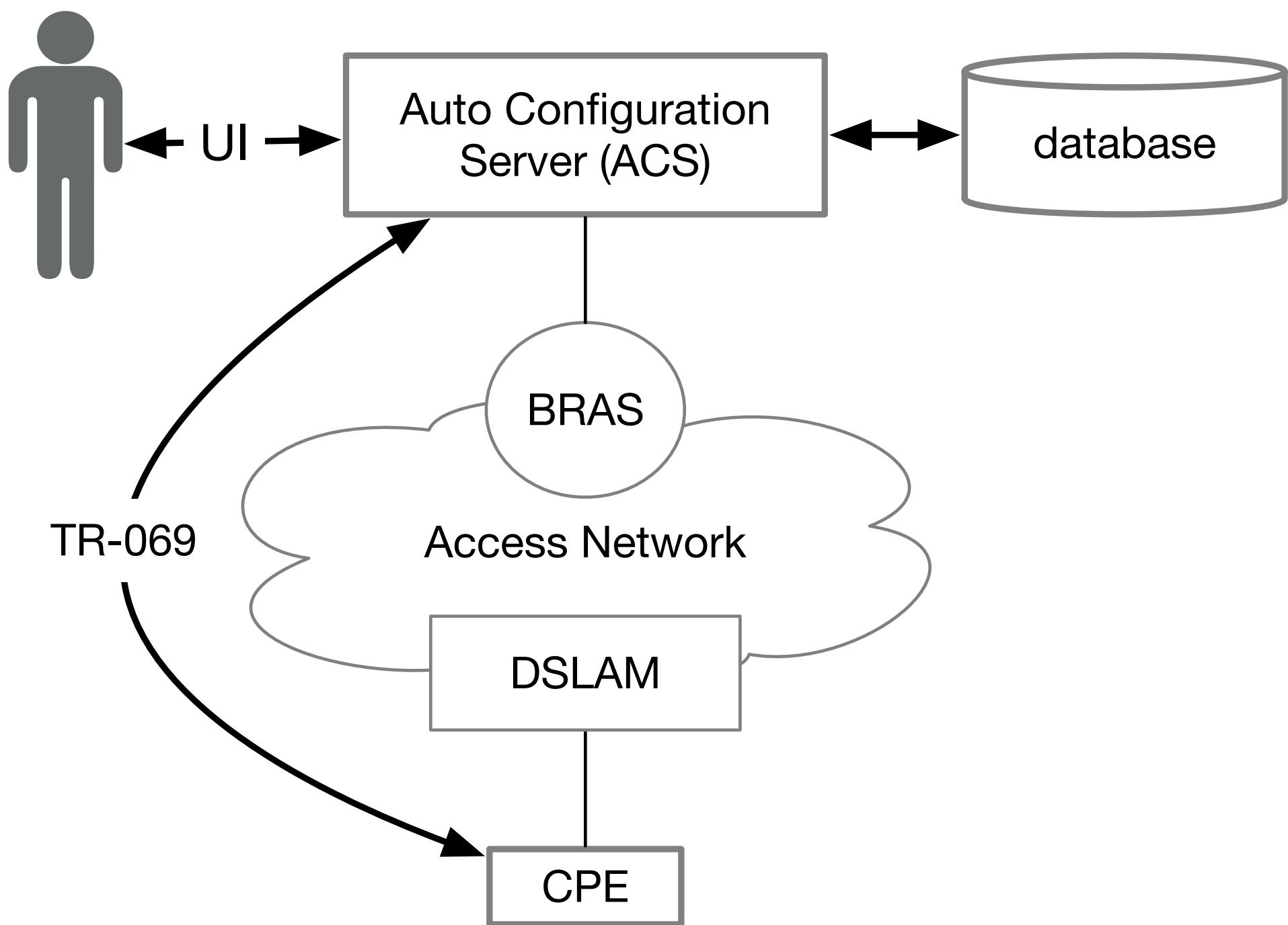
- InternetGatewayDevice.WANDevice.1.WANConnectionDevice.1.WANPPPConnection.1.DNSOverrideAllowed
 - true (boolean, read-write)
- InternetGatewayDevice.WANDevice.1.WANConnectionDevice.1.WANPPPConnection.1.DNSServers
 - "2001:7b8:650:1::44,87.251.42.44,87.251.42.45" (string, read-write)
 - Comma separated list

ACS

- User interface
 - Mostly web
 - Java
 - Windows
 - Help desk / call center modules

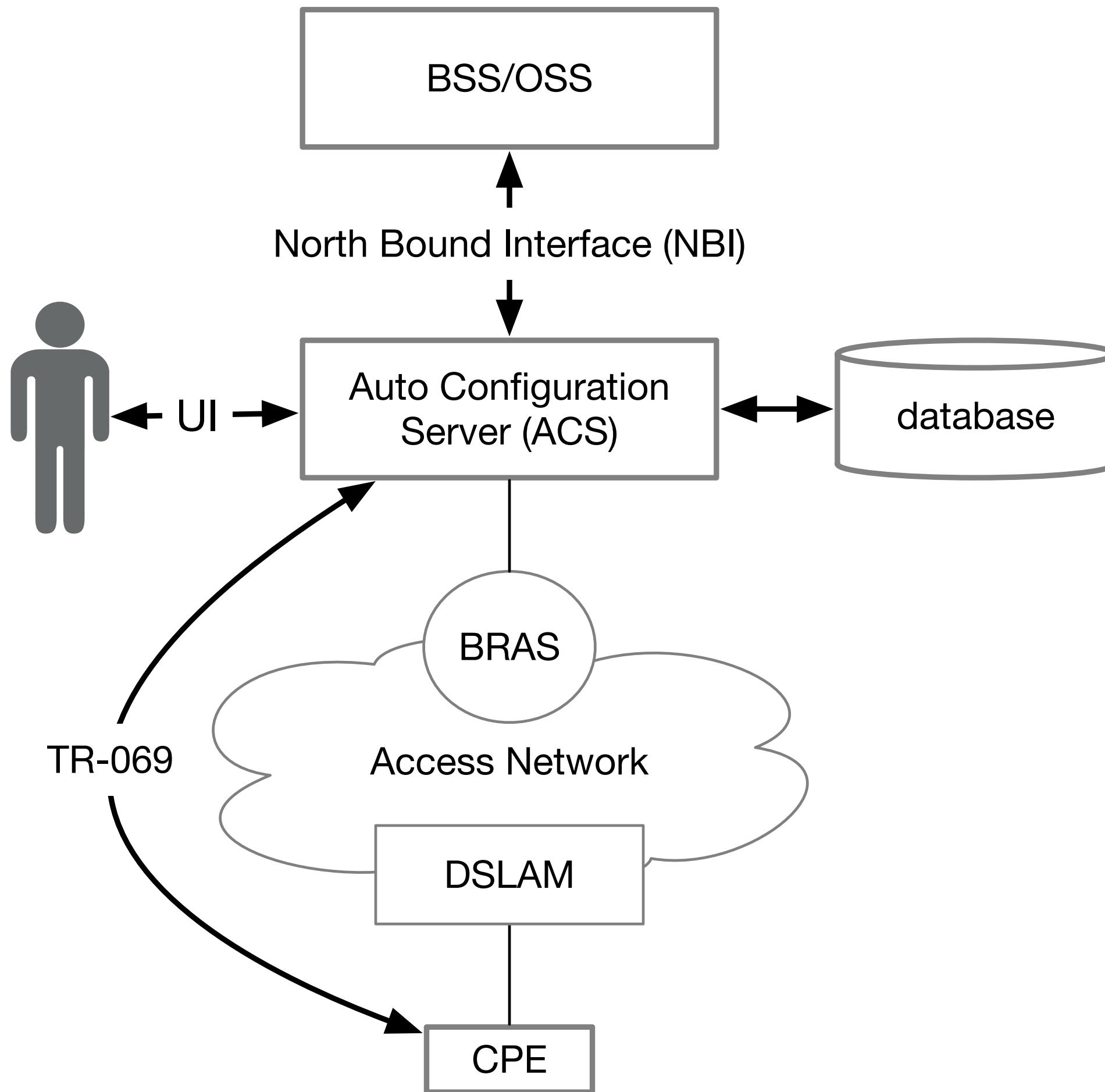


ACS



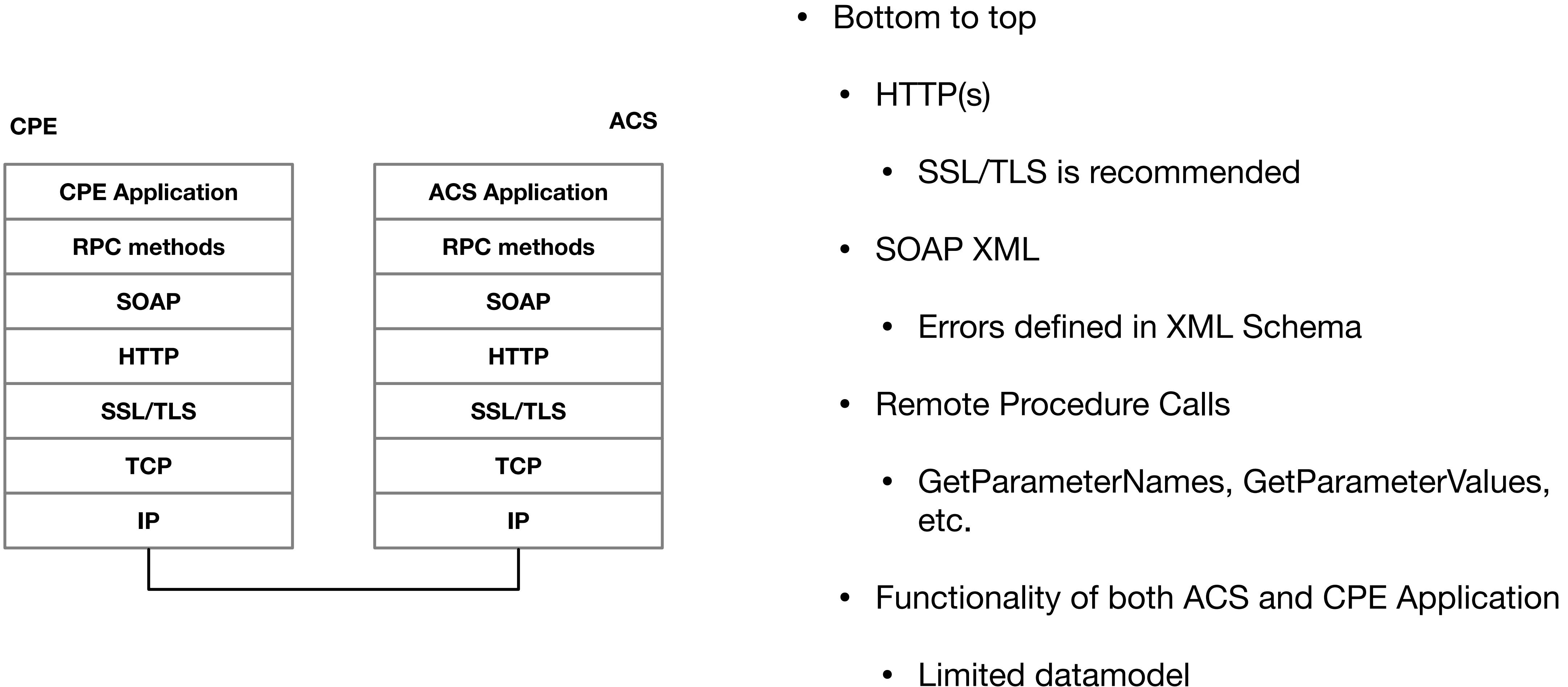
- User interface
- Mostly web
- Java
- Windows
- Help desk / call center modules
- Database

ACS

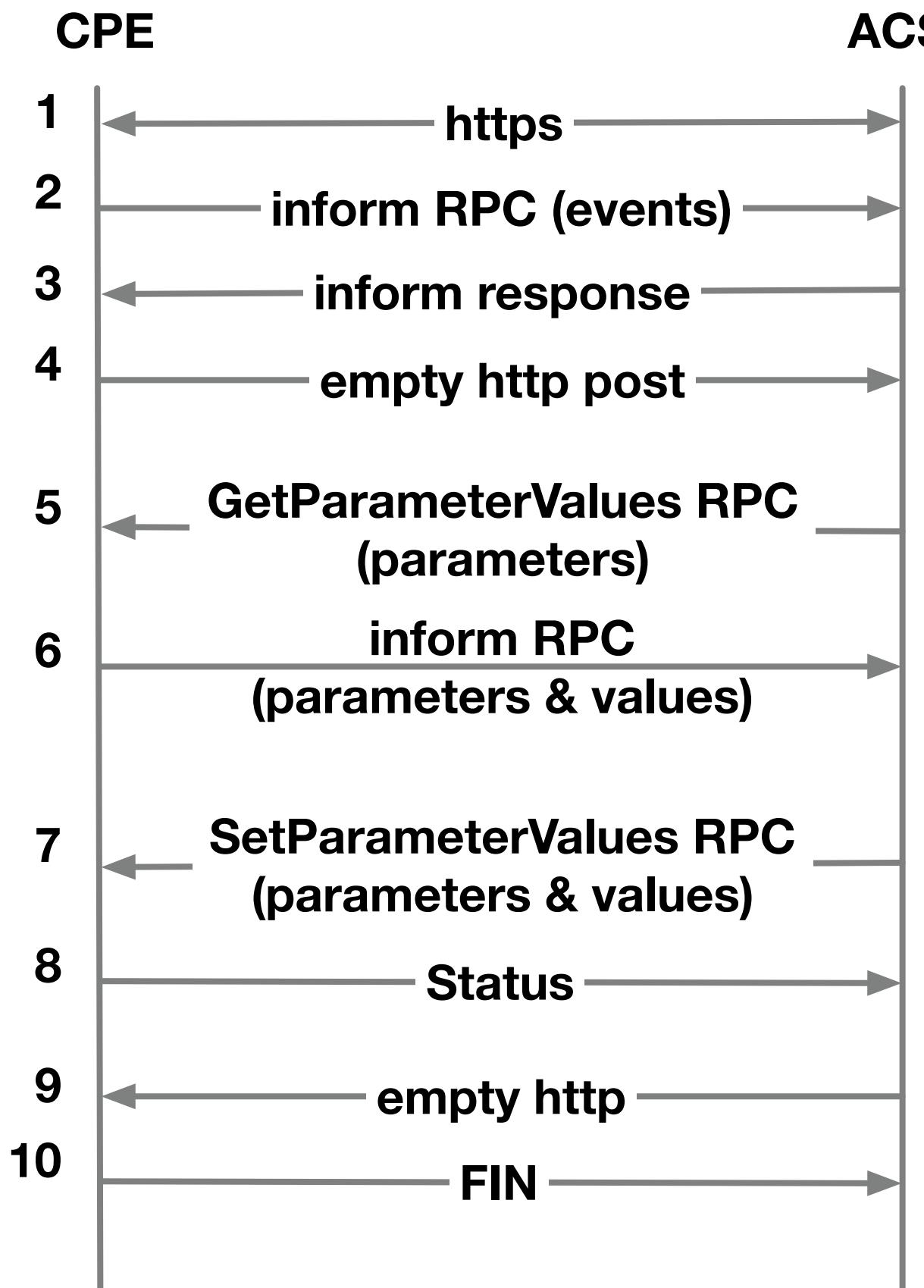


- User interface
 - Mostly web
 - Java
 - Windows
 - Help desk / call center modules
- Database
- North Bound interface (NBI)
 - Business Support System (BSS)
 - Operational Support System (OSS)

TR-069 protocol stack

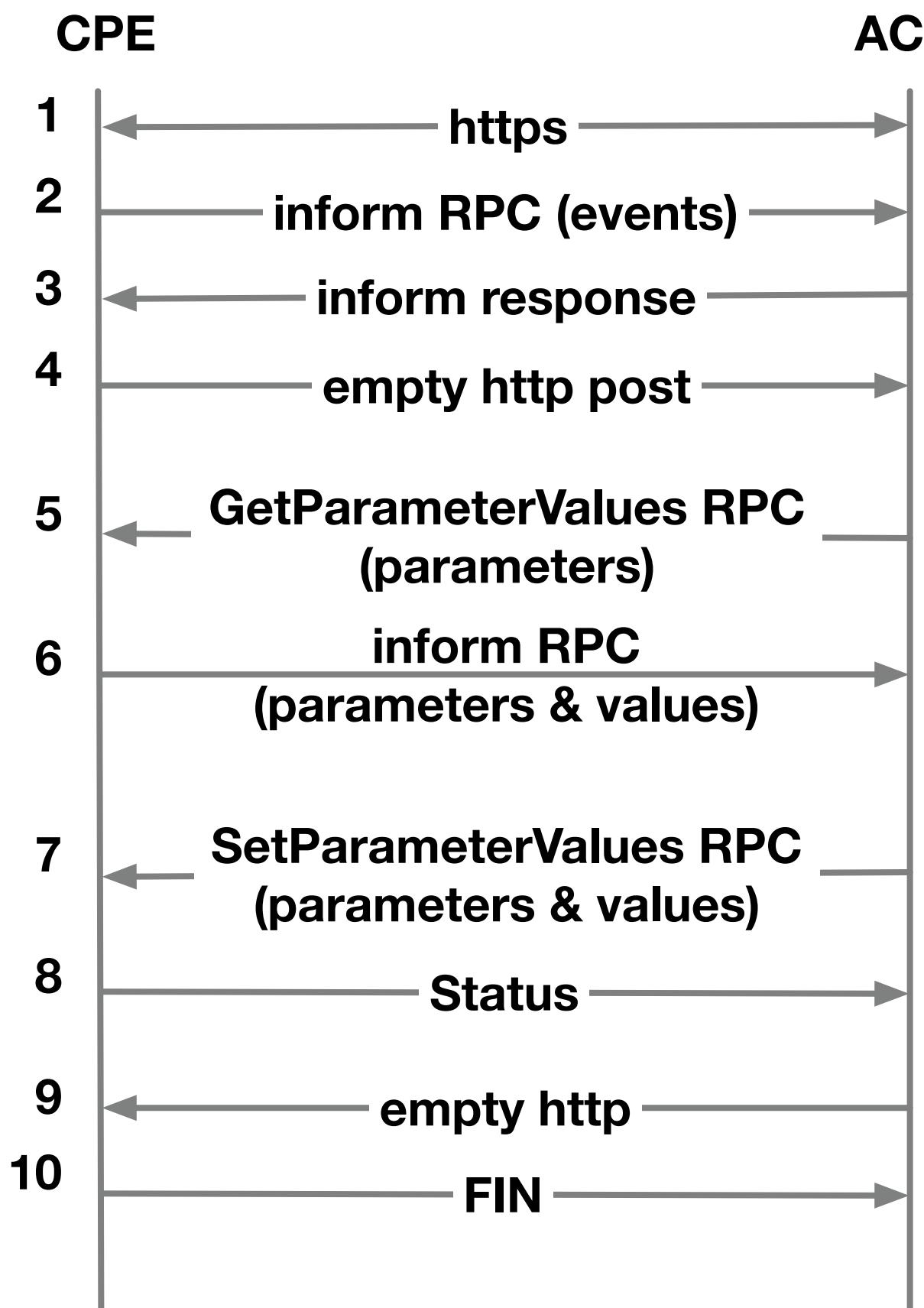


TR-069 Session



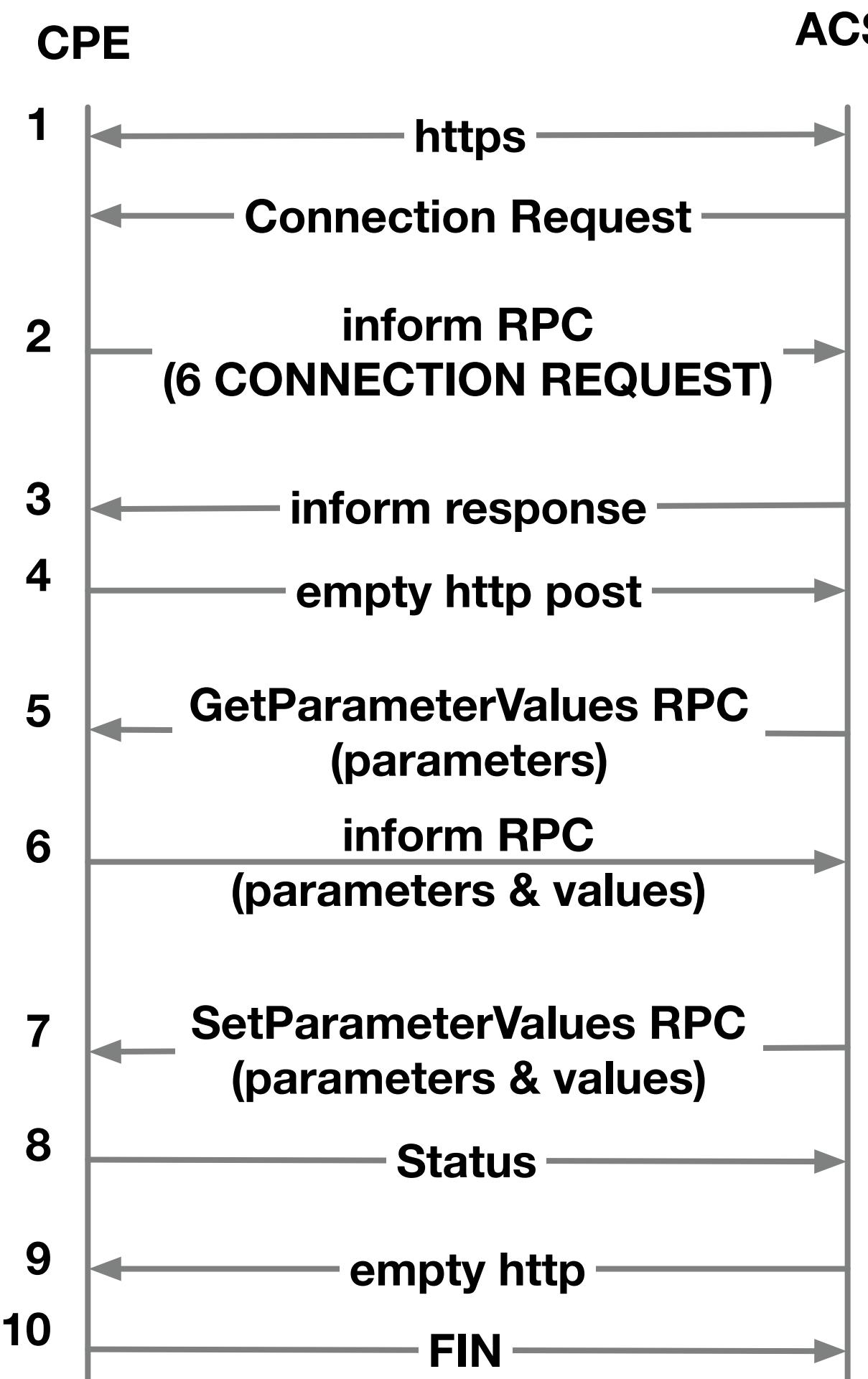
- CPE always initiates the session (1)
 - Push model
- Starts by sending an **event** (2).
- Periodic, on first boot, on reboot, when some value is changed, etc.
- ACS responds by sending an **InformResponse** (3)
- CPE signals that it is done via an empty http post message (4)
- ACS gets its turn

TR-069 Session



- ACS requests parameter values (5)
- CPE provides the requested parameters (6)
- ACS may want to set parameters (7)
- CPE provides information regarding the just set parameters (8)
- ACS informs the CPE that it is done by sending an empty http post (9)
- CPE closes the TCP session (10)

Connection Request



- CPE always initiates the session
- ACS can stimulate the CPE to start a session
- ACS sends an HTTP GET to a URL defined by the CPE
 - May be username and password authenticated
 - This URL is send with every inform RPC to the ACS
- CPE sends an Inform RPC with event code 6
- Next steps are identical

Standardised TR-069 events

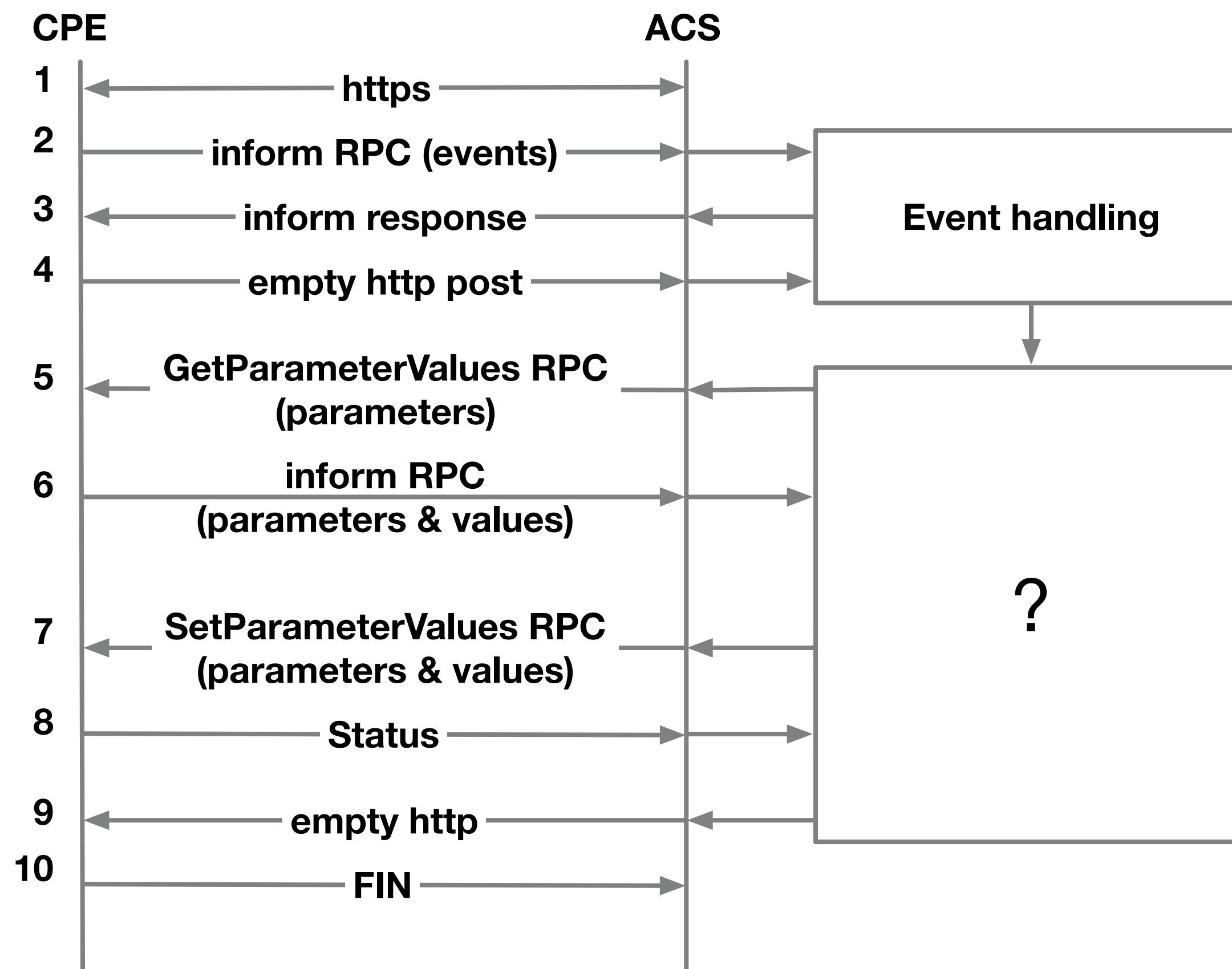
0 BOOTSTRAP	CPE contacts the ACS either for the first time or when the ACS URL was changed
1 BOOT	CPE software was restarted
2 PERIODIC	CPE contacts the ACS on a preset interval
3 SCHEDULED	Session was scheduled independently from the regular periodic interval
4 VALUE CHANGE	One or more parameters marked for notification got changed in value
6 CONNECTION REQUEST	The ACS requested this session
7 TRANSFER COMPLETE	A file transfer triggered by the ACS was completed
8 DIAGNOSTICS COMPLETE	CPE completed built-in tests
9 REQUEST DOWNLOAD	CPE contacted the ACS with the intent to download a file
10 ANONYMOUS TRANSFER COMPLETE	A file transfer NOT triggered by the ACS was completed
11 DU STATE CHANGE COMPLETE	Deployment Unit (application on the CPE) change is finished
12 AUTONOMOUS DU STATE CHANGE COMPLETE	Deployment Unit changed its state autonomously
13 WAKEUP	CPE came back online after it got into low power mode

Standardised M or Method Events

M Reboot	Reboot triggered by the ACS when send together with a 1 BOOT event
M Scheduled Inform	Always send together with a 3 SCHEDULED event
M Download	Send together with a 7 TRANSFER COMPLETE once a download triggered by a download RPC completes
M ScheduleDownload	Send together with a 7 TRANSFER COMPLETE once a download triggered by a scheduled download RPC completes
M Upload	Send together with a 7 TRANSFER COMPLETE once a download triggered by a upload RPC completes
M ChangeDUState	Send together with a 12 DU STATE CHANGE COMPLETE event if that event was triggered by a ChangeDUState RPC

Vendors may define their own using vendor-specific events

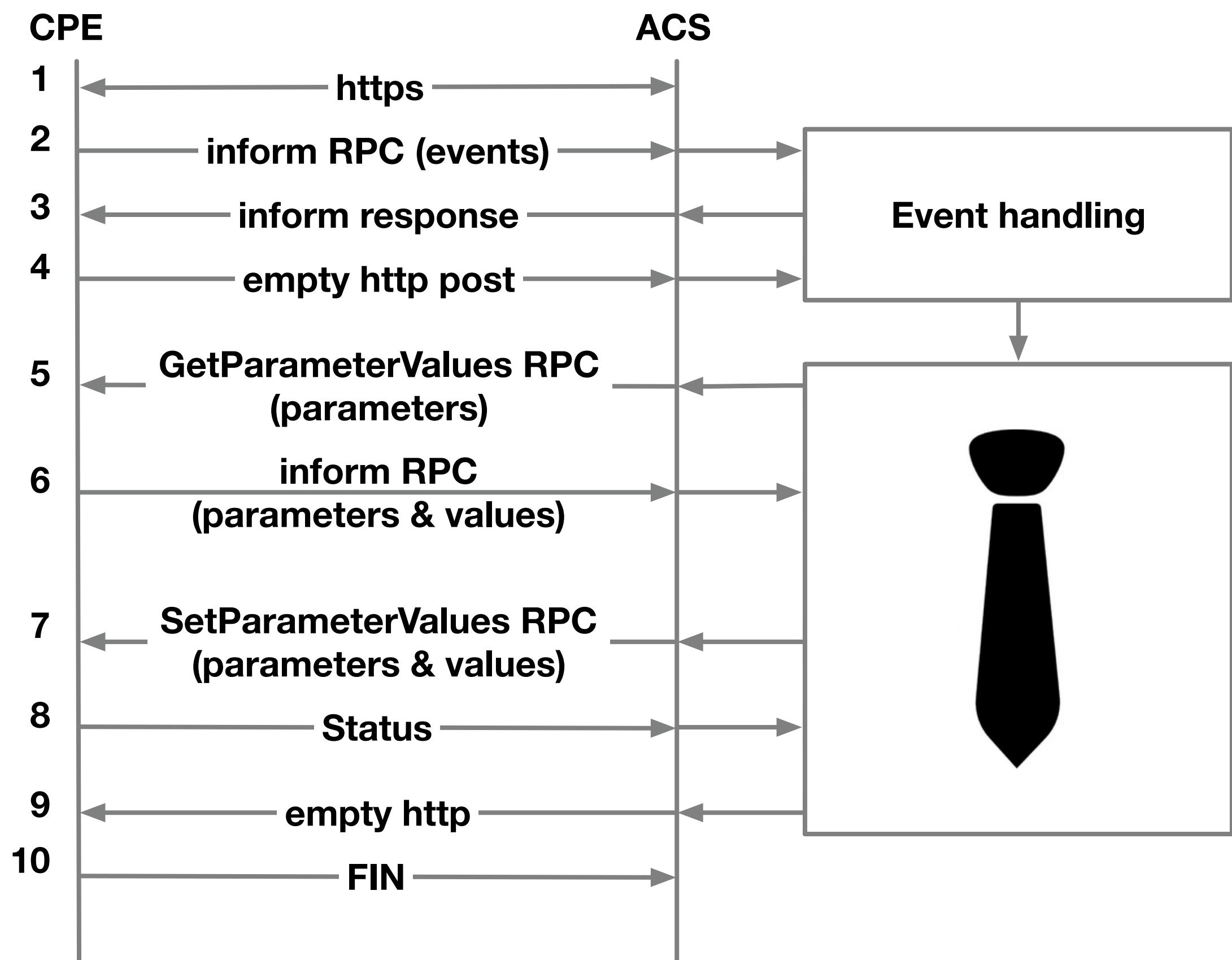
ACS



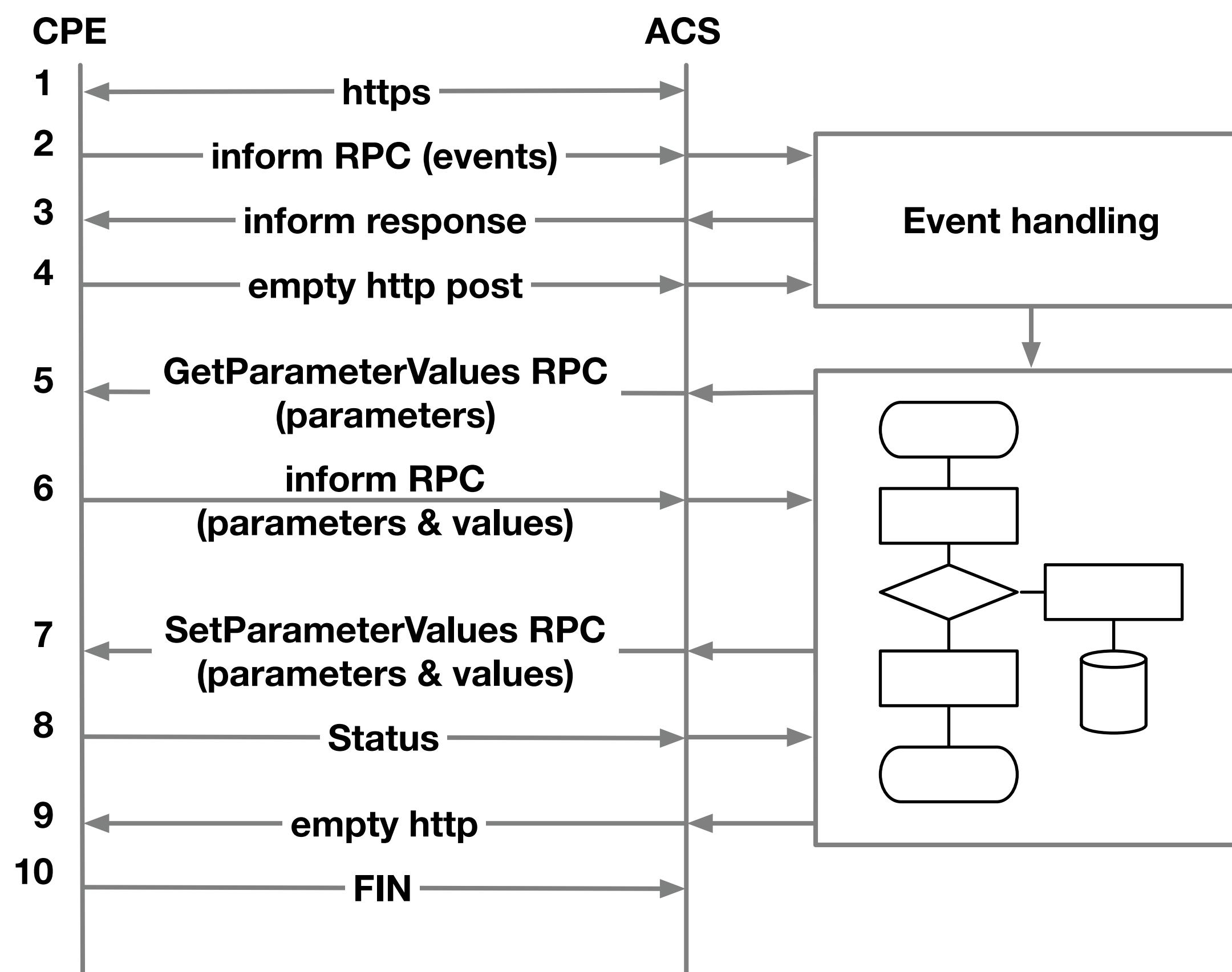
- Handling the event itself is pretty standard
- What to do with an event?
 - Depends on the use case
 - Depends very much on the CPE
 - Brand / Type
 - Functionality
 - Wi-Fi
 - VoIP

ACS

- Consultancy / support contract

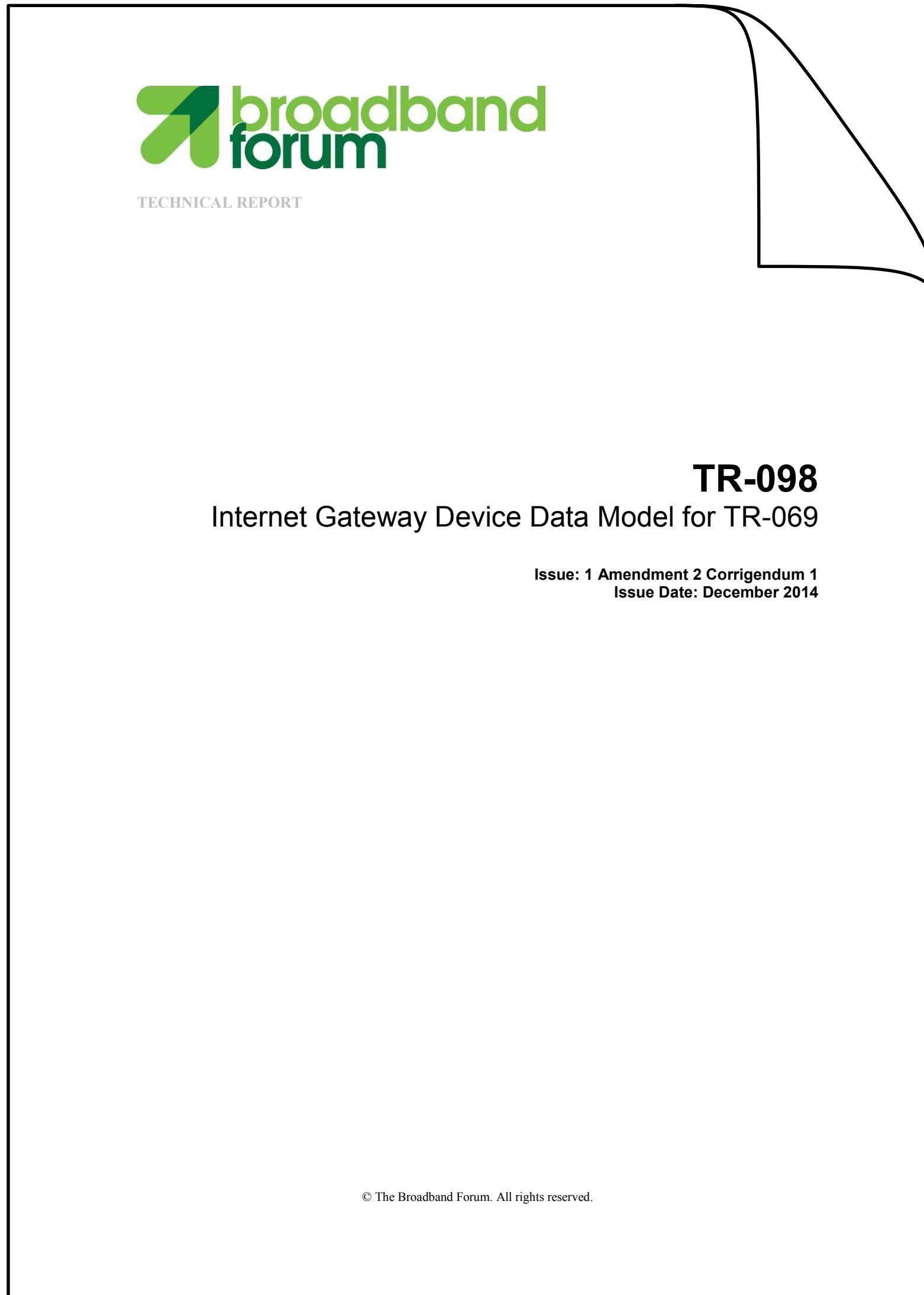


ACS



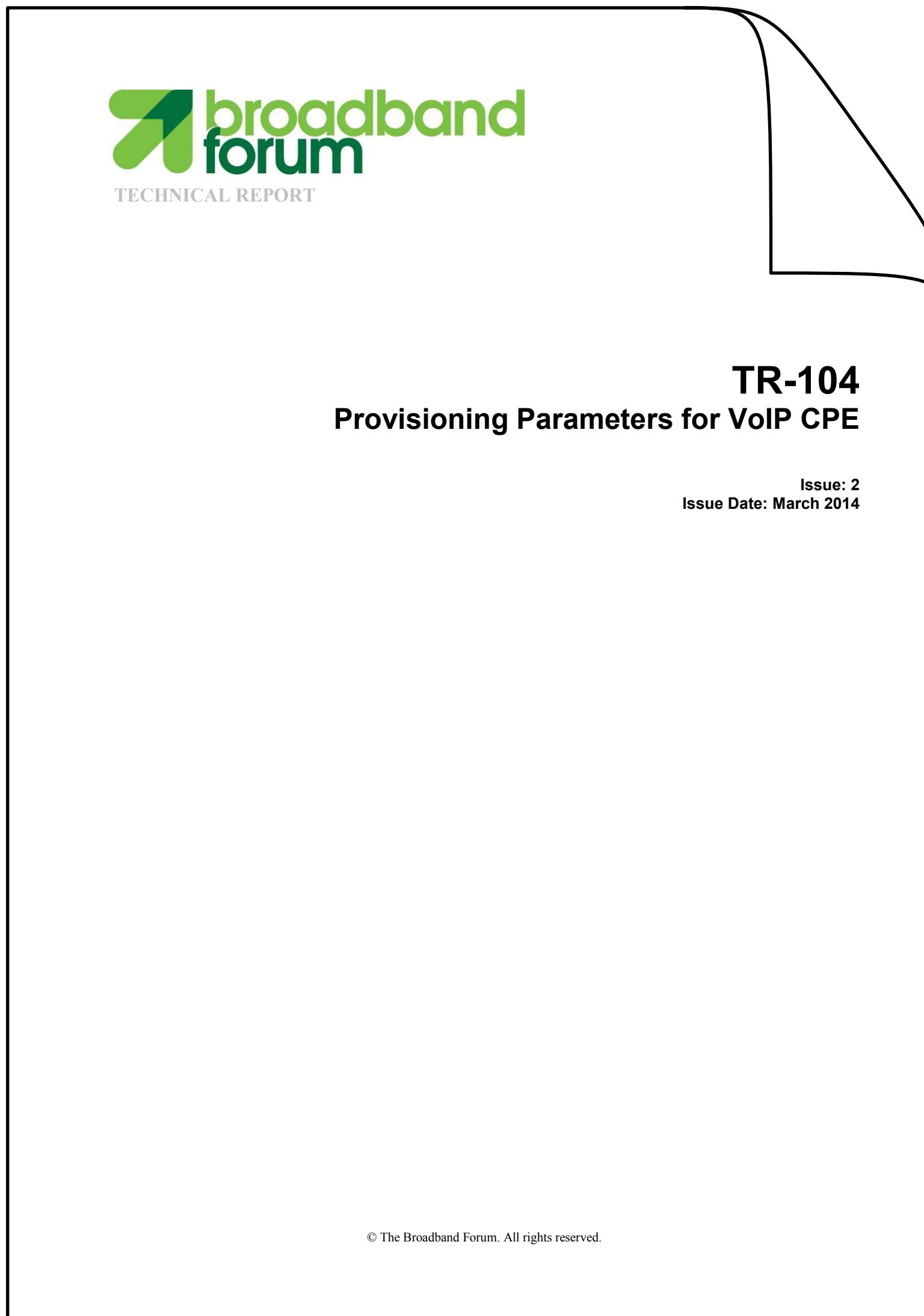
- Consultancy / support contract
- Script language
 - Vendor specific language
 - Node.js
 - Python

Data models



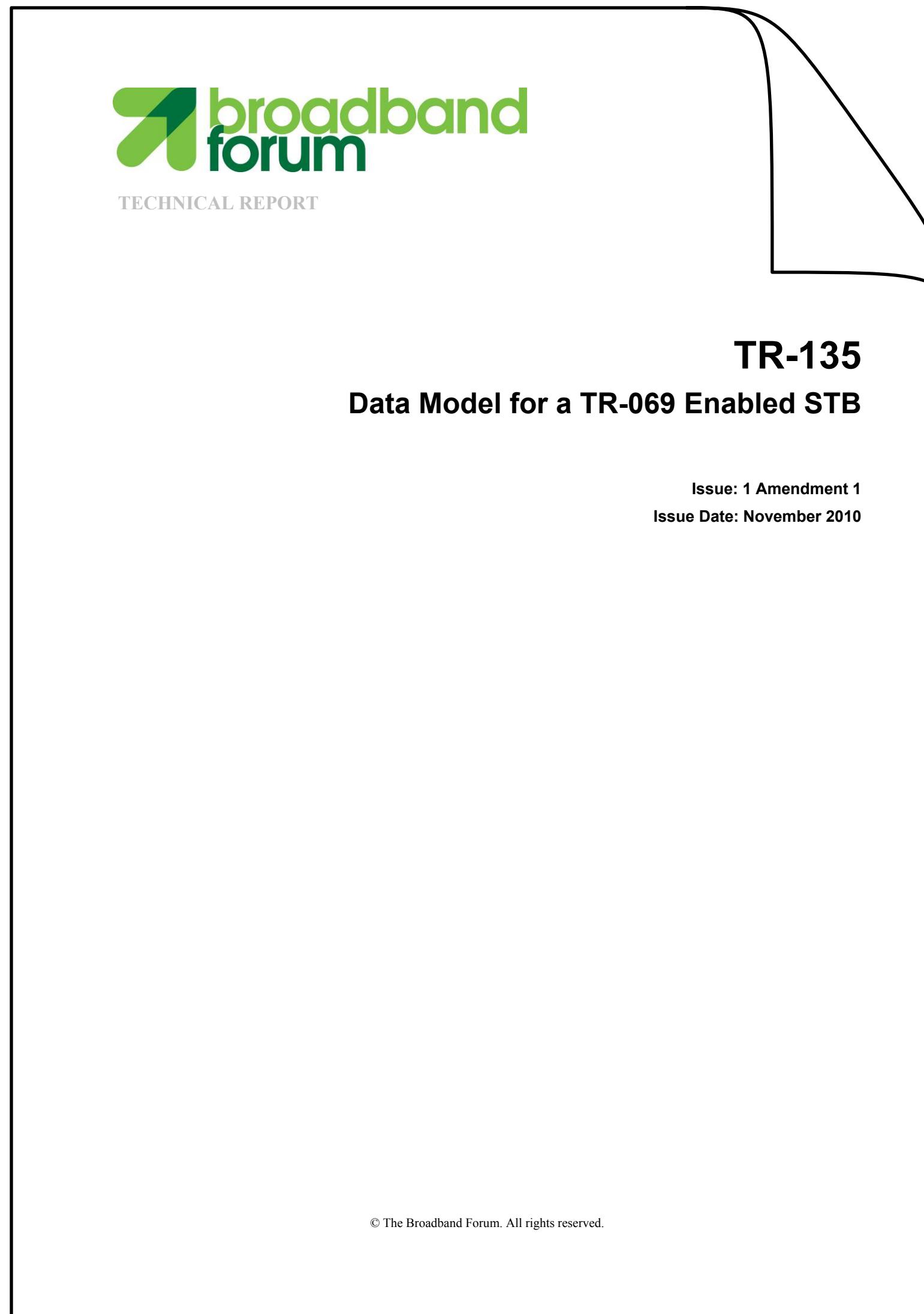
- TR-098 Internet Gateway Devices

Data models



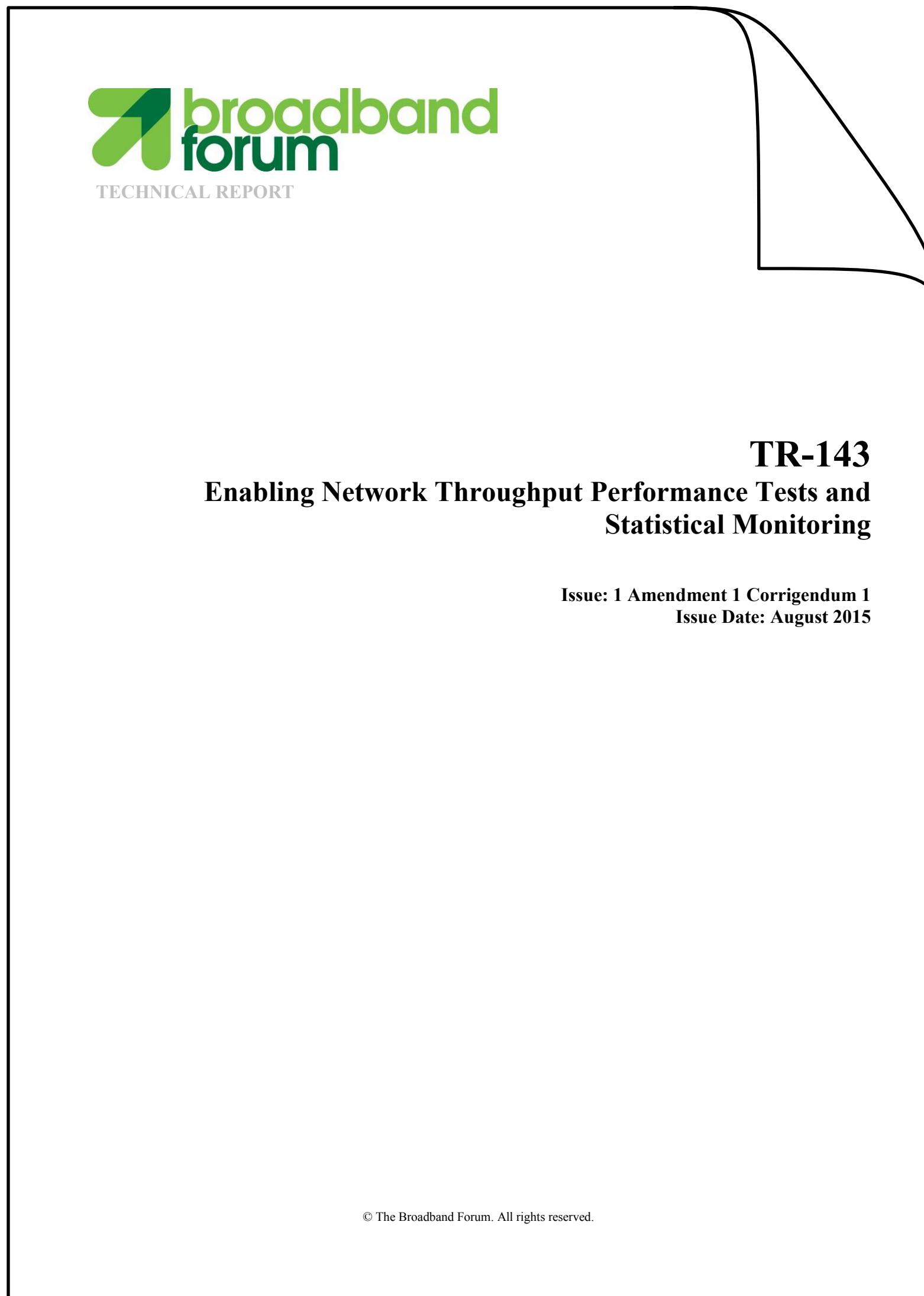
- TR-098 Internet Gateway Devices
- TR-104 VoIP Provisioning

Data models



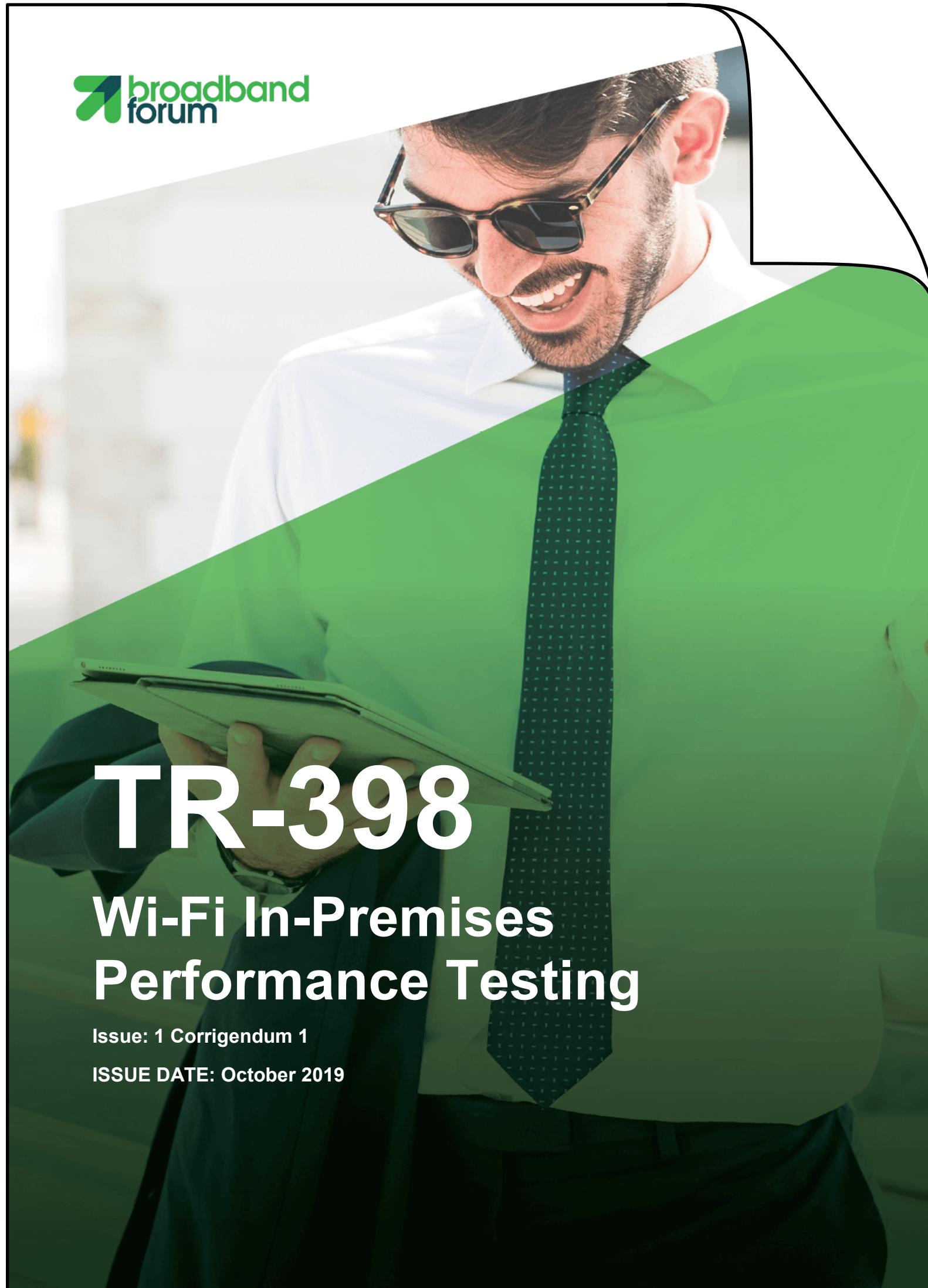
- TR-098 Internet Gateway Devices
- TR-104 VoIP Provisioning
- TR-135 TR-069 enabled STBs
 - TR-069 NAT-traversal
 - STUN or XMPP
 - TR-143 Throughput testing and statistics

Data models



- TR-098 Internet Gateway Devices
- TR-104 VoIP Provisioning
- TR-135 TR-069 enabled STBs
- TR-069 NAT-traversal
 - STUN or XMPP
- TR-143 Throughput testing and statistics

Data models



- TR-098 Internet Gateway Devices
- TR-104 VoIP Provisioning
- TR-135 TR-069 enabled STBs
- Requires TR-069 NAT-traversal
 - STUN or XMPP
- TR-143 Throughput testing and statistics
- TR-398 Wi-Fi performance testing

TR-369



- Replacement for TR-069
- Goals
 - Management of IoT devices
 - Self-service through customer portals and smart devices
 - Enabling provider partnerships
 - Consistent user experience (home and mobile)
 - Simple migration from TR-069

TR-369



- Compatible data model
- Multiple controllers
 - The ACS is a controller
 - Allows 3rd party controllers
- Multiple transport protocols
 - TR-069 is bound to HTTP
 - CoAP, STMP, MQTT
- Protocol buffers instead of XML
 - Binary encoding

TR-369



- Agents get to use a command set
 - Add, Get, Set, Delete, etc...
- Message structure
 - Allows for relative paths
 - Allows for the use of keys instead of instance numbers
- Allows search expressions

Credits, Thanks, Questions

Opening slide image by Viki Navratilova

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["spaceship"](#)

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[Slide 4: Extreme Networks](#)

[Slide 5: AVM](#)

[Slide 9: Techcentral](#)

[Slide 10: speedguide.net](#)

[Slide 11: esellerpro.com](#)

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Thanks to Freedom Internet for the
opportunity to let me choose and setup
their ACS



[<a href="mailto:<u>arien@freedomnet.nl](mailto:<u>arien.vijn@linklight.nl</u></p></div><div data-bbox=)