

RFS Microwave antenna products

Radio Link Network

July 2014 – EMAI Partner Certification Training



WIRELESS / MICROWAVE / INDOOR / BROADCAST

RFS is a worldwide leading provider of innovative wireless and broadcast infrastructure products

www.rfsworld.com

RADIO FREQUENCY SYSTEMS
The Clear Choice®

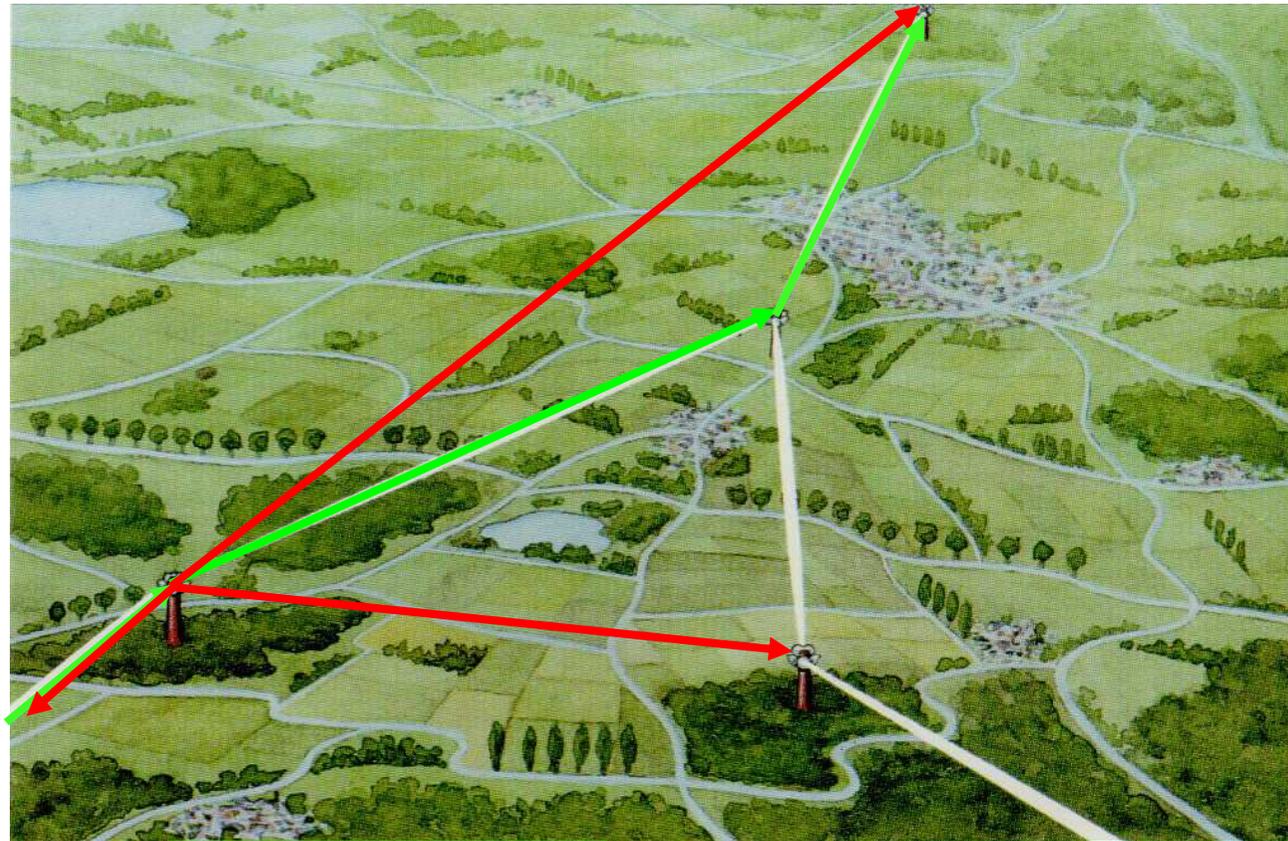


Agenda

1. Applications
2. Antenna Product portfolio
3. RLN value proposition
4. Products launched in 2013
5. Focus on some products launched in 1H14
6. Introduction to the new product line dedicated to small cells backhauling

RLN Applications

Point to Point scenario



 **Wanted Signal**

 **Interfering Signal**

Application Overview

RLN – Main applications

- **Trunk Networks**
 - **Fixed Wire Operators**
Usually larger diameter antennas. Most systems use elliptical waveguides.
 - **Broadcast Organisation**
Many broadcast organisations build their own trunk networks
 - **Private Networks**
Utility companies such as power companies build their own networks for maintenance and controlling
- **Mobile backhaul**
 - **Mobile operators want independence from Telcos and build their own backbone networks.**
Medium size antennas remote mounted.
- **Base station connectivity**
 - **Mobile operators use microwave in about 70% of cases to connect base station to base station and base station to switching centres. Usually use of smaller diameter direct mounted antennas and higher frequencies.**
- **Enterprise solutions**
 - **Universities and other organisation use microwave to build their own network on the campus.**
Small antennas at higher frequencies.

3G Network topology for Mobile applications

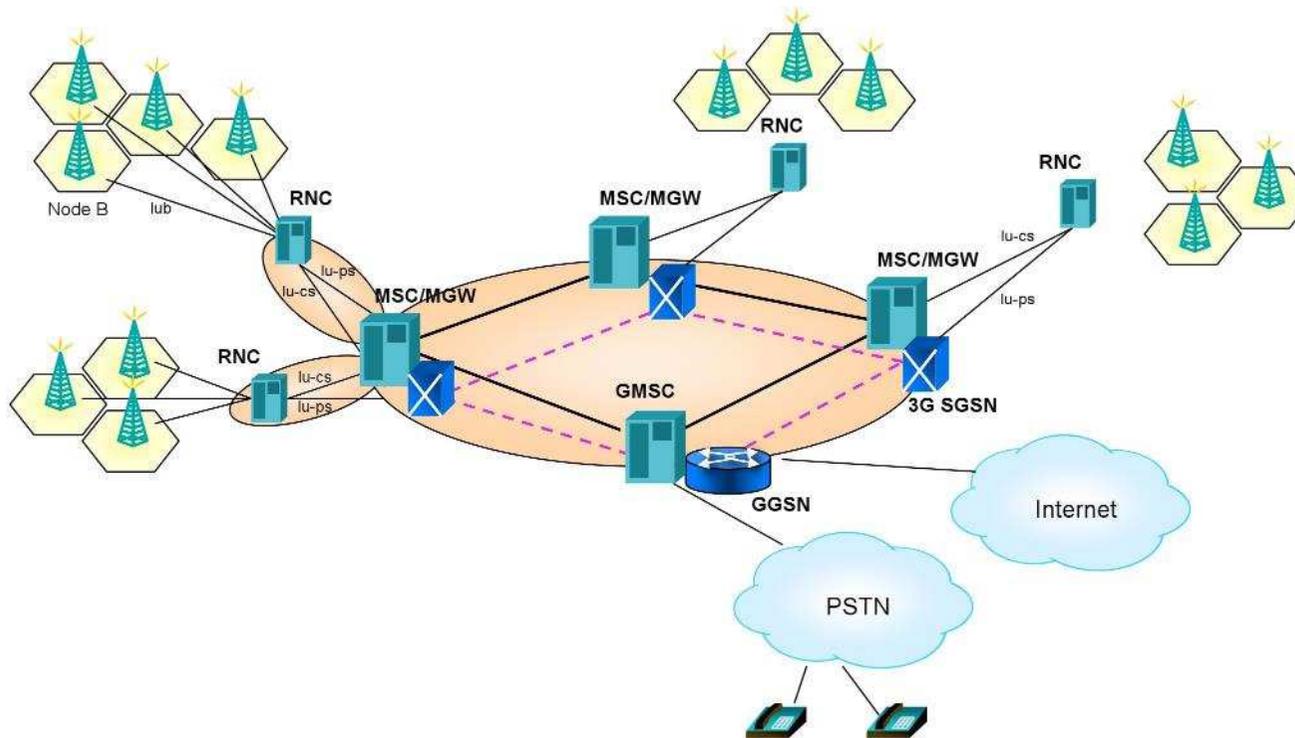


Figure 1: A Typical 3G Network



LTE Network Topology for Mobile applications

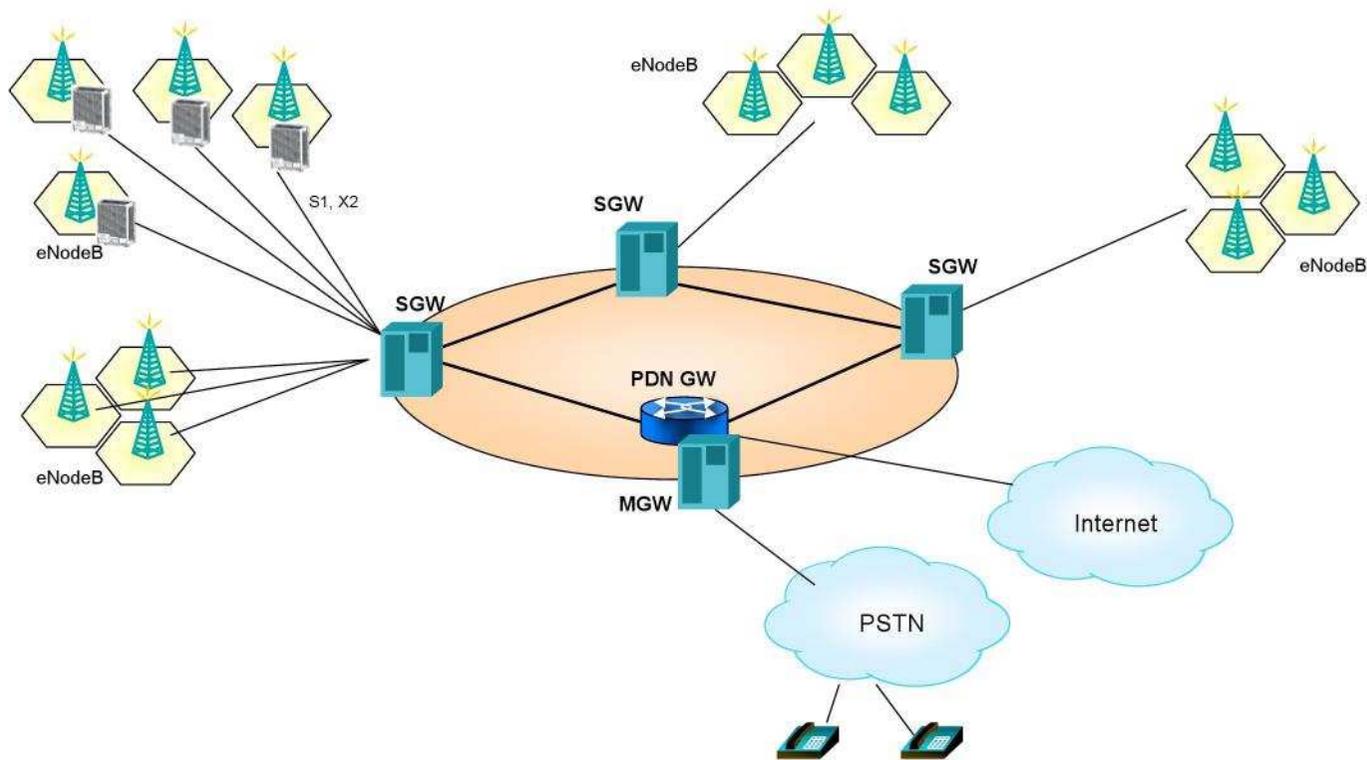
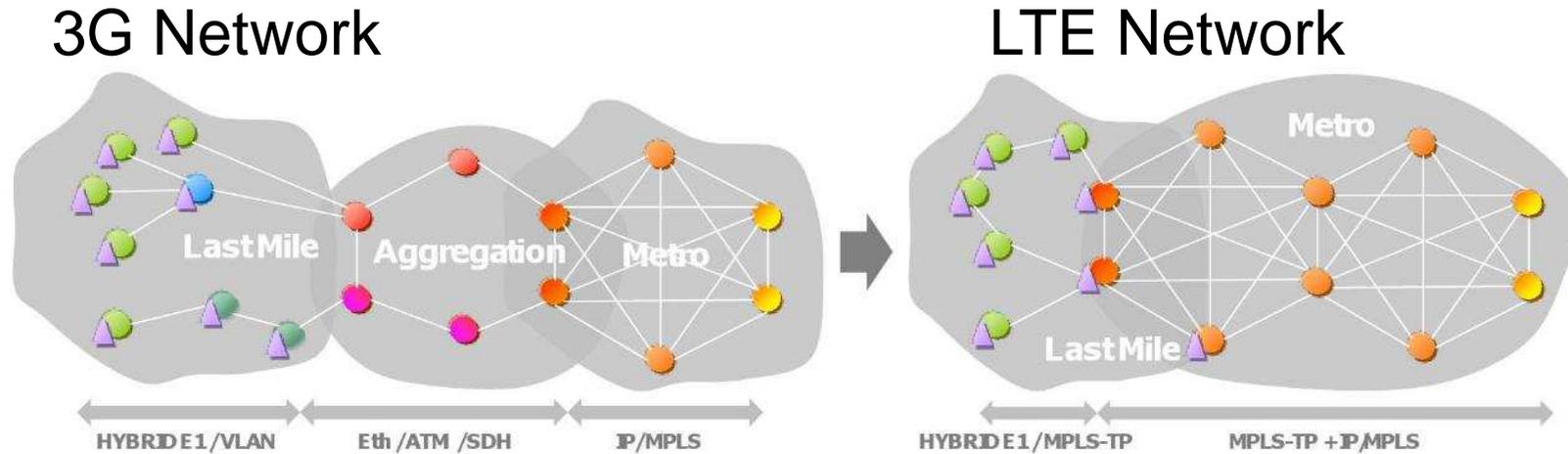


Figure 2: A Typical LTE Network

Mobile Operator Network Topology



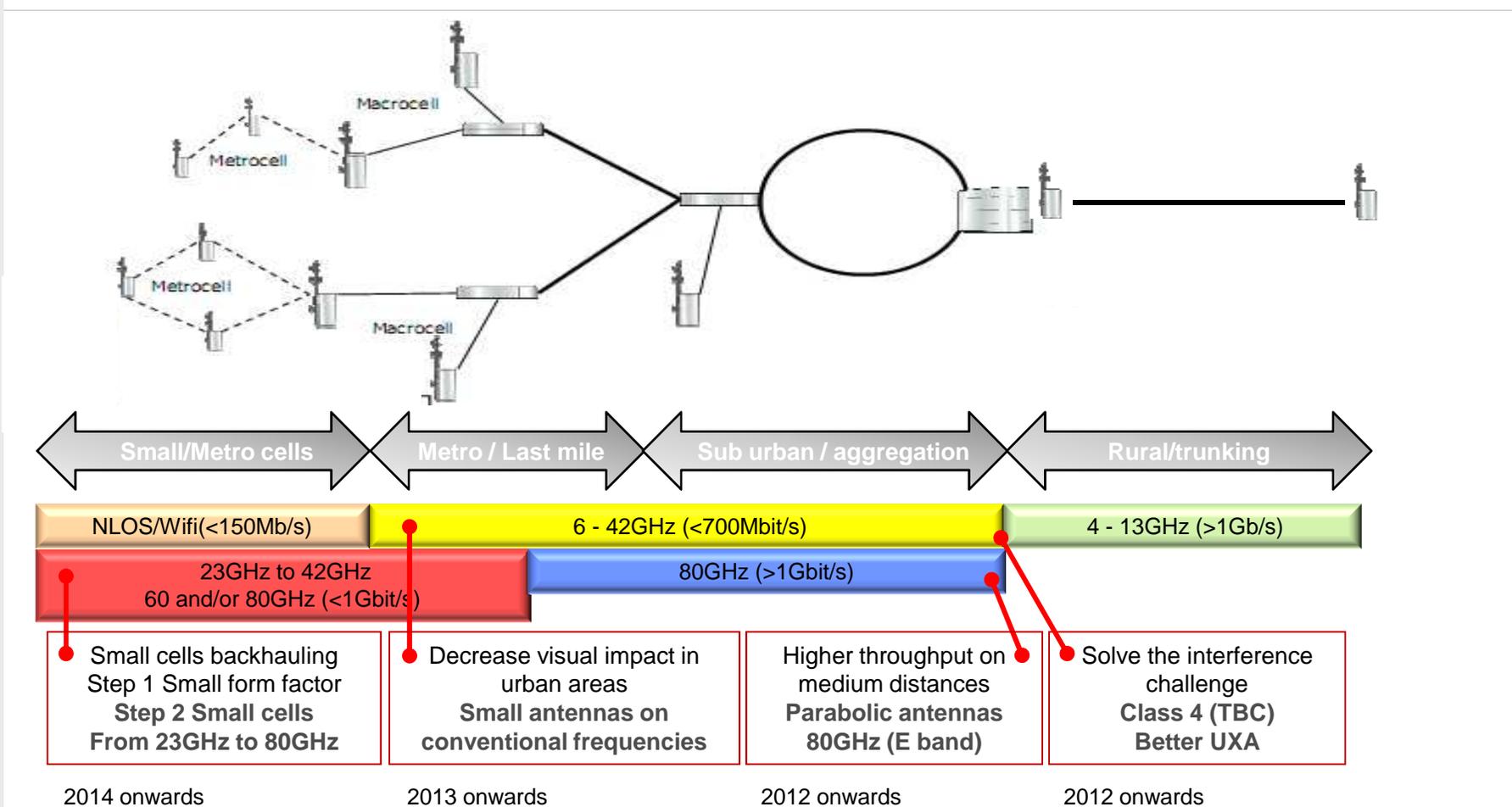
⌚ Simplified Network topology

- **Last mile**
 - ✓ Ring topology network
 - ✓ Hybrid E1 / IP Ethernet
- **Aggregation network**
 - ✓ Meshed network combined with Metro network
 - ✓ IP Ethernet

>50 % Microwave
35 - 40 % Fibre optic

Microwave backhaul evolution

Impact on MWA



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RFS microwave antennas portfolio

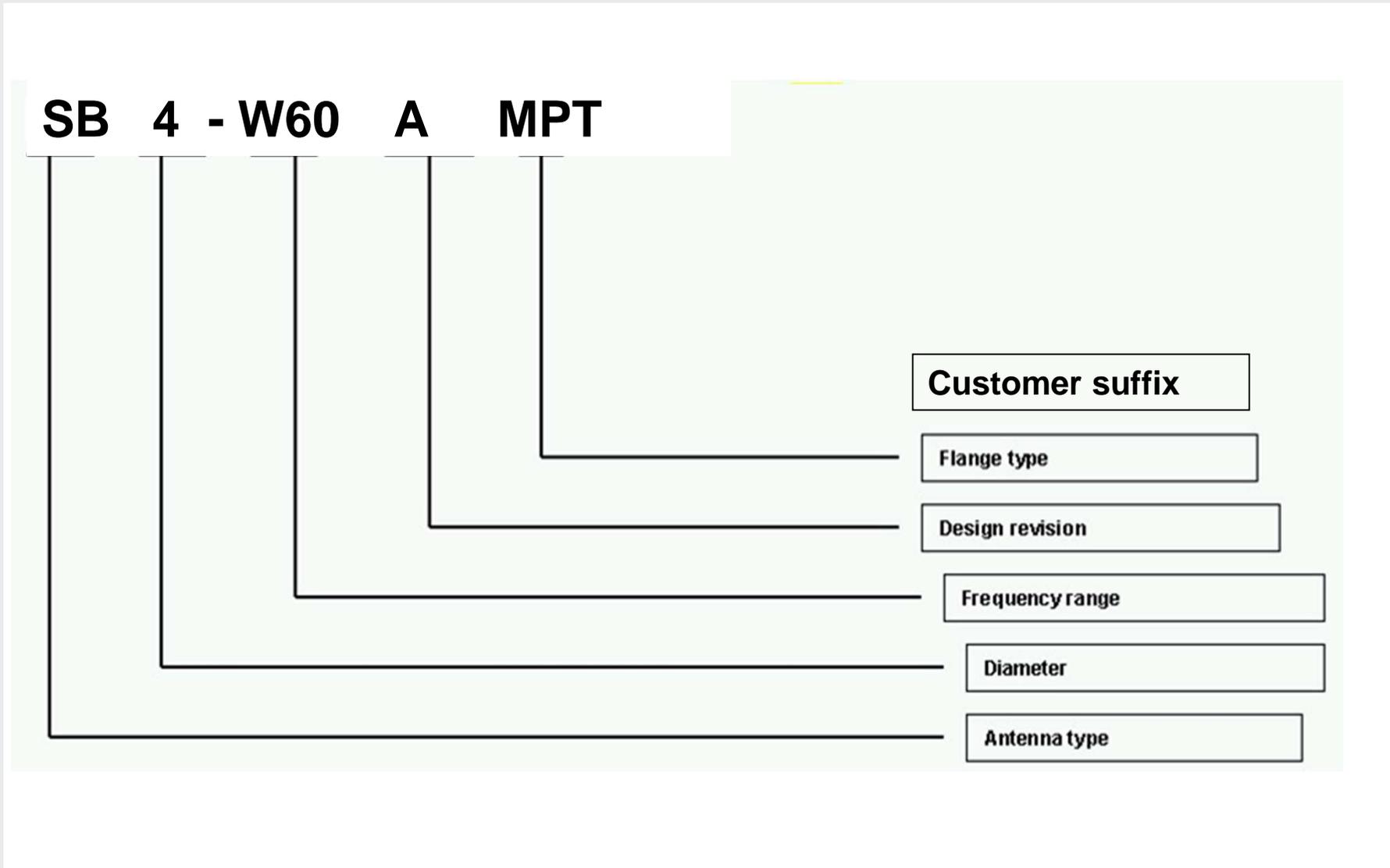
4 main product categories:

- **Compact Line and Compact Line Easy:** for small and medium antennas 1 to 6 ft
- **Trunk Line:** for large antennas 8 to 15 ft
- **Prime Line :** for ultra high RF performances (very high XPD)
- **Harsh Area Line :** for extreme environmental performances

1		2		3		4		6		8		10		12		15	
Single	Dual	Single	Dual	Single	Dual	Single	Dual	Single	Dual	Single	Dual	Single	Dual	Single	Dual	Single	Dual
 Compact Line (SB & SBX)										 Trunk Line (Class 3) (UA & UDA)							
SB1	SBX1	SB2	SBX2	SB3	SBX3	SB4	SBX4	SB6	SBX6	UA8	UDA8	UA10	UDA10	UA12	UDA12	UA15	UDA15
 Compact Line Easy (SC & SCX)										Trunk Line (Class 2) (DA & DAX)							
										Prime Line (Very High XPD) (UXA - Dual Polar)							
		UXA2				UXA4		UXA6		UXA8		UXA10		UXA12		UXA15	
										Harsh Area Line (SU & SUX, DA and DAX)							
		SU2	SUX2			SU4	SUX4	SU6	SUX6	DA8	DAX8	DA10	DAX10	DA12	DAX12	DA15	DAX15

Antenna range available as integrated version

RLN Antenna Model name structure



RLN Model name structure: Antenna type

High performance		Ultra High performance	
single	dual	single	dual
DA 	DAX 	UA, SU 	UDA, SUX 
			UXA 
		SB 	SBX 
		SC 	SCX 
		LA 	

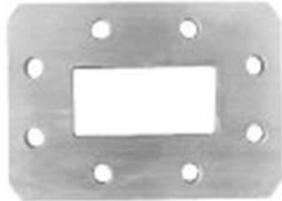
Model name structure: Frequency range and size

		Performance									
		High		Ultra High							
Frequency [GHz]	RFS Code	single	dual	single				dual			
		DA	DAX	SC	SB	UA	LA	SCX	SBX	UDA	UXA
3.6 - 4.2	36	6-15ft	6-15ft								6-15ft
4.4 - 5.0	44	6-15ft	6-15ft								6-15ft
5.925 - 7.125	W60			4-6ft				4-6ft			
5.925 - 6.425	59	8-15ft	8-15ft			8-15ft					6-15ft
6.425 - 7.125	65	8-15ft	8-15ft			8-15ft					6-15ft
7.125 - 7.75	71										4-15ft
7.125 - 8.5	W71	8-15ft	8-15ft	2-3ft	3-6ft	8-15ft		2-3ft	4-6ft	8-15ft	
7.75 - 8.5	78										4-15ft
10.0 - 11.7	W100			2-3ft	4-6ft			2-3ft	4-6ft		
10.3 - 10.7	103	8-12ft	8-12ft								4-12ft
10.7 - 11.7	107	8-12ft	8-12ft			8-12ft					4-12ft
12.7 - 13.25	127	8-10ft	8-10ft	2-3ft	1, 4-6ft	8-10ft		2-3ft	1, 4-6ft		4-10ft
14.2 - 15.35	142	8ft	8ft	2-3ft	1, 4-6ft	8ft		2-3ft	1, 4-6ft		2-8ft
17.7 - 19.7	190			2-3ft	1, 4-6ft			2-3ft	1, 4-6ft		2-6ft
21.2 - 23.6	220			2-3ft	1, 4-6ft		0.5ft	2-3ft	1, 4-6ft		2-6ft
24.25 -26.5	250			2-3ft	1, 4ft			2-3ft	1, 4ft		
27.5 - 29.5	280			2ft	1ft			2ft	1ft		
31.0 - 33.4	320			2ft	1ft			2ft	1ft		
37.0 - 40.0	380			2ft	1ft		0.5ft	2ft	1ft		
40.5 - 43.5	420			2ft	1ft			2ft	1ft		
51.4 - 52.6	520					1ft					
71.0 - 86.0	W800			2ft	1ft						

RLN Model name structure: Antenna Flanges



PDR



UDR



PBR



UBR

Flange	Size
D - PDR	R40 – R120

V – UDR	R40 – R120
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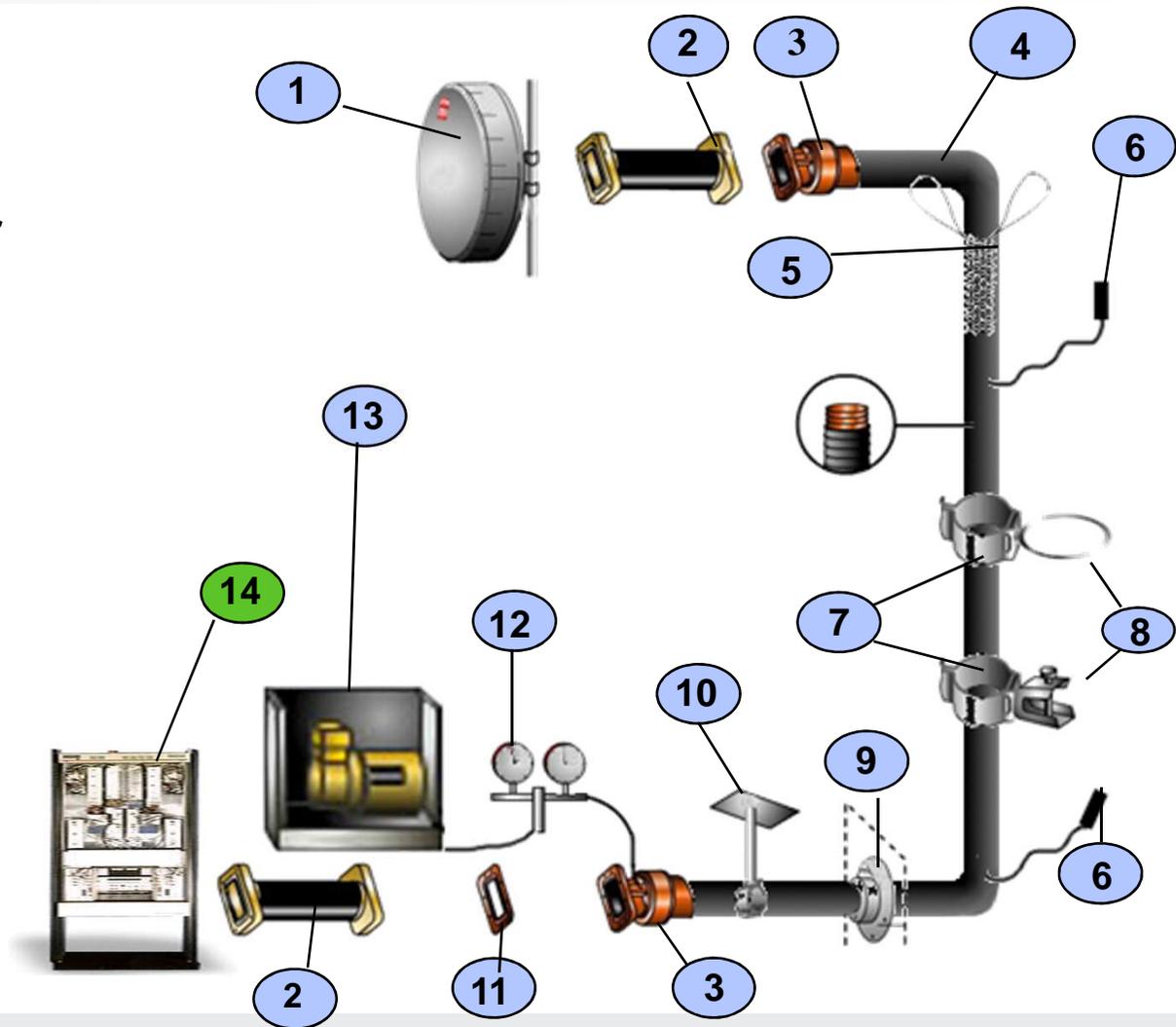
B - PBR	R84 – R320
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W – UBR	R84 – R320
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LONG HAUL – remote mount

Site Architecture

- 1 Antenna
- 2 Twist Flex or Jumper
- 3 Connector
- 4 Transmission Line
- 5 Hoisting Grip
- 6 Grounding Kit
- 7 Hanger
- 8 Hanger Mount
- 9 Wall/Roof Feed Thru
- 10 Ceiling Adapter
- 11 Pressure Window
- 12 Gas Dist. Manifold
- 13 Dehydrator
- 14 Radio
(IDU – Indoor Unit)





Application Backbone for Mobile application



Mobile backhaul

- Customer: OEMs, Mobile operator
-
- typ. antenna size: 4ft to 6ft
- typ. frequency range: 7 to 15 GHz
- typ. Distance: 10 – 20 km short haul
- typ. Capacity: >155 Mbs SDH up to 2Gbs IP-Packet
- typ. Antennas: Dual polar. **SBX, UXA**

SHORT HAUL remote mount

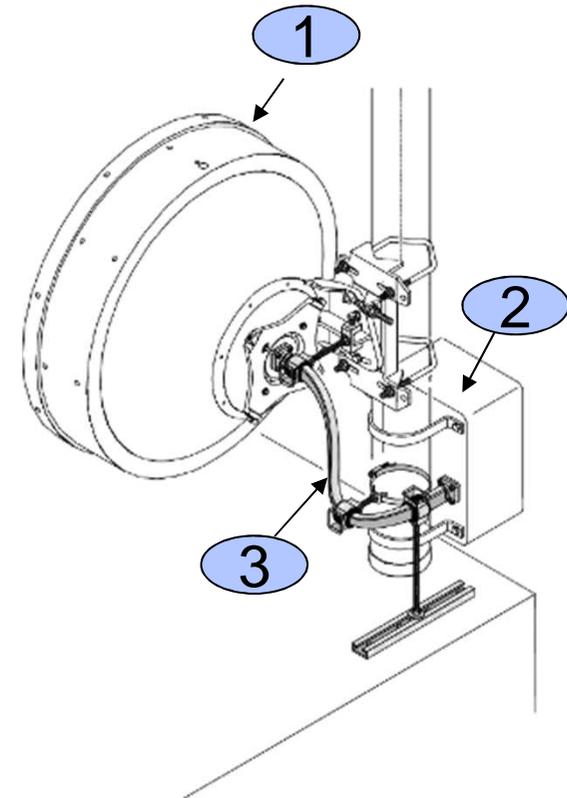
Site Architecture

1. Antenna
2. Outdoor Unit (ODU)
3. TwistFlex
4. Indoor Unit (IDU)

Radio close to the antenna

RFS solution

- **TwistFlex waveguide** “jumper” enables radio connection
- **TwistFlex waveguides** in **all frequency bands** with **different lengths**. Necessary fixing hardware can be ordered separately



SHORT HAUL –RFS antenna portfolio

Single polarized

- SB (Ultra High performance)

Antennas size: 4ft to 6ft

Increase of dual polarized antennas

Increase of integrated antennas (Split mount)

Twistflex

Elliptical waveguides and accessories

Dual polarized

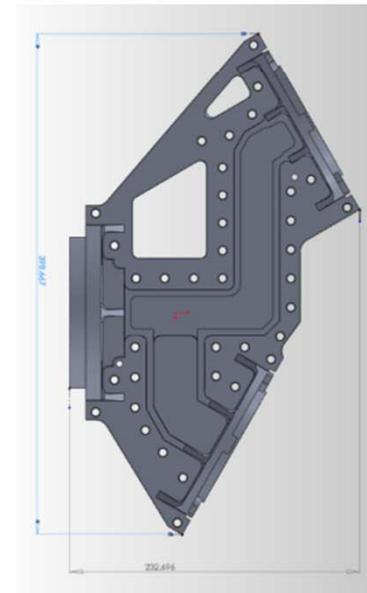
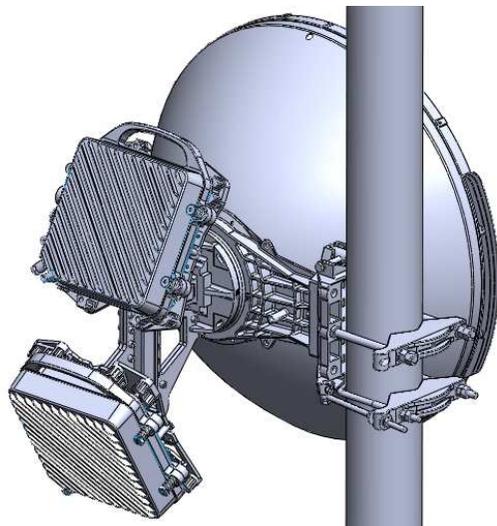
- SBX (Ultra High Performance)
- UXA* (Ultra High Performance, Ultra High XPD)



FUTURE PRODUCT

- **RFS OMT**

- Compatible with several OEM ODU.
- Vertical / Slanted design.
- Possibility to upgrade to a 4 ports OMT.



Application Mobile distribution network



Base station connectivity

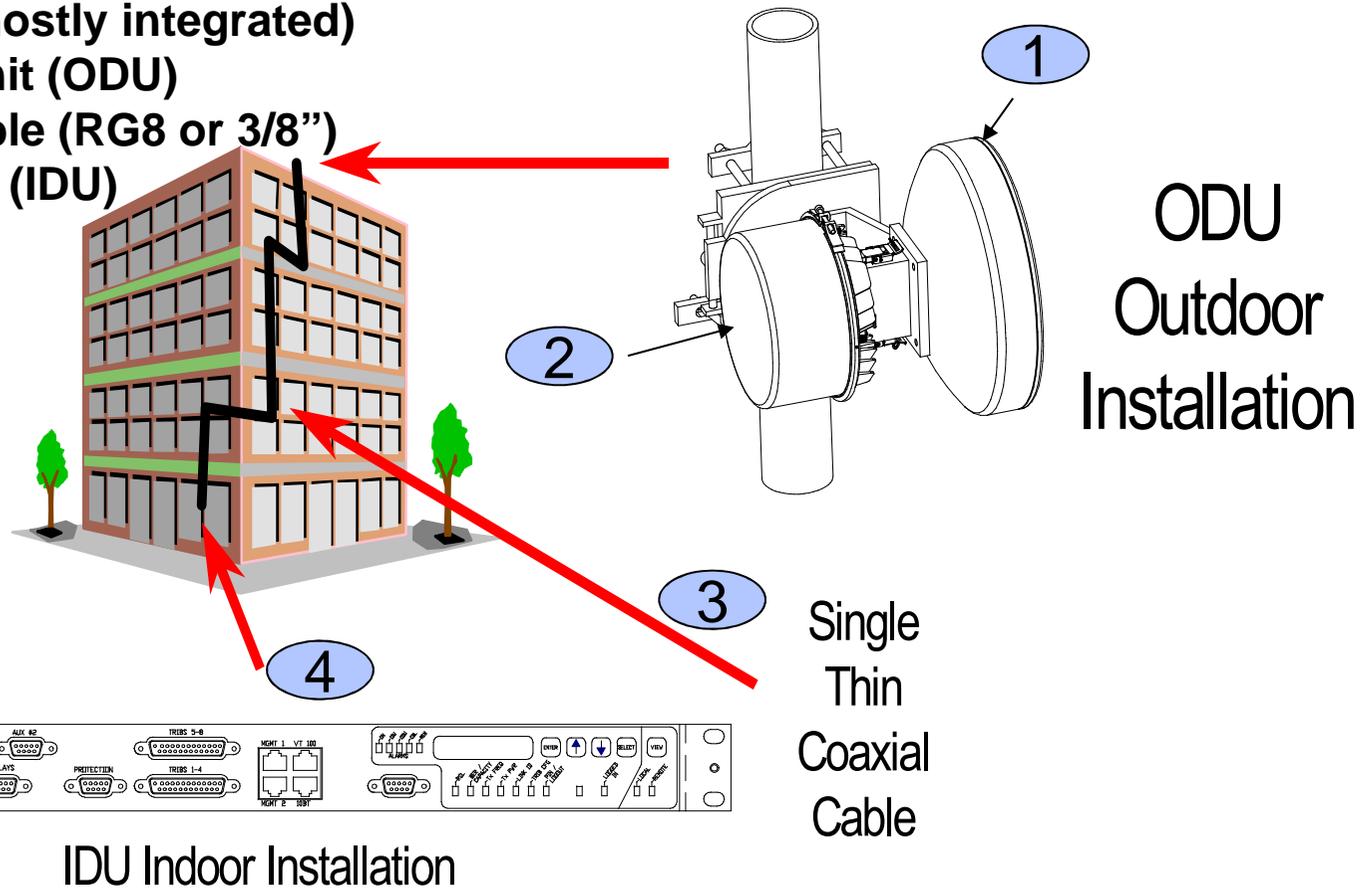
- Customer: OEMs, Mobile operator
- typ. antenna size: 1ft to 4ft
- typ. frequency range: 15 to 40 GHz (42 to 86 GHz)
- typ. distance: 0.5 – 10 km short haul
- typ. capacity: < 34 Mbs PDH up to 1 Gbs IP packet,

- typ. Antennas SB, SC SBX, SCX

SHORT HAUL – Split mount

Site Architecture

- 1. Antenna (mostly integrated)
- 2. Outdoor Unit (ODU)
- 3. Coaxial cable (RG8 or 3/8")
- 4. Indoor Unit (IDU)



SHORT Haul split mount – RFS antenna portfolio

Single polarized

- SB (Ultra High performance)
- SC (Ultra High performance)

Dual polarized

- SBX (Ultra High Performance)
- SCX (Ultra High Performance)

CompactLine SB, SBX antennas

CompactLineEasy SC, SCX antennas

Almost all antennas have customized interface

Antennas size: 1ft to 6ft

Antenna Integrated version Overview

Customer	Antenna Suffix	Size, Polarisation
ALU	MPT, STX, AWY	1-6ft single and dual
NEC	NEC	1-6ft single and dual
NSN, Dragonwave	ITE3, NOK	1-6ft single (under phase out)
Aviat	STX	1-6ft single
Huawei	XMC, HUA	1-6ft single (under phase out)
Intracom	INT2	1-6ft single
SIAE	SIA1, SIA2	1-6ft single
Ceragon, Nera	IPN, NR3	1-6ft single (obsolete)
Remec	REC, RER	1-6ft single and dual

Customized Antennas

RFS is not allowed to offer antennas with customized interface to third parties without permission of the ODU supplier.

Most ODU supplier deny the permission to sell antennas with customized interface to third parties.

Exceptions are for antennas with Remec interface as Remec provide only the ODU to system suppliers of operators and RFS can supply the antennas.

RFS PrimeLine (UXA)

Optimized for all applications requiring the best RF performance, especially where interferences could be an issue

- Tested and validated ultra-high electrical performance (ETSI EN 302 217 Class 3)
- Excellent radiation pattern envelope (RPE)
- Very low ROS (VSWR<1,1 – RL>26dB)
- Extremely high cross polar discrimination(40dB) for complete isolation between the radios in each polarization
- Support for winds up to 200 km/h with high-wind versions that support winds up to 252 km/h
- Optional sway bars for added assurance in case mistakes are made during installation
- Sizes ranging from 0.6 m (2 ft) to 4.6 m (15 ft)



RFS Harsh Areas Line

Designed for marine environments, off-shore locations, industrial and highly corrosive locations, volcanic areas, tropical climates, mountaintops with severe wind, ice and snow conditions

- Reflectors, shrouds and feeds painted inside and outside with a two-component epoxy paint
- Mounting hardware and attachment hardware in corrosion-resistant ISO 3506 A4 (SAE 316L) steel stabilized with molybdenum
- Steel mounting with an extended galvanic layer
- A flexible radome that is designed to avoid snow accumulation
- Sizes ranging from 0.6 m (2 ft) to 3.7 m (12ft)



RLN Edition GB-2014-01

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Why RFS will bring you value?

1 A long term
and **reliable** supplier

Reliable delivery

- A manufacturing presence in all continents
- Short leadtime guaranteed with proper forecast
- An ultra modern factory
- A comprehensive portfolio

2 Minimize your TCO
(and not only the more visible costs)

No extra cost during and after deployment

- Very easy installation procedure: no mistake
- All antennas have passed the most stringent RF, mechanical and environmental qualification tests

3 No compromise on
performance

Mobile Operators feel safe with RFS

- Radiation patterns are Class 3 and FCC A
- Antennas are tested in real conditions in windtunnel
- RFS 1 to 4ft are # 10 to 20% lighter than competition

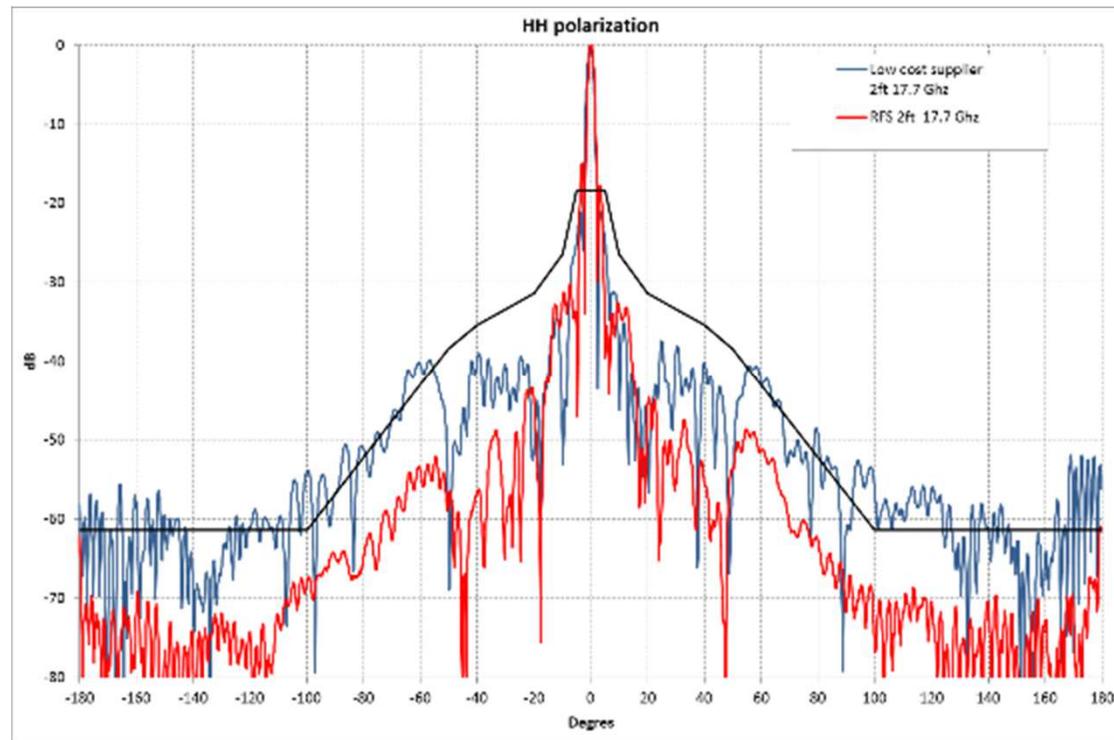
4 Prepare
the future together

Leading the small cells backhauling

- Ultra small parabolic antennas (SFA)
- A new product line : InvisiLine

RFS antennas: no compromise on performance

There is no magic : low cost is much often associated to compromise on performance, especially on RF pattern



Comparison of the radiation pattern of 2ft antennas from:

- A low cost supplier
- RFS

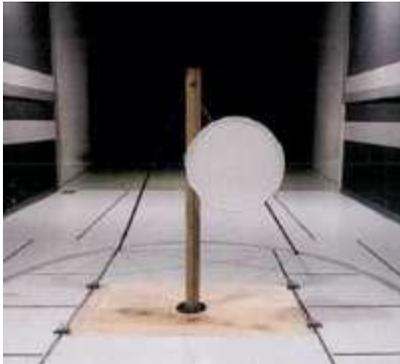
Measurements done on RFS test range

The low-cost antenna is far from being ETSI class 3 !

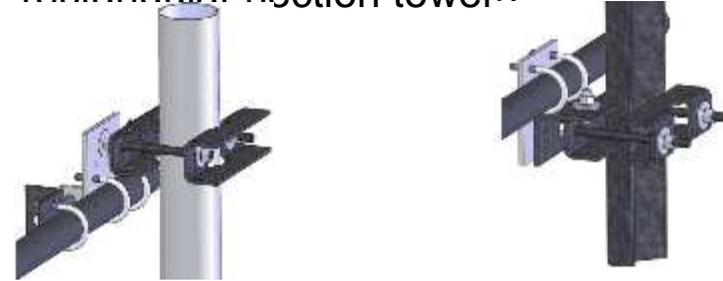
RFS antennas: no concession on safety

250km/h survival windspeed is available for all sizes

All antennas are fully tested in real conditions in a **wind tunnel**

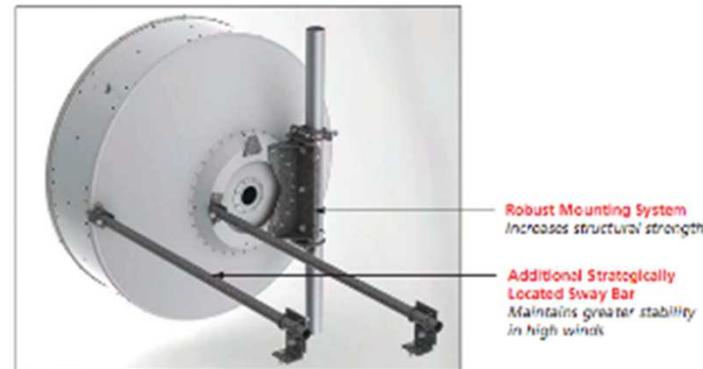


A universal sway bar fixation kit allows 100% safety on circular poles and rectangular section towers



No need to drill holes on towers !

Extra perimeter sway bars





RFS antennas: easy to transport and deploy



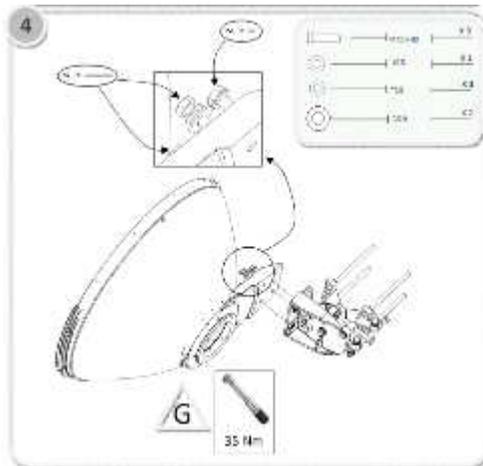
Robust



Light



Very compact cardboards and crates



**Self explicit
installation instructions**

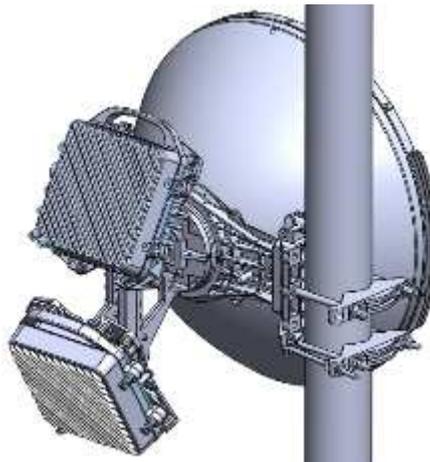


Tested against humidity and corrosion

4 port OMT (Ortho mode transducer)

With RFS OMT, you can implement a “**pay as you grow**” scheme up to 4 ODUs

- Start with a 2 ports OMT (2+0)
- Easy addition of 2 couplers when needed (2+2 or 4+0) : no mechanical conflict with the antennas thanks to the slanted/vertical shape of the OMT



Total Package Solutions



RFS offers a complete Microwave Antenna System Portfolio from One Source



Accessories



Connectors



Twist flex cable



Jumper cable



A world wide presence

Meriden (US) – North America

- Antennas from 1 to 12ft
- Capacity up to 15k / year
- Waveguides and accessories
- RLN R&D # 10 people



Trignac (France) – EMEA

- Antennas from 1 to 15ft
- Capacity up to 150k / year
- RLN R&D # 20 people



Hannover (Germany) – EMEA & APAC

- Waveguides and accessories



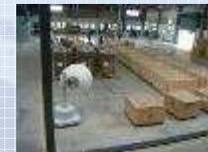
Embu (Brazil) – Latam

- Antennas from 1 to 12ft
- Capacity up to 25k / year
- Waveguides and accessories



Kolkata (India) – India, APAC

- Antennas from 1 to 4ft
- Capacity up to 120k / year



Trignac factory

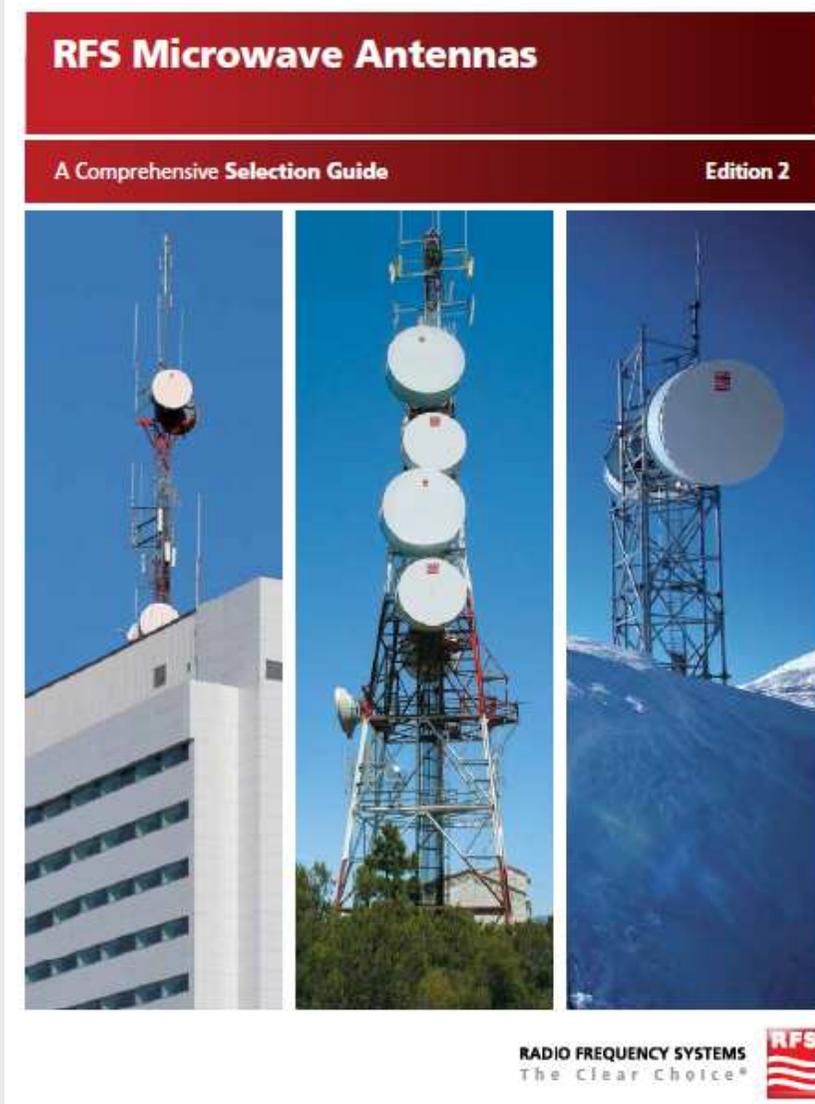


The automated line is now in operation => [video](#)



The video can be shown to customers but can't be given

Microwave Antenna Catalog (Edition 2)



This [brochure](#) has to be given to all customers

All datasheets, RPEs, Installations instructions can be found on the RFS **DataXpress Product Finder** (one click from WWW.RFSWORLD.COM)

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CompactLine Easy (SC, SCX)

Easy to integrate in network planning

- Excellent radio-electrical performances (high gain and ETSI Class 3)
- Wide band frequencies available for 6GHz (W60), 7/8GHz (W71) & 10/11 GHz (W100)
- Available in dual polarization version

Easy to transport: reduced packaging volume

- Very low packing volume : 0.16m³ for 2ft, 0.44m³ for 3ft

Easy to deploy: the most compact antennas on the market

- Compact deep dish reflector
- Very low weight : 20% less than competition
- New compact mount

Easy to install: very self-explicit installation instructions

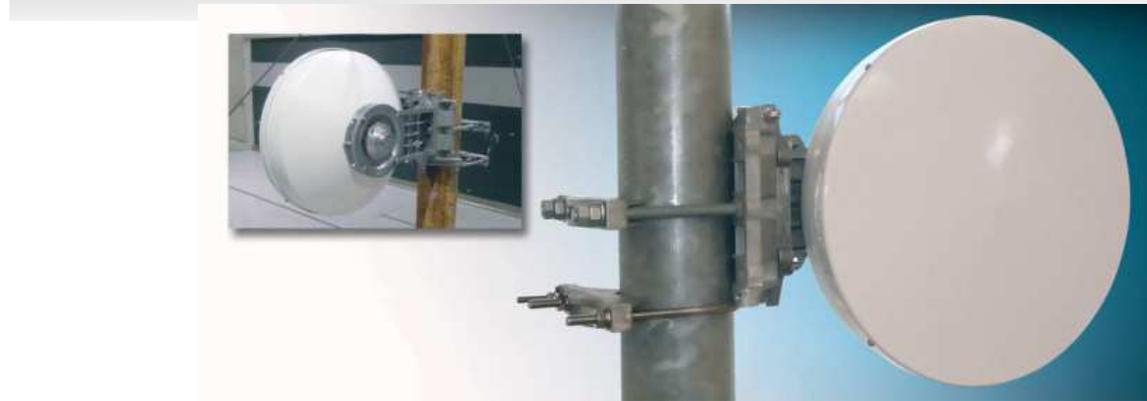
Easy to upgrade : a flexible feeder design

- In field upgrade from single to dual polarization
- In field change of frequency





New generation of SB1/SBX1



- The most compact and light 1ft antenna on the market (6kg)
- More robust structure with increased operational (252km/h) and survival wind speeds (**320 km/h**).
- A new flexible feed design allows easy upgrades from single to dual polarization in the field.
- Very low packing volume (15% to 30% less than competition).
- Optimized palletization for reduced transportation costs.
 - **875 antennas par 40ft container, 1170 per european trailer**



New generation of SC2/SCX2

Even easier to deploy and install

- The most compact and light antenna on the market:
 - 9 kg (weight decreased by 10%)
 - 20% lighter than Andrew/Commscope VHLP2 (11kg)
 - > 25% lighter than Chinese competitors
 - Potevio (12kg)
 - Mobi (15kg)
- More compact mounting system
- Easier zoning and lower installation costs



SC2 vs VHLP2 (15 GHz)

	VHLP2	SC2	
Gain (dB)	36.8	37.1	Very similar RF and mechanical performances
ETSI Class	3	3	
F/B (dB)	64	65	
XPD (dB)	30	30	
Survival windspeed (km/h)	252	252	
Net weight (kg)	11	9	

RFS SC2 has 20% lower weight than VHLP2

The best 3ft (1m) antenna : SC3/SCX3

Extension of CompactLine Easy ® family to 3ft/1m

- Gain and radiation pattern performances close to 4ft
 - **50% of microwave links deployed with 4ft would be compatible with 3ft / 1m**
 - **>25% cheaper than 4ft**
- Very easy to install : no shroud
 - 20% less installation effort compared to traditional architecture
 - Lower profile, lower visual impact
 - Assembly video
- Very easy to deploy : 25% lighter than competition Andrew VHLP3
- Very easy to upgrade: Feed can be mounted and dismantled from the back
 - Easier maintenance, including frequency change



New SC3 (1m)



Traditional 1m

4ft / 1.2m

SB4 vs VHLP4 (15 GHz)

	VHLP4	SB4	
Gain (dB)	43.0	42.9	Very similar RF and mechanical performances
ETSI Class	3	3	
F/B (dB)	71	72	
XPD (dB)	30	30	
Survival windspeed (km/h)	252	252	
Net weight (kg)	40	35	

RFS SB4 has 10% lower weight than VHLP4

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E-band antennas (71 – 86 GHz)

E-band antennas for 5 customers will be launched in end of 1Q14

- NEC (2 interfaces : AOR and CPRI)
- SIAE
- Aviat
- Ceragon
- Fujitsu



NEC CPRI interface



Aviat interface

E-band

SB1-W800 (1ft) and SC2-W800 (2ft)

- Fully compliant to ETSI requirements (ETSI class 3)
- In line with the best available products



SB1



SC2

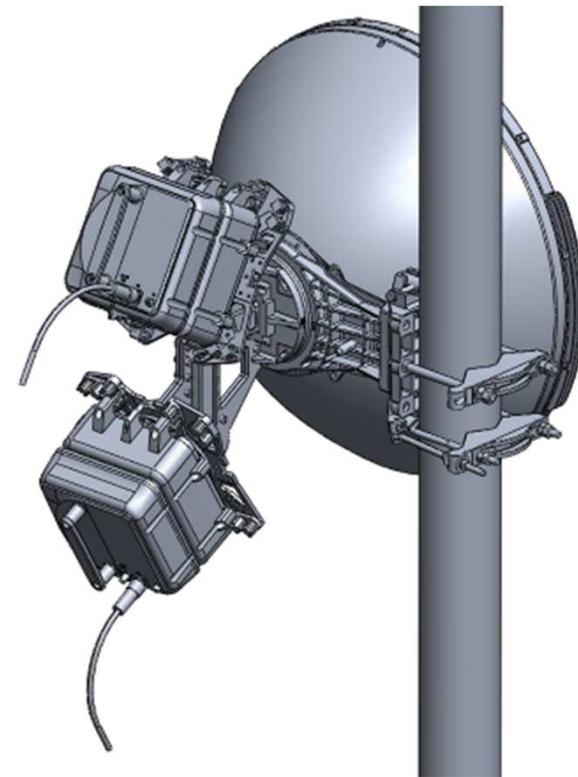
- 1ft / 0.3m : SB1-W800Cyyy
- 2ft / 0.6m : SC2-W800Byyy



Status on RFS OMT

Revised planning of start of shipment of dual polarization antennas with OMT:

- **Phase 1 (W71, 142, 190, 220): April 15th 2014**
- **Phase 2 (W100, 127 250): July 1st 2014**
- **Phase 3 (280, 320, 380, 420): October 1st 2014 with a target to anticipate it to May 2014**



Dual polarisation antennas: ordering information

Dual polarization antennas including OMT (example for NEC in 19GHz)

- SBX1-190CNEO
- SCX2-190BNEO
- SCX3-190ANE0
- SBX4-190CNEO
- SBX6-190CNEO

A single part number including the antenna and the OMT

Class 4: what is RFS position?

Class 4 is an ETSI standard with higher RF performances than Class 3

Andrew/Commscope has been (since 2012) heavily promoting their Class 4 “ Sentinel” antennas with the following arguments:

- It would allow to deploy more microwave links: 40% better spectrum utilization
- It would allow to use 2ft antenna instead of 4ft

As far as we know, there is no significant deployment.

RFS position is that Class 4 is not a significant market need. Reaching class 4 implies a much more stringent design, leading to much higher cost (order of magnitude of 2). Rather than imposing Class 4, regulation bodies should rather ensure that low-cost antennas are really class 3

Even if it is not in high priority, RFS is putting some R&D resources on Class 4, targeting to have some frequencies (eg 32GHz) in 2015

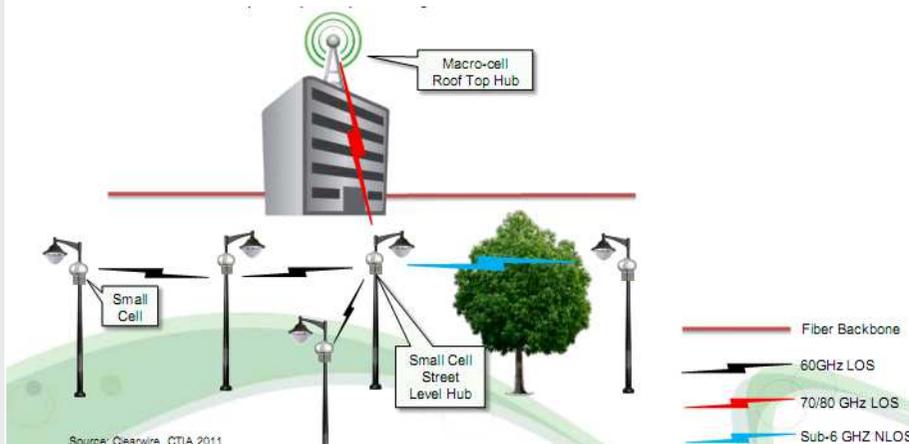
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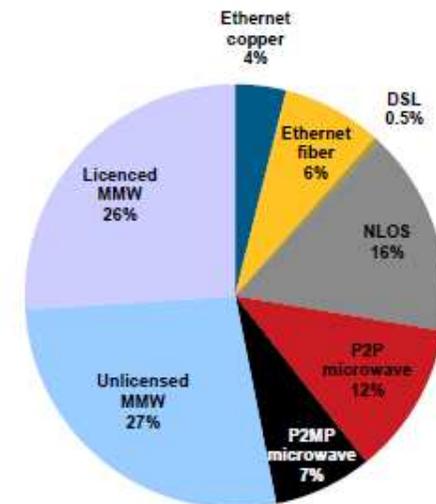
Dominance of Wireless backhauling in small cells

Several technology will co-exist, but **wireless should represent > 50% of total backhauling**

- Backhauling will be shared between fiber, copper and wireless (NLOS and LOS)
- Infonetics is predicting 80% of wireless, with very large proportion of 60GHz and 80GHz
- Total Market of >500k for 60GHz / 80GHz antennas



2017 Small Cell Backhaul Equipment Revenue



Challenges of small cells backhauling

How antennas can help?

Transparent

Very easy installation
on various types
of structures

Very small

Very low
price

Integration

Minimum RF
interferences

A challenge of small cells backhauling

Very low visual impact

Small cells shall be « **emotionally transparent** »

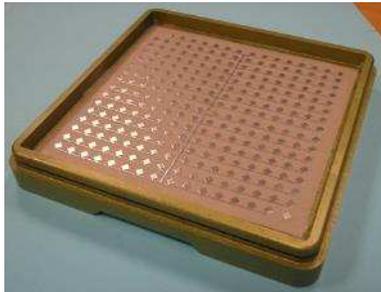
- Traditional « large » antennas with apparent parabolic shapes are not welcome by public
- Very small size for easy installation in public area
- Integration of antenna and electronics/TRX in a single packaging is probably a must



RFS ultra small parabolic SFA
(Small Form Antennas)
answer those challenges

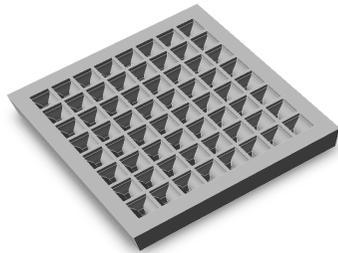
Patent
pending

SFA: several technologies have been studied



Microstrip / PCB

- Limited to low frequencies (<38GHz)
- RF performances are a challenge



Horn Array

- Optimized for high frequencies (60 and 80GHz)
- High cost of this technology does not look compatible with small cells challenges



Ultra Small parabolic

- Same reflector for 60GHz (V-Band) and 80GHz (E-Band)
- Full compatibility with dual polarization

Ultra small parabolic antennas / SFA

A safe, simple and proven solution

A traditional parabolic shape with backfire feed

- Well mastered performances
- Good XPD (even in E-band)

A widely « deployed » material for reflector

- High level of commonalties with automotive industry requirements (car lights)

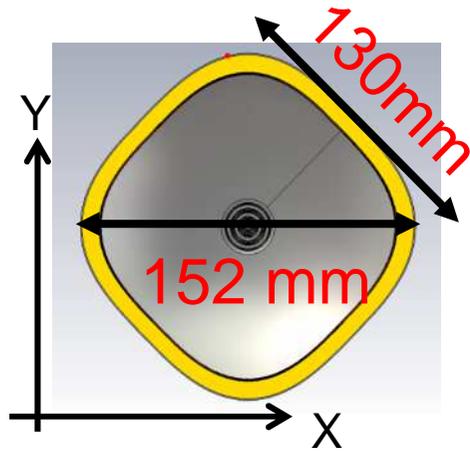
A very simple integration process with ODU TRX

- Very light antennas: 4 screws only



Making the TCO compatible with small cells ecosystem

Ultra small parabolic antennas / SFA : dimensions



Similar to alternative flat technologies

Thickness of the reflector ~ 44 mm

Shape close to a parabola (optimized for patterns and efficiency)

Same reflector for V-Band and E-Band



Ultra small parabolic antennas: future evolution

2013



SFA04-600

- 0.4ft
- 60GHz

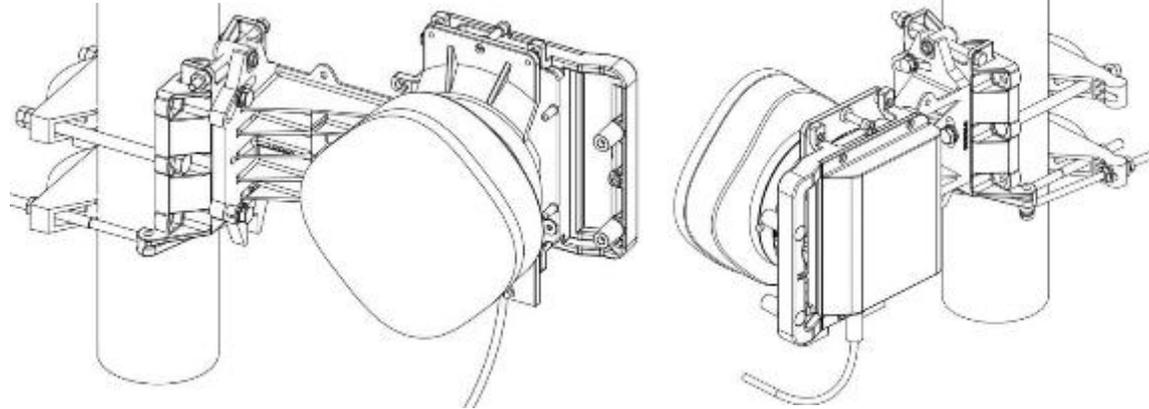
2014



SFA04-W800

- 0.4ft
- 80GHz
- ETSI C3

2015



SFA07-xxxxx

- 0.7ft
- From 23GHz to 80GHz
- ETSI C3

Small cells backhauling shall be “emotionally transparent”

Traditional microwave links are highly visible and can be rejected by public:



Separated ODU and parabolic antenna



Not hidden mounting structure



+/- complex azimuth and elevation tuning

RFS is elaborating innovative packaging structure focusing small cells:

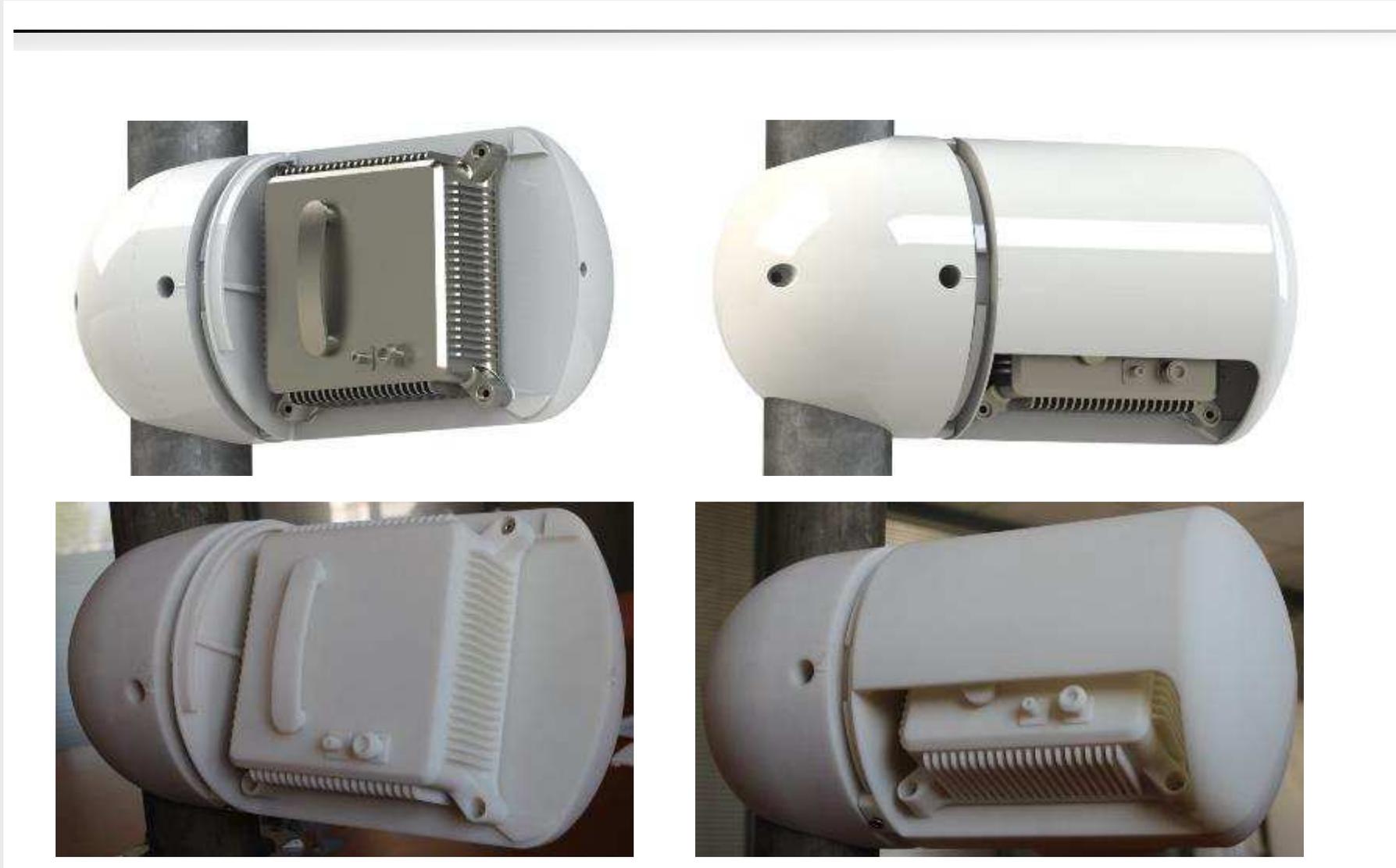
- integration of the ODU with the antenna
- complete camouflage
- easy installation

Can't be « detected » as a radiating element

New product line : **The InvisiLine** (name TBC)



InvisiLine: Integration of the ODU with the antenna



InvisiLine: Complete camouflage



Different shapes



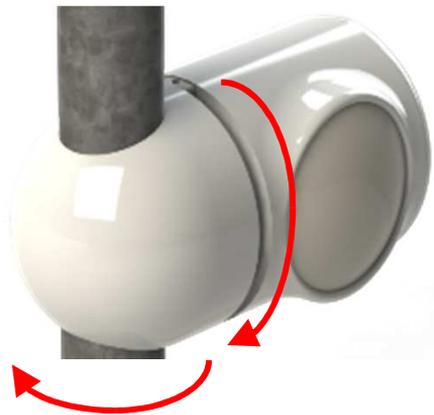
Hidden mounting structure



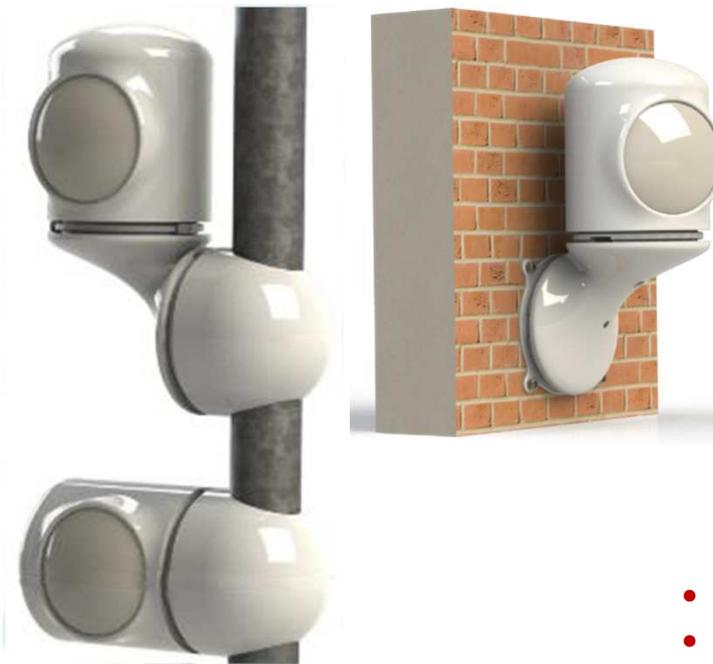
Different colors



InvisiLine: Easy installation



Easy and fine azimuth and elevation tuning for fast alignment



Pole and wall mounting



Compatible with various structure:

- 48 to 89mm pipes
- horizontal, vertical

Follow us !

