



Cisco Expo  
2008

## 3G Mobile Broadband for the Branch office

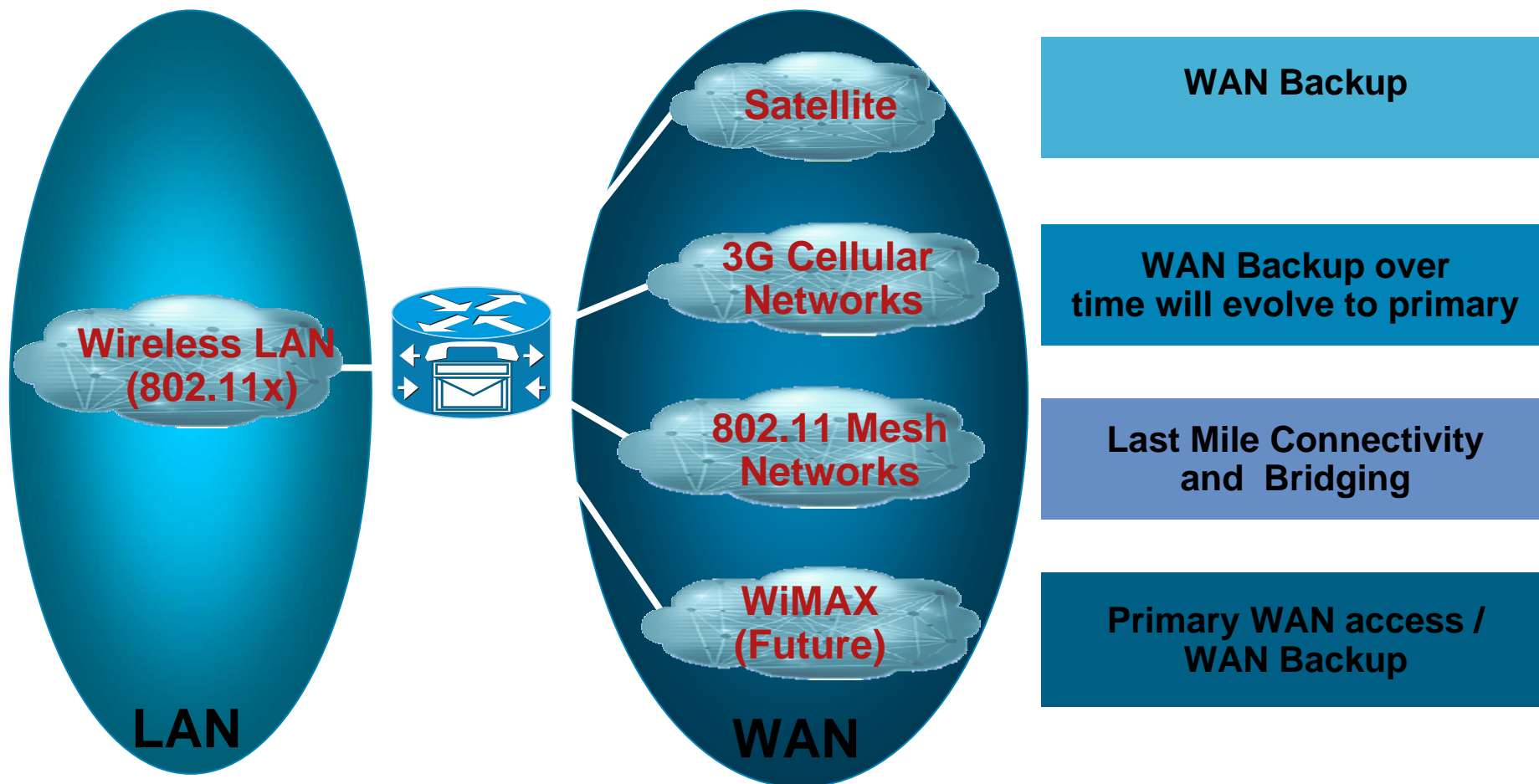


**Lars Thoren**

# Product Information



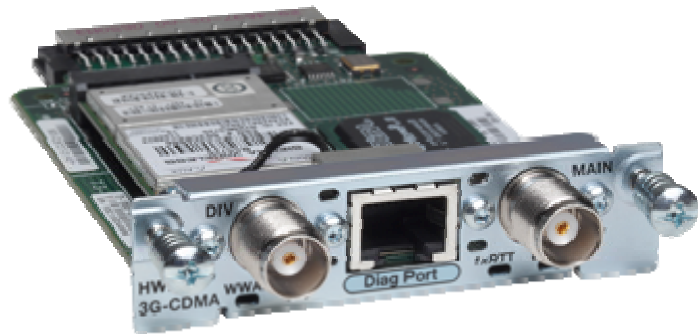
# Cisco ISR Wireless Portfolio



**Most Extensive Wireless Service Portfolio in the market.**

# Cisco 3G Wireless WAN HWIC

The Cisco 3G Wireless WAN HWIC provides a cost-effective alternative to ISDN dial back up and rapid deployment for temporary and nomadic sites

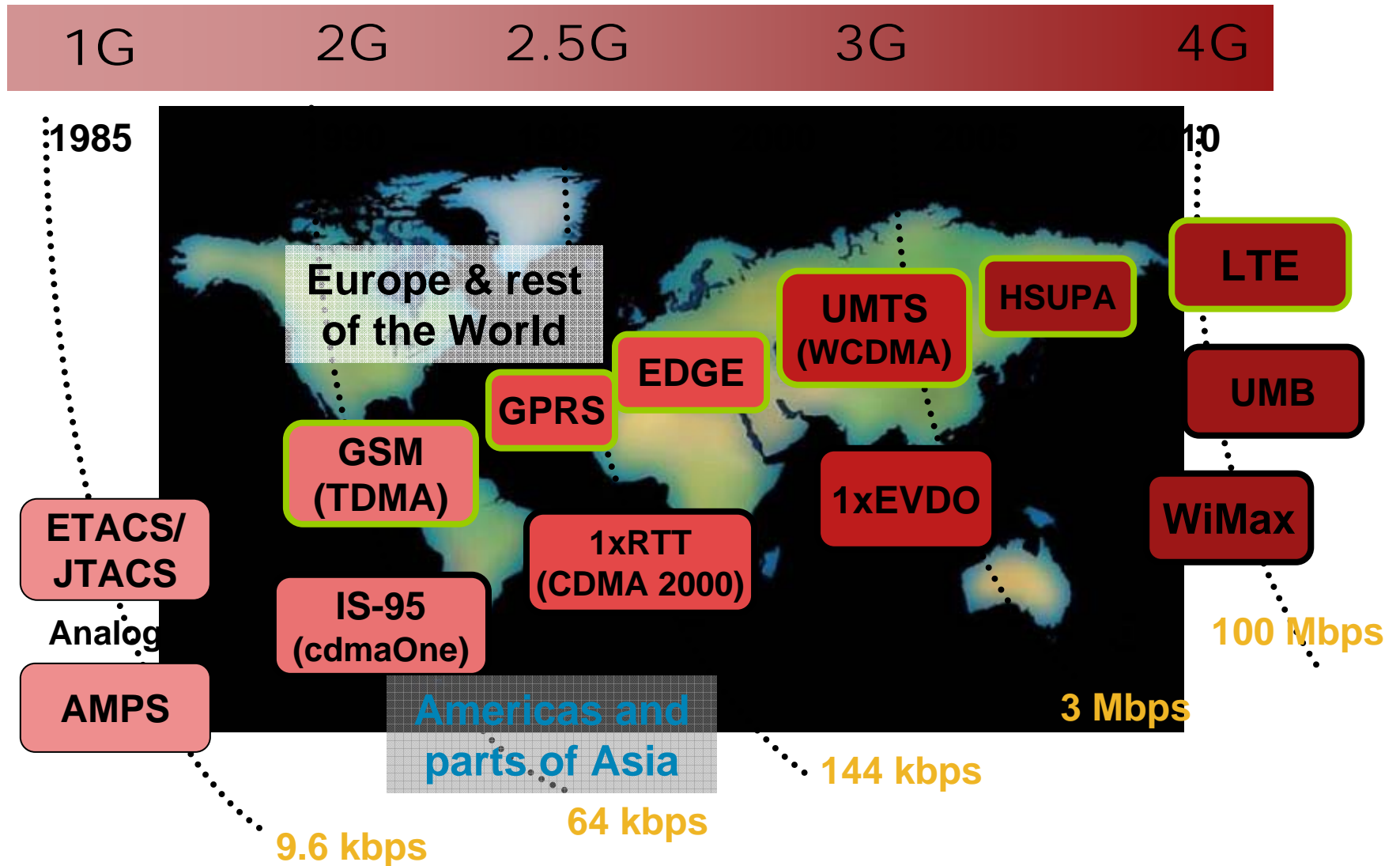


## 3G Wireless HWIC offers:

- Broadband Speeds
- Ease of management
- WAN Diversity
- Rapid Deployment
- Leverages ISR features

- Offers Broadband data rates up to 3.2 Mbps with EVDO and 3.6 Mbps with HSDPA
- Supports CDMA and GSM/UMTS standards (EVDO Rev A / HSDPA)
- Target Applications – WAN Backup, Rapid Deployment, Portable Applications
- Supported on Cisco 1841 / 2800 / 3800 Series Routers
- Embedded mini PCI express Cellular modem from Sierra Wireless
- Multiple external antenna options for in-building deployments
- Certified on all major carrier networks, attractive data services offerings

# 3G/4G Evolution



# Cellular Data Standards recap

## GSM

TDMA based World wide cellular standard

**Speeds: 28 Kbps**

## GPRS, EDGE

Packet Data service over GSM overlay, using multiple time slots

**Downlink: 384 Kbps**

**Uplink: 180 Kbps**

## UMTS/HSDPA

WCDMA based Data services.

**Downlink: 3.6 Mbps**

**Uplink: 380 Kbps**

## CDMA

IS-95 followed by cdmaOne

Adopted in North America, parts of S America & Asia

**Speeds: 28 Kbps**

## 1xRTT

Packet data service using single 1.25MHz channel.

**Downlink: 307 Kbps**

**Uplink: 153 Kbps**

## EVDO Rev0

Dedicated radio channel for data.

**Downlink: 2.4 Mbps**

**Uplink: 160 Kbps**

## EVDO RevA

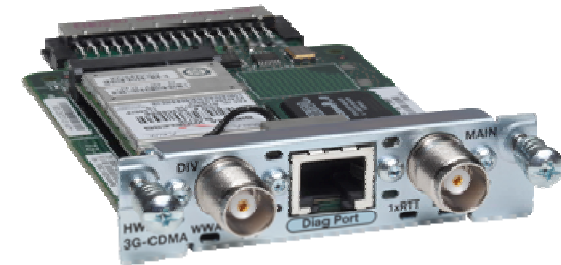
Improved uplink and QoS

**Downlink: 3.2 Mbps**

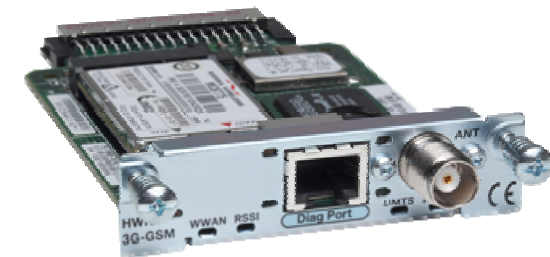
**Uplink: 1.8 Mbps**

# 3G HWIC Models

HWIC-3G-CDMA	HWIC-3G-GSM
Based on worldwide CDMA standards (CDMA2000)	Based on GSM/UMTS technology
Supports 1xRTT, EVDO Rev0 and EVDO RevA	Supports GPRS, EDGE, UMTS and HSDPA
Embedded modem Sierra Wireless <b>MC5725</b> card	Embedded modem Sierra Wireless <b>MC8775</b> card
800/1900 MHz bands	850/900/1800/ 1900 MHz GPRS & 850/1900/2100 MHz UMTS bands
Diversity Antennas	Single Antenna
Carrier profile provisioned on the modem	Carrier profile in SIM card



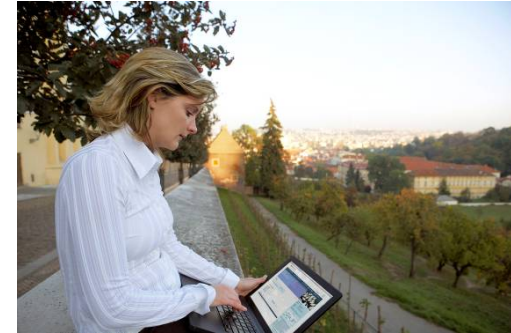
**HWIC-3G-CDMA**



**HWIC-3G-GSM**

# Applications powered by 3G

- **Reliable, resilient WAN backup for**
  - Network outages
  - Disaster recovery
- **Rapid deployment**
  - Instant branch connectivity for temporary or new sites
  - Temporary connectivity for nomadic sites
- **Portable deployments**
  - Kiosks, construction trailers, and mobile banks
- **“Primary data” connection**
  - Store-in-store, smaller retail stores, ATM connectivity, gas stations, and Telemetry



# Key 3G Benefits



- **High Speed Broadband WAN Connectivity** – use for either primary or backup at EVDO Rev A/ HSDPA speeds
- **High availability**— provides a true multi-path back-up option independent of the terrestrial infrastructure
- **Rapid deployment** – no wires to install, simplified installation
- **Portability** – one time activation, ability to quickly bring up new and temporary sites
- **Cost effective** – flexible data access plans

**Enterprise Class  
Broadband Wireless WAN for  
Integrated Services Routers**

# Faceplate LEDs



4 LEDs

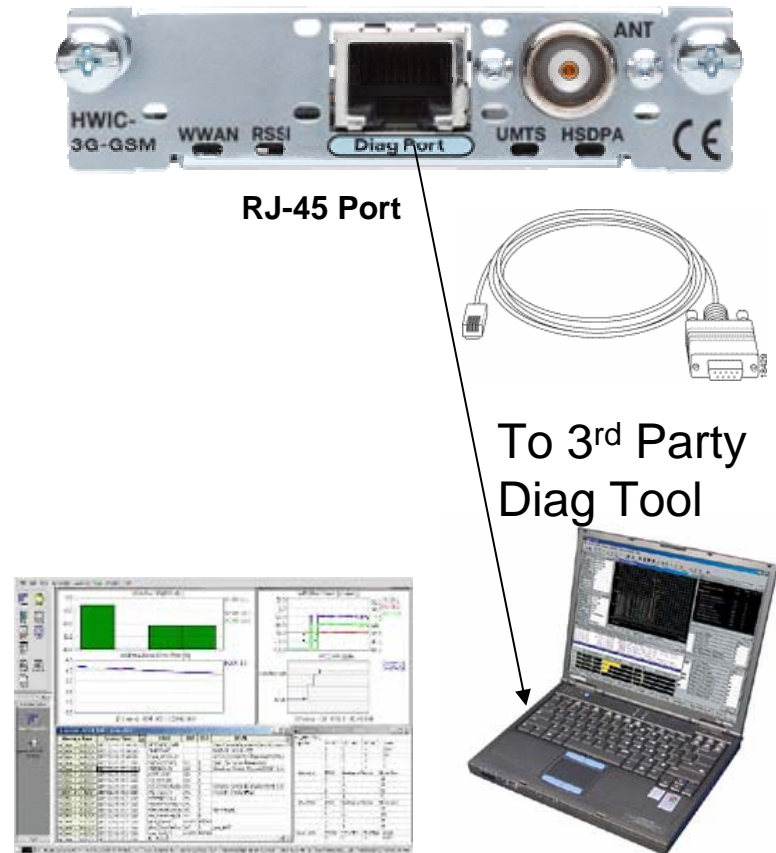


4 LEDs

LED	Function	States
<b>RSSI</b>	Denotes Received Signal Strength	<b>off</b> = low RSS <b>blinking green</b> = good <b>solid green</b> = excellent <b>solid yellow</b> = no service
<b>WWAN</b>	WAN Activity	<b>Off</b> <b>Blinking green/Solid green</b>
<b>1xRTT/EVDO (CDMA)</b>	Denotes Active Service	<b>On/Off</b>
<b>UMTS/HSDPA (GSM)</b>	Denote Active Service	<b>On/Off</b>

# Diagnostic Monitoring Support

- 3G WWAN HWIC has an RJ45 port on the faceplate for Diagnostics
- Use the standard cisco console cable to connect to PC with diag tool
- Use the following command to enable the diag port:  
`test cell-hwic 0/0/0 dm-port on`
- Useful for debugging protocol level issues on the modem
- Examples of 3<sup>rd</sup> party Diag tools
  - Qualcomm – **CAIT**
  - Spirent – **UDM**
- Plans to make the diagnostic capability available remotely over the network



# Antenna Options

## Antenna Connectors

HWIC-3G-CDMA: Main + Diversity

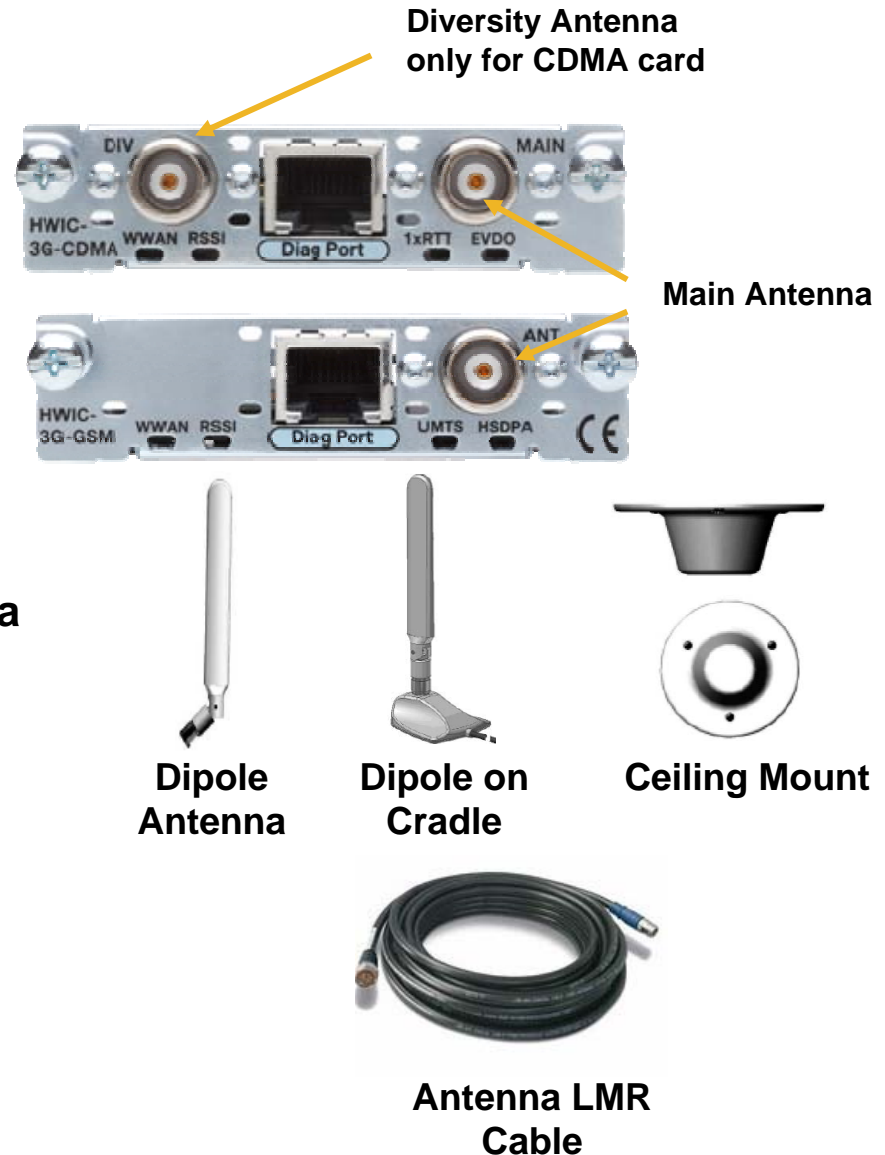
HWIC-3G-GSM: Only Main Antenna

## Antenna Accessories:

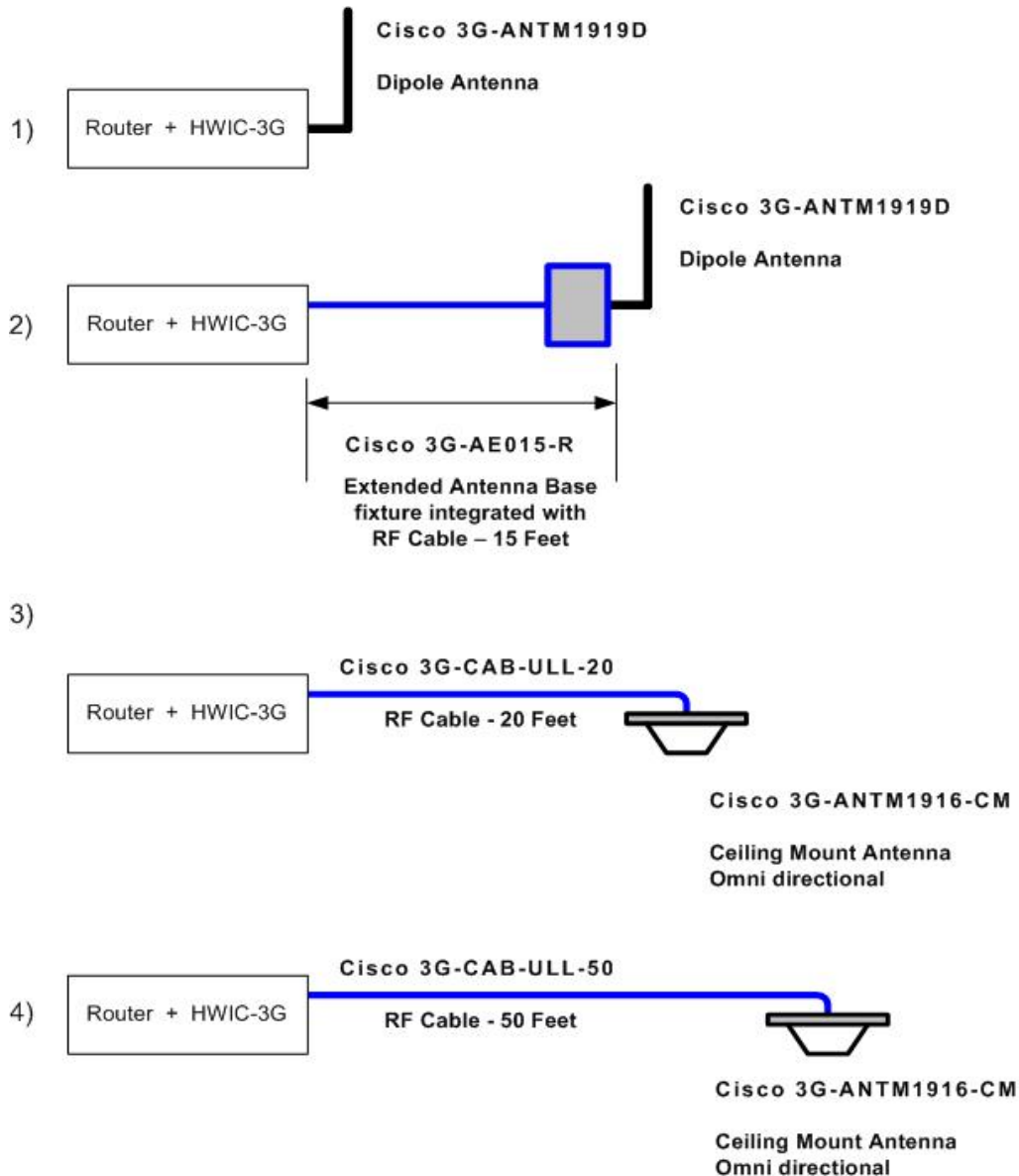
- Multi-Band Dipole Antenna
- Remote cradle with 15ft Cable
- Multi-Band Omni Ceiling Mount Antenna

## Antenna Cables:

- LMR400 20 feet
- LMR400 50 feet



# Antenna Installations



- (1) Dipole
- (2) Ceiling Mount
- (3) Cradle for Dipole with LMR195
- (4) LMR400 20 FT
- (5) LMR400 50FT

# 3G-ANTM1919D - Multi-Band Dipole Antenna

***Frequency Range:***

***806 – 960 MHz  
1710 – 2170 MHz***

***Antenna Gain:***

***0 dBi***

***Connector: TNC male***

***Omni-directional radiation pattern***

***Articulating knuckle provides 0 -90 and 180 degree swivel movement allowing vertical + horizontal orientation of the antenna.***



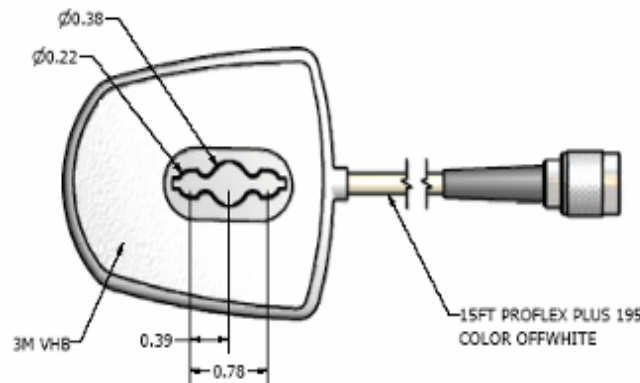
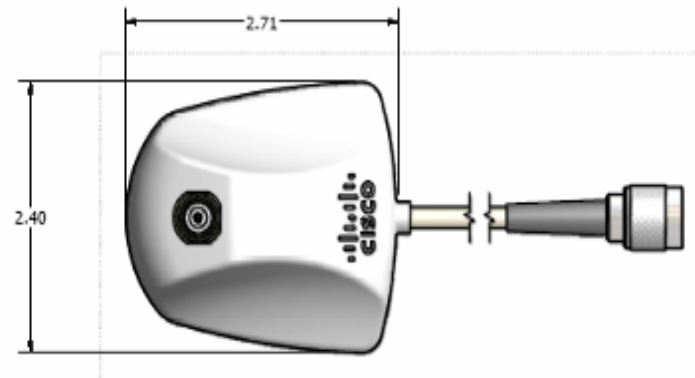
# 3G-AE015-R - Extended Antenna Base with 15 FT cable

**Frequency Range:**  
DC – 6 GHz

**Attenuation:**  
<3 dB at or below 2.5 GHz

**TNC (male) cable**  
- Connect to HWIC-3G

**TNC (female) base**  
- Connect to 3G-ANTM1919D



# Ceiling Mount Antenna

## 3G-ANTM-1916-CM

### Ceiling Mounted Antenna

**Antenna Gain:**

1.5 dBi 806 – 960 MHz

2.5 dBi 1710 – 2170 MHz

**Connector:**

TNC male

*Omni-directional radiation pattern*



**Mounting Hardware**  
Includes white caps to hide the screw heads

# Cables for Ceiling Mount Antenna

**3G-CAB-ULL-50**

**3G-CAB-ULL-20**

**LMR-400-LLPL**  
**Ultra Low Loss**  
**Plenum rated**

***Cable Loss:***

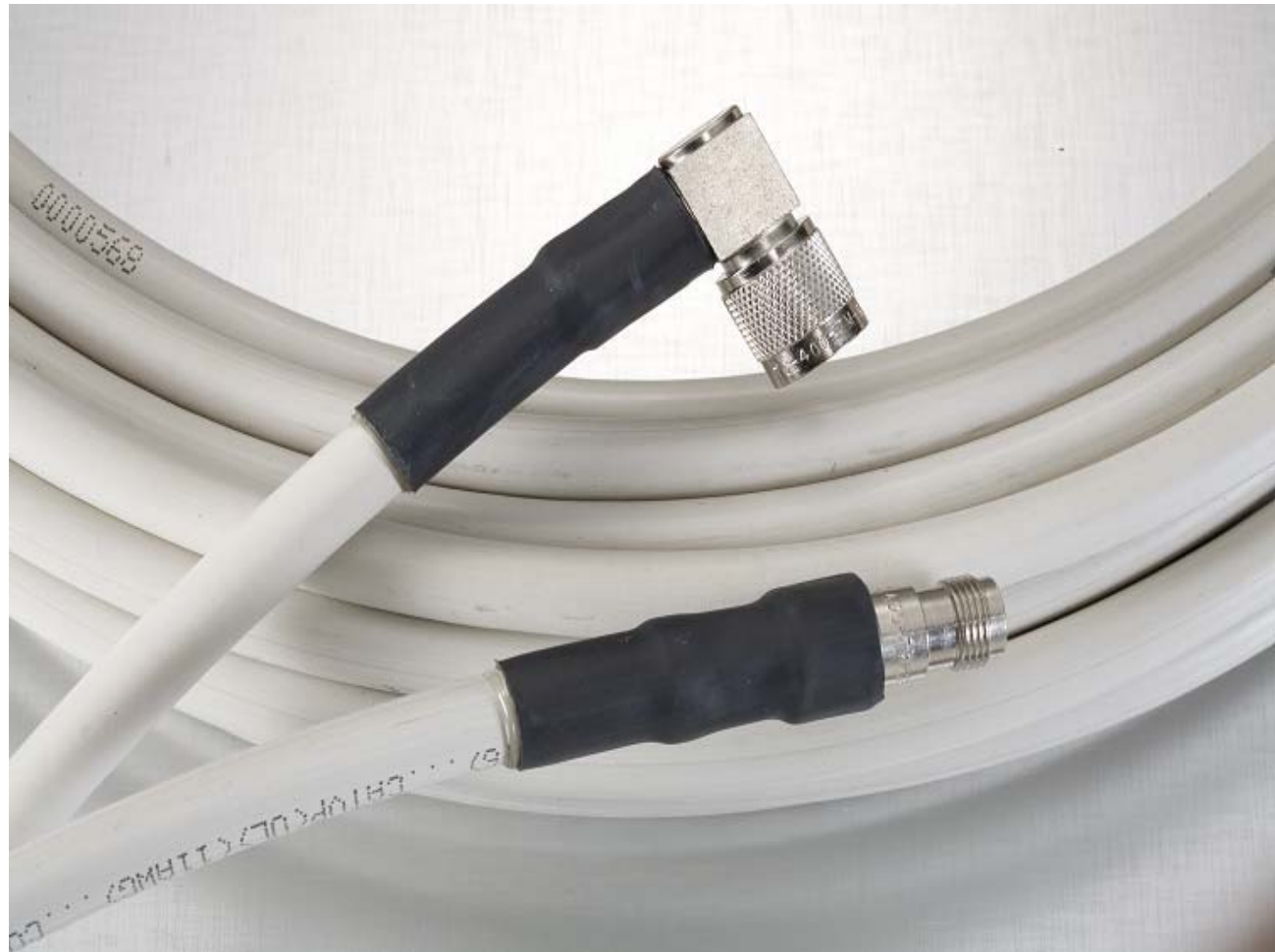
***20 FT 1.5 dB max @ 2 GHz***

***50 FT 3.5 dB max @ 2 GHz***

***Connector:***

***TNC male (at HWIC-3G)***

***TNC female (at antenna)***



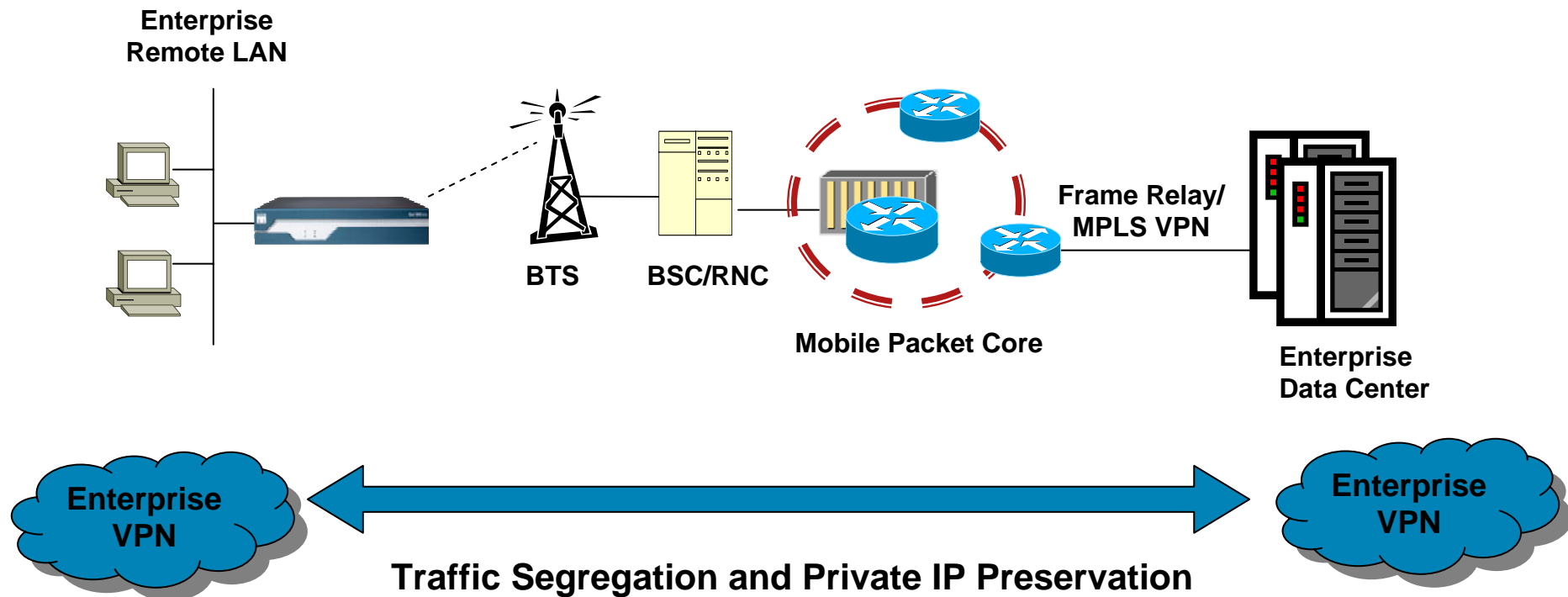
# Wireless WAN Service and Carrier Certification

- Cisco and the Mobile Carrier certifies The 3G HWIC on the mobile carrier network
- Most Carriers have the following certification tests:
  - RF Parametric Tests
  - Antenna Tests
  - Network Compatibility Tests
- In Turkey Turkcell have certified the Cisco 3G HWIC

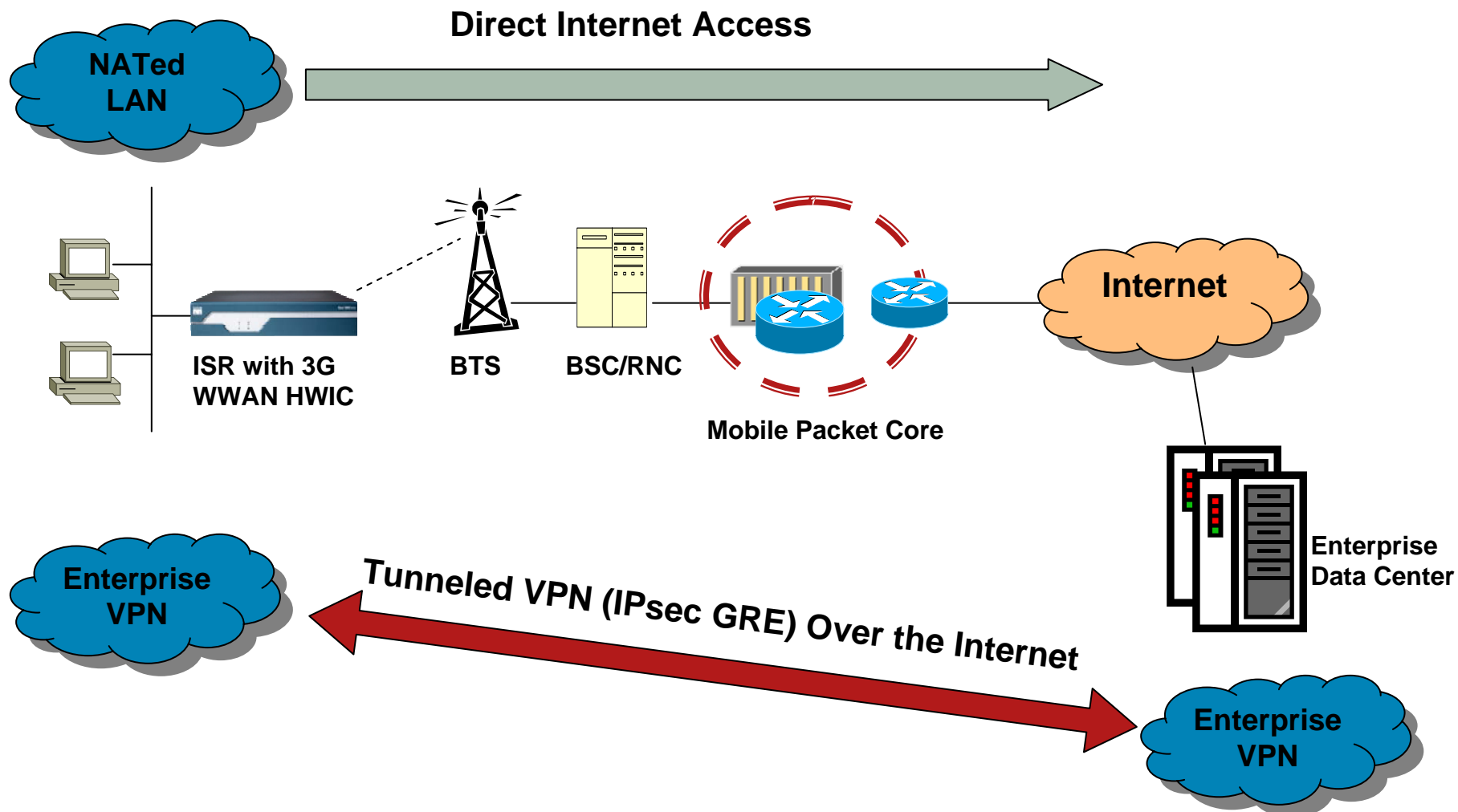
# Deployment options and Installation Tips



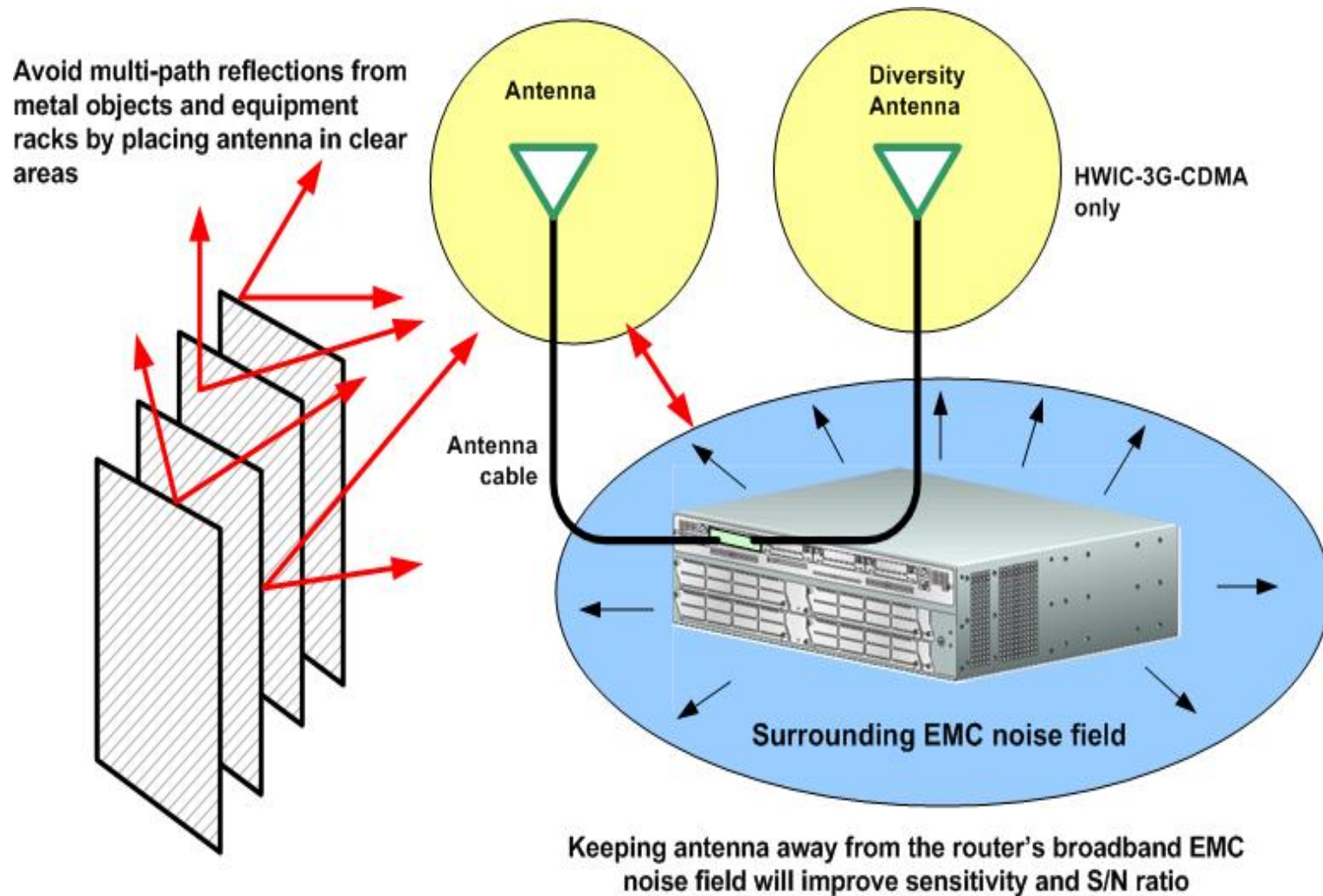
# Deployment Scenarios: Custom APN/Managed Data Service



# Deployment Scenarios: Internet Service and IPsec VPN



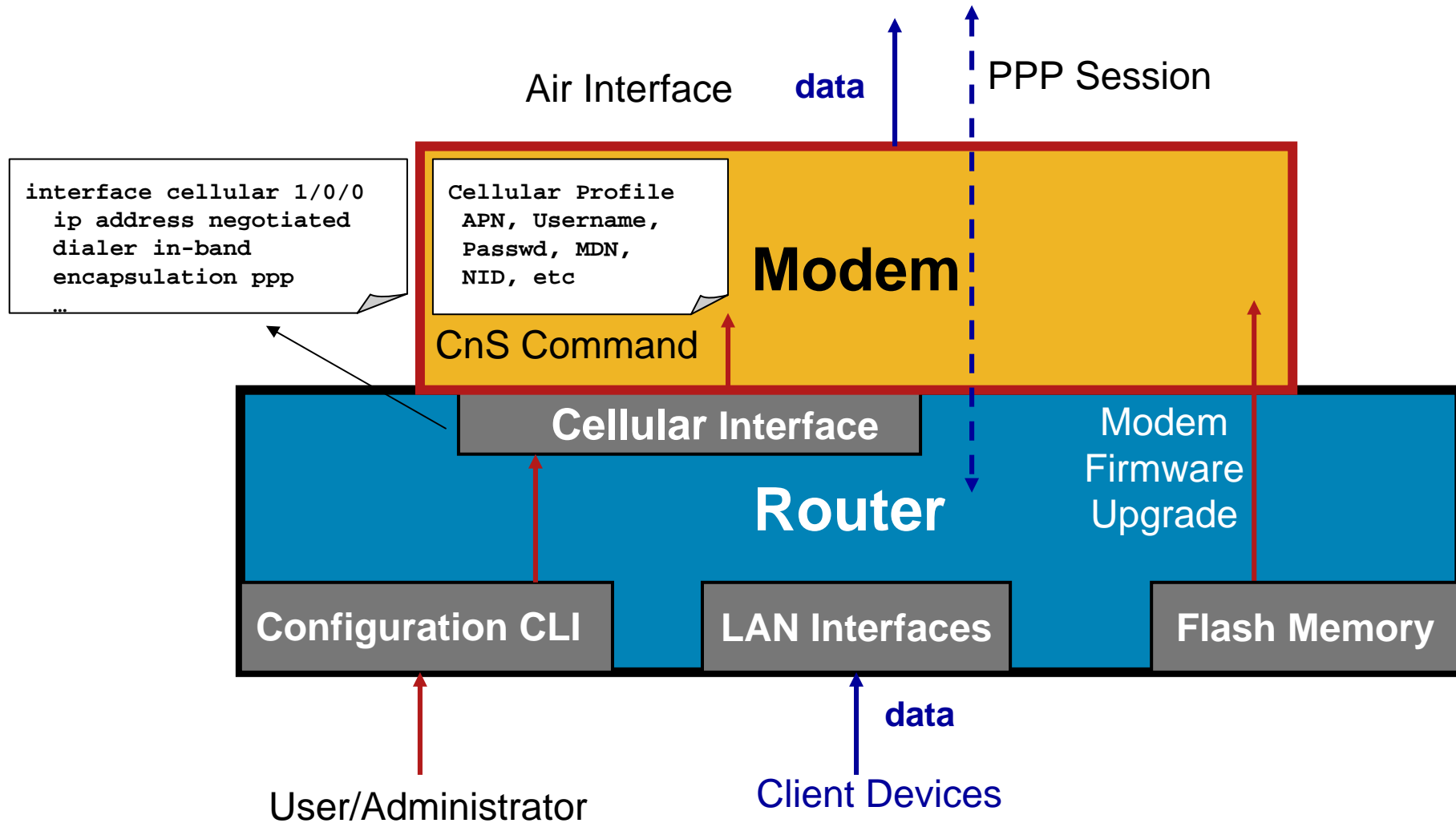
# Installation Tips



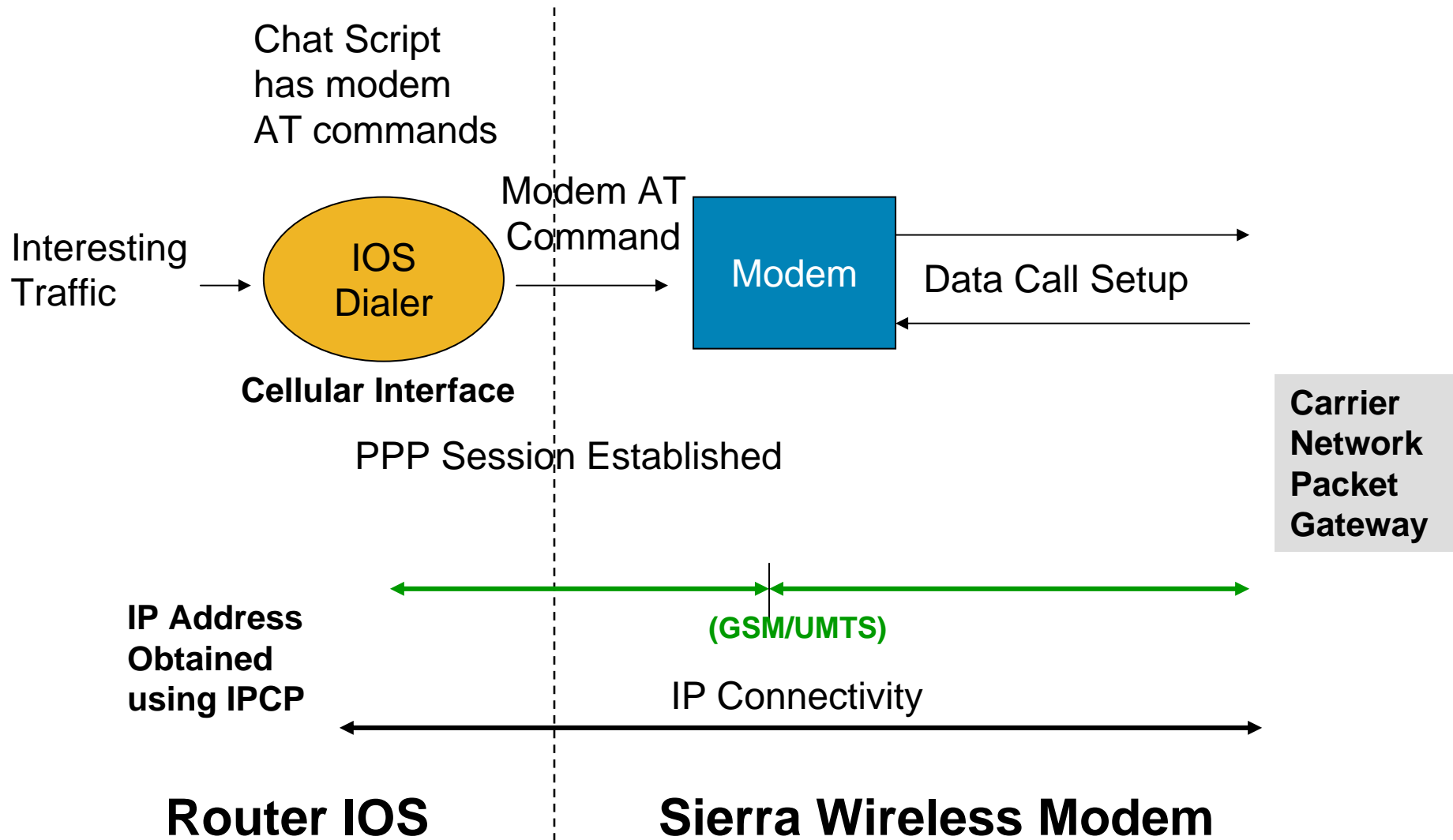
# Architecture and packet flow



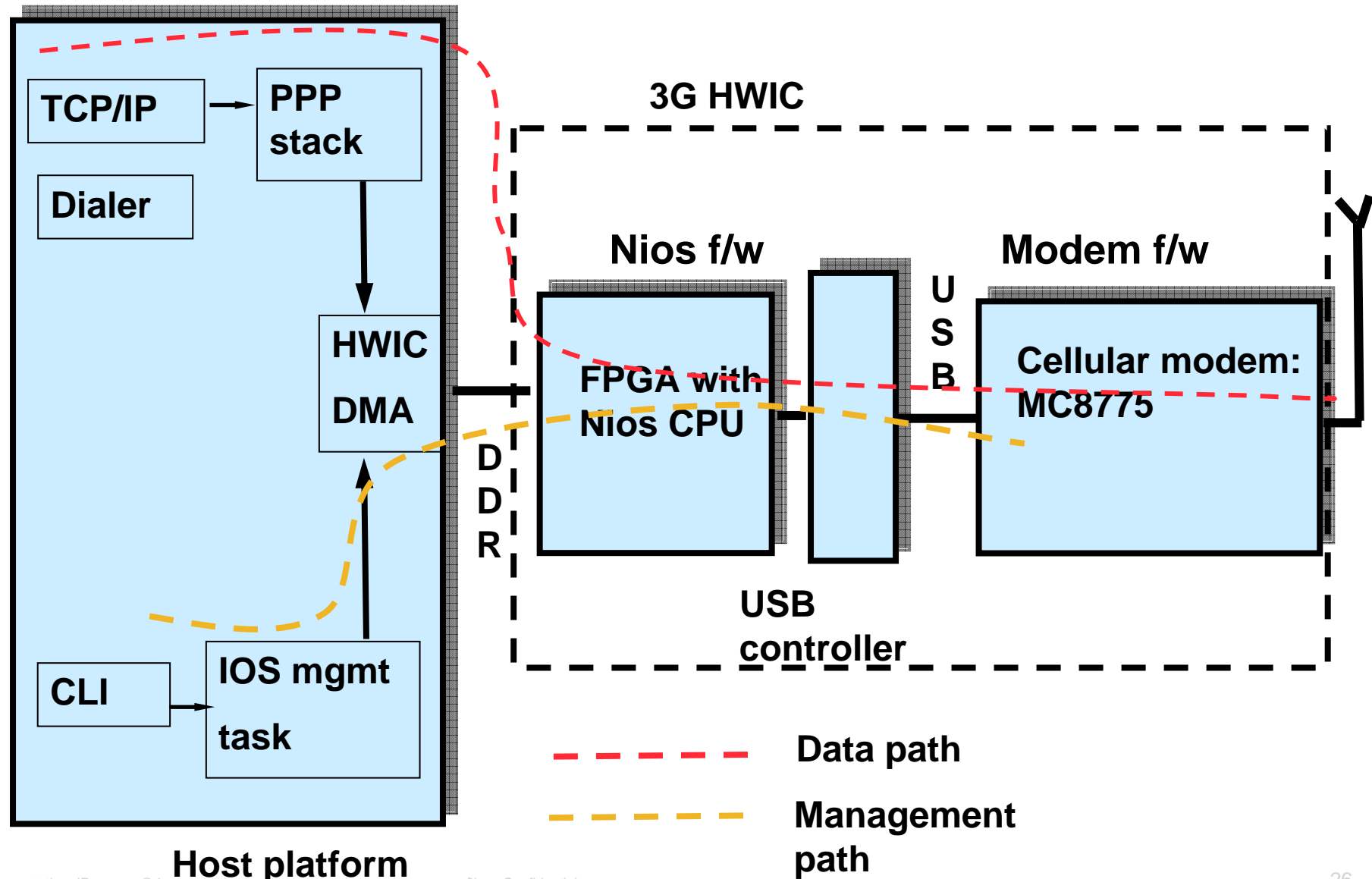
# Architecture overview



# Data call setup



# Path of the Packet



# Management and Provisioning



# SNMP Management and Cisco SDM Support

- No standard Cellular MIB exists today
- No Cellular MIB exist today in IOS, project in progress to provide a cellular MIB
- IOS Interface MIB support for 3G WWAN HWIC

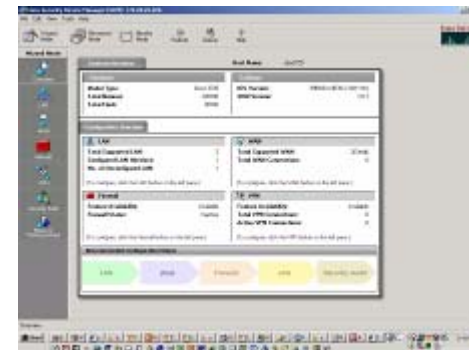
**ifxTable**: Interface counters

**IfStackTable**: Interface sublayer information

Traps: **linkDown**, **linkUp**

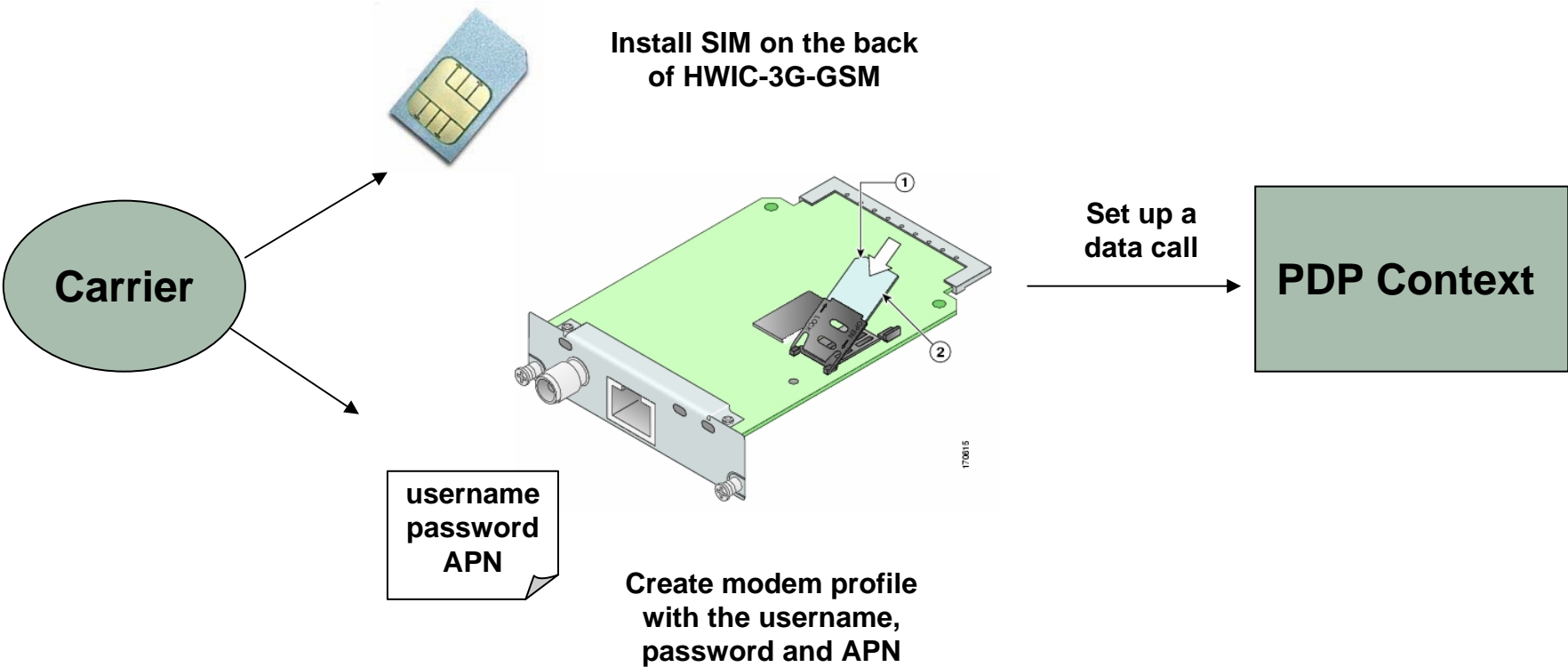
## Cisco SDM 2.5 support 3G WWAN HWICs

- Cellular Interface configuration
- CDMA/GSM Profile creation and Activation
- Status Monitoring and Traffic Statistics



Cisco SDM provides GUI based router configuration and management

# GSM/UMTS Modem Provisioning



# Configuration and Troubleshooting



# 3G WWAN HWIC Configuration and Monitoring

## CONFIGURATION

Modem Profile configuration and activation  
Cellular Interface configuration  
IOS Dialer/Backup Configuration

## MONITORING

Modem HW/SW Status  
Modem Signal/Network/Service Status  
Data connection Status

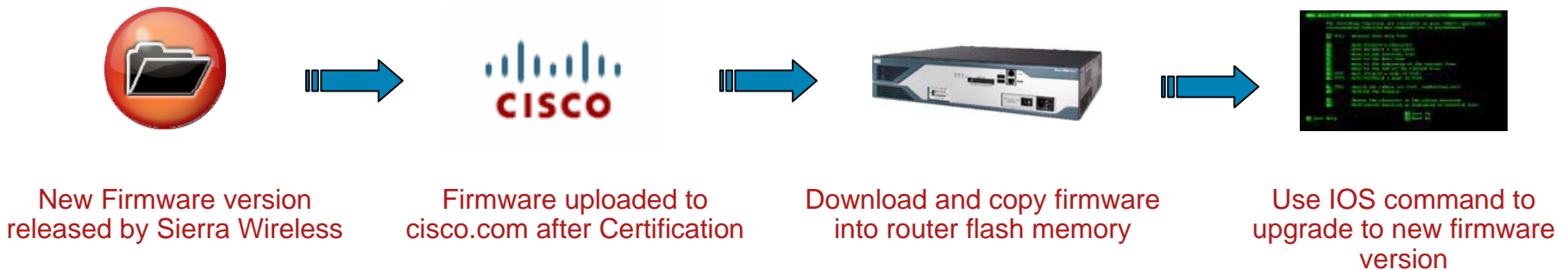
## IOS CLI

- Modem profile configuration and account activation
- Cellular interface configuration
- Data connection setup and teardown
- Reverse Telnet for modem AT command prompt
- Cellular modem firmware upgrade
- Show cellular commands
- Debug and test

Only for troubleshooting,  
not supported officially

# Modem firmware upgrade using IOS

Sierra Wireless modem firmware is not bundled with IOS. Modem firmware upgrade may be required for bug fixes and enhancements



**Download link on cisco.com for modem firmware:**  
<http://www.cisco.com/kobayashi/sw-center/sw-wireless.shtml>

## IOS Commands to upgrade firmware:

`microcode reload cellular <pa-bay> <slot> cdma modem-provision`  
where pa-bay is 0 for HWIC, slot is the slot number where the 3G HWIC is plugged in (0-3).

Note: The firmware is packaged as a TAR archive. After copying to router flash, use the following command to untar:

`archive tar /xtract flash:<firmware> flash:`

# GSM/UMTS Modem Profile Configuration CLI

## GSM Profile configuration command:

```
cellular x/x/x gsm profile create <number> <apn> [chap|pap] username passwd  
cellular x/x/x gsm profile delete <number>
```

## Profile Parameters

**username:** BSS authentication credential

**password:** BSS authentication credential

**authentication:** PAP/CHAP

**apn:** Access Point Name

**16 GSM Profiles can be configured at one time**

**Note: When no profile is selected profile 1 is used**

## Profile Selection

Using “**ATDT\*98\*<profile-number>#**” in the dialer chat script

```
Router# cellular 0/0/0 gsm profile create 1 ISP.CINGULAR chap  
ISP@CINGULARGPRS.COM CINGULAR1
```

```
Profile 1 = INACTIVE*
```

```
-----
```

```
PDP Type = IPv4, Header Compression = OFF
```

```
Data Compression = OFF
```

```
Access Point Name (APN) = ISP.CINGULAR
```

```
Authentication = PAP
```

```
Username: ISP@CINGULARGPRS.COM, Password: CINGULAR1
```

# GSM/UMTS Network Selection Command

## PLMN Selection commands:

```
cellular x/x/x gsm plmn search
```

```
cellular x/x/x gsm plmn select auto
```

```
cellular x/x/x gsm plmn select manual <mcc> <mnc>
```

Default PLMN Selection Mode

## Manual PLMN Selection Parameters

**mcc:** Mobile Country Code

**mnc:** Mobile Network Code

**plmn:** public land mobile network

## Note:

- The PLMN Search command may take anywhere between 30 secs to 5 minutes
- To see the available PLMNs, run the 'show cellular x/x/x network' command

```
Network Information
=====
Current Service Status = Normal, Service Error = None
Current Service = Combined Packet Service = EDGE (Attached)
Packet Session Status = Inactive Current
Roaming Status = Roaming
Network Selection Mode = Automatic
Country = USA, Network = AT&T
Mobile Country Code (MCC) = 310
Mobile Network Code (MNC) = 17
Location Area Code (LAC) = 230
Routing Area Code (RAC) = 1
Cell ID = 25573
Primary Scrambling Code = 0
PLMN Selection = Automatic
Registered PLMN = T-Mobile , Abbreviated =
Service Provider =
```

# HWIC Insertion and Recognition

**show version:**

```
1 Virtual Private Network (VPN) Module
1 Cellular interface
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
```

**show diag:**

```
WIC slot 0:
3G WWAN HWIC-HSDPA/UMTS/EDGE/GPRS-850/900/1800/1900/2100MHz
Hardware Revision      : 1.0
.....
Top Assy. Part Number  : 800-28846-01
Product (FRU) Number   : HWIC-HSDPA-N
Version Identifier     : NA
```

**show run:**

```
!
interface Cellular0/0/0
  no ip address
  shutdown
!
```

# New Cellular Interface configuration

The new Cellular interface is an Async Serial interface and requires following configuration

- **PPP Configuration**

```
encapsulation ppp
ppp chap hostname <username>
ppp chap password <passwd>
ppp ipcp dns request
```

- **Dialer Configuration**

```
async mode interactive
dialer in-band
```

- **IP Address configuration**

```
ip address negotiated
```

## Sample Configuration:

```
interface Cellular0/0/0
 ip address negotiated
 ip nat outside
 encapsulation ppp
 dialer in-band
 dialer string gsm
 dialer-group 1
 async mode interactive
 ppp chap hostname dummy
 ppp chap password 0 dummy
 ppp ipcp dns request
!
```

**Note: The ppp chap authentication credentials under the cellular interface needs to be obtained from the carrier.**

# DDR Configuration refresher

Cellular is an Async dialer interface similar to an analog modem

Interface Cellular → Implementation: Routing  
Encapsulation: PPP  
Media Type: Async

## DDR Configuration Steps:

1. Enable DDR on the interface
2. Define chat-script for the dialer interface
3. Define Interesting traffic
4. Create dialer list for interesting traffic
5. Map dialer list to the dialer interface

```
interface Cellular0/0/0
  dialer in-band
```

```
chat-script gsm "" "ATDT*99#"
interface Cellular0/0/0
  dialer string cingular
```

```
ip access-list 1 permit any 66.0.0.0
```

```
dialer-list 1 protocol ip list 1
```

```
interface Cellular0/0/0
  dialer-group 1
```

# Dialer/Chat Scripts for Cellular modem

- **GSM/UMTS**

**ATDT\*98\*<profile-number>#**

where profile-number could be 1-16 and represents the modem profile to be used for the call. Example chat script:

```
chat script gsm "" "ATDT*98*2" TIMEOUT 30 CONNECT
```

- **CDMA/EVDO**

**ATDT#777**

Example chat script:

```
chat script cdma "" "ATDT#777" TIMEOUT 30 CONNECT
```

# Dial Backup options

## Using Backup interface command:

- When primary interface goes down backup interface is activated
- While the primary line is up, the backup interface is placed in standby mode.
- Independent of routing protocol convergence

```
interface Serial 1/0:1
  backup interface cellular 0/0/0
  backup delay 30
!
```

## Using floating static route:

- Higher administrative distance used for the route over backup interface
- Independent of line protocol status of primary interface, dependent on routing protocol convergence

Administrative  
Distance



```
ip route 0.0.0.0 0.0.0.0 cellular 0/0/0 200
```

## Using Dialer Watch:

- DDR with no need to define interesting traffic
- Integrates dial backup with routing capabilities

```
interface cellular 0/0/0
  dialer watch-group 1
!
dialer watch-list 1 ip 3.1.1.0 255.255.255.0
dialer watch-list 1 ip 4.1.1.0 255.255.255.0
!
```

# New 'show cellular' commands

```
c3825#show cellular 0/0/0 ?
```

all	Display all the information
connection	Current active connection and statistics
hardware	Cellular modem hardware information
network	Cellular network information
profile	Profile information in the modem
radio	Cellular modem radio information
security	Modem security status

# CLI: show cellular connection

- Displays the current active connection state and statistics for GSM

## GSM

```
Data Connection Information
=====
Data Transmitted = 868892423 bytes, Received = 867644510 bytes
Profile 1, Packet Session Status = INACTIVE
    Inactivity Reason = Normal inactivate state
Profile 2, Packet Session Status = INACTIVE
    Inactivity Reason = Normal inactivate state
Profile 3, Packet Session Status = ACTIVE
    IP address = 166.138.186.118
Profile 4, Packet Session Status = INACTIVE
    Inactivity Reason = Normal inactivate state
Profile 5, Packet Session Status = INACTIVE
```

# CLI: show cellular hardware

- Displays the Modem firmware version and hardware details
- For GSM/UMTS, SIM card information is displayed
- For CDMA ESN and PRL information is displayed

## CDMA

```
V2800#sh cellular 0/0/0 hardware
Hardware Information
=====
Modem Firmware Version = p2005700
Modem Firmware built = 12-14-06
Hardware Version = 2.0
Electronic Serial Number (ESN) = 0x603C63E2
Preferred Roaming List (PRL) Version = 50719
Current Modem Temperature = 27 degrees Celsius
```

## GSM

```
enzo-3845#sh cellular 0/1/0 hardware
Hardware Information
=====
Modem Firmware Version = H1_1_8_3MCAP C:/WS/
Modem Firmware built = 03/08/07
Hardware Version = 1.0
International Mobile Subscriber Identity (IMSI) = 310410064603443
International Mobile Equipment Identity (IMEI) = 352678010002795
Factory Serial Number (FSN) = X2819460297100D
Modem Status = Online
Current Modem Temperature = 27 deg C, State = Normal
```

# CLI: show cellular network (GSM)

- Displays carrier network information, very useful in debugging
- Provides system and network ids for profile activation

**GSM**

```
C3845#show cellular 0/0/0 network

Network Information
=====
Current Service Status = Normal, Service Error = None
Current Service = Combined Packet Service = EDGE (Attached)
Packet Session Status = Active Current
Roaming Status = Roaming
Network Selection Mode = Automatic Country = USA,
Network = AT&T
Mobile Country Code (MCC) = 310
Mobile Network Code (MNC) = 17
Location Area Code (LAC) = 230
Routing Area Code (RAC) = 1 Cell ID = 25573
Primary Scrambling Code = 0
PLMN Selection = Automatic Registered
PLMN = Cingular , Abbreviated = Service Provider =
```

Type of service  
EDGE



# CLI: show cellular profile

- Displays all the modem profiles and related details
- 16 Profiles supported for GSM

**GSM**

```
C3845#show cellular 0/0/0 profile
Profile Information
=====
Profile 1 = INACTIVE*
-----
PDP Type = IPv4
Access Point Name (APN) =
Authentication = None
Username: , Password:

Profile 3 = ACTIVE
-----
PDP Type = IPv4
PDP address = 166.138.186.118
Access Point Name (APN) = wwan.ccs
Authentication = CHAP
Username: crlayiaprl@wwan.ccs, Password: br6eqiUh10
```

# CLI: show cellular radio

- Displays modem radio statistics like signal strength and channels/band connected to
- GSM and CDMA have different data displayed

## GSM

```
c3825#show cellular 0/0/0 radio
Current Band = WCDMA 1900, Channel Number = 9721
Current RSSI = -89 dBm,
```

## CDMA

```
# show cellular 0/0/0 radio
Current RSSI = -81 dBm, ECIO = -5 dBm
Current Channel Number = 1175
Current Band Class = Band Class 1
Sector ID (Hex) = 0080:0580:0000:0000:000A:CCC5:4501:6001
Subnet Mask = 104, Color Code = 237, PN Offset = 132
Rx gain control(Main) = 0 dBm, Diversity = Unavailable
Tx total power = 6 dBm, Tx gain adjust = 1536 dBm
Carrier to interference (C/I) ratio = 0
```

# New 'debug cellular' commands

```
c3825# deb cellular 0/0/0 messages ?
```

```
all          All debugging
async        Cellular async debugging
data         Data debugging
dm           DM debugging
management   Mgmt debugging
virt-con     Virtual console
```

```
c3825# deb cellular 0/0/0 virt-con ?
```

```
clear          Clear all virtual console debug log messages
disable        Disable virtual console real time debug monitoring
dump-data-structs  Dump virtual console data structures
log            Display virtual console messages from the debug log
monitor        Enable monitoring of real time virtual console debug
               messages
wrapper-off    Disable wrap around for virtual console log messages
wrapper-on     Enable wrap around for virtual console log messages
```

# Access to Modem AT commands

- Configure the modem line interface

```
line 0/0/0
modem InOut
transport input telnet
!
```

- Reverse telnet from router console to modem

```
telnet 128.1.1.1 2002
```

Note: If encounter connection refused error, clear line using the command:  
`# clear line 2002`

Port number is obtained by doing a show line:

```
c2851#show line
  Tty Line Typ      Tx/Rx    A Modem  Roty AccO AccI  Uses  Noise Overruns  Int
*   0   0 CTY          - -      - -    -    0     0     0/0     -
   1   1 AUX    9600/9600 - -      - -    -    0     0     0/0     -
I0/0/0 2 TTY          - inout  - -    -    0     0     0/0     -
322 322 VTY          - -      - -    -    0     0     0/0     -
```

Look for the interface number (0/0/0), add 2000 to the corresponding Line number

- To return to router console, press **ctrl + shift + 6** followed by **'x'**. Once you get back router CLI, type **'disc'** and hit enter.

# Sample Configuration

```
ip dhcp excluded-address 10.1.1.1
ip dhcp excluded-address 10.1.10.1
!
ip dhcp pool lan-client
  network 10.1.0.0 255.255.0.0
  default-router 10.1.0.1
  dns-server 66.102.163.231 66.102.163.232
!
chat-script cdma "" "ATDT#777" TIMEOUT 60 "CONNECT"
chat-script gsm "" "ATDT*99#" TIMEOUT 60 "CONNECT"
chat-script gsm-profile "" "ATDT*98*2#" TIMEOUT 60 "CONNECT"
!
interface FastEthernet0/1/0
  switchport access vlan 1
!
interface Cellular0/0/0
  ip address negotiated
  encapsulation ppp
  dialer in-band
  dialer string gsm
  dialer-group 1
  async mode interactive
  ppp chap hostname cisco@wwan.ccs
  ppp chap password 0 cisco
  ppp ipcp dns request
!
```

DHCP Pool for  
LAN Clients

Chat scripts for  
CDMA and GSM  
data calls

Router Switch port

Dynamically  
Allocated IP

Authentication  
Credentials

# Sample Configuration (contd.)

```
interface Vlan1
  ip address 10.1.0.1 255.255.0.0
  ip nat inside
  !
  ip route 0.0.0.0 0.0.0.0 Cellular0/0/0
  !
  ip nat inside source list 10 interface Cellular0/0/0 overload
  !
  access-list 1 permit any
  dialer-list 1 protocol ip list 1
  !
  line 0/0/0
    exec-timeout 0 0
    script dialer gsm
    login
    modem InOut
    no exec
    transport preferred all
    transport input all
    transport output all
    autoselect during-login
    autoselect ppp
  !
```

Dynamic NAT  
configuration

Dialer list for  
interesting traffic

# Initialization SIM Card not recognized

- When booting up if Sim Card is not inserted properly

## Booting up Message

```
Mar  8 10:19:22.875: %CELLWAN-2-MODEM_UP: Cellular0/3/0 modem is now UP
*Mar  8 10:19:22.931: %CELLWAN-2-SIM_FAILURE: SIM read failed
```

## Show cell x/x/x

### Security

```
Modem Security Information
=====
Card Holder Verification (CHV1) = Disabled
SIM Status = Removed
SIM User Operation Required = None
Number of Retries remaining = 255
```

# Problems during Router booting up

- **Initialization problems.**

**Modem is not properly inserted. Firmware was not upgrade successful.**

- **SIM Card Insertion problem.**

**SIM card is not insert properly or SIM card is not functional.**

# CLI: show controller cellular x/x/x (GSM)

- Displays what service provider your modem is attached to.
- LED status/ Theoretical speed of the technology

## GSM

```
Interface Cellular0/1/0
HSDPA/UMTS/EDGE/GPRS-850/900/1800/1900/2100MHz unit 0,
HWIC cellular modem configuration:
-----
Modem is recognized as valid for this HWIC
manufacture id: 0x00001199      product id: 0x00006812
Sierra Wireless MC8775 UMTS modem.
Modem Uplink Speed = 118 kbit.
Modem Downlink Speed 236 kbit.
Modem Management Statistics
-----
Modem resets = 1
Packets sent = 63, Packets received = 101034, Packets pending = 0
RSSI LED = Fast Blinking
UMTS LED = OFF
HSDPA LED = OFF
DM port = Disabled
```

# 3G HWIC Information on CCO

[HTTP://www.cisco.com/go/3G](http://www.cisco.com/go/3G)

# Q and A



