WHITE PAPER

RADIO FREQUENCY SYSTEMS
The Clear Choice®

Technical Analysis: Flexible Feed Design

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January 2016

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Introduction

The adoption of mobile phone services is occurring at one of the fastest rates in technological history, with current penetration far exceeding that predicted at the early stages of deployment. In terms of coverage, the Ericsson Mobility Report states that mobile cellular networks covered 94% of global population in 2013, with coverage in certain regions close to a 100% saturation point for many years. In 2014, global mobile data traffic amounted to 2.5 exabytes per month, and by 2020, it is expected to reach as high as 30 exabytes per month.

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This escalation demands corresponding advancements in network infrastructure to handle expanding traffic. With growing service requirements and changing technologies, upgrading the network systems is an expensive affair for operators. Due to frequent upgrades, optimizations, or systems standardization, operators need components that are adaptable and can be upgraded or modified with minimum cost and effort.

In addition, several uncertainties exist in designing network backhaul systems. Sometimes parameters such as frequency range of operation are not confirmed until the last minute. This can potentially cause delays in finalizing specifications of passive components such as antennas, and hence, delays in overall system installation.

Radio Frequency Systems (RFS) provides solutions to these problems in the “flexible feed” architecture of its CompactLine® and CompactLine® Easy antennas. The flexible, easily-modified design lowers redesign costs and allows quicker response to changes.

This paper will demonstrate the need for flexible antenna systems, and explains how they provide optimum solutions for the above mentioned problems.

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What is Flexible Feed Architecture?

The flexible feed is an arrangement of the individual components of a feed system, each of which can be customized to meet specific requirements, while keeping the other antenna components unchanged. The following diagram (Figure 1) shows the assembled view of a flexible feed design.

The feed is inserted from the rear side of the antenna, making it easier to modify or upgrade onsite without dismantling the antenna. In addition, antennas with flexible feed design need no re-alignment or re-adjustments after making the changes.

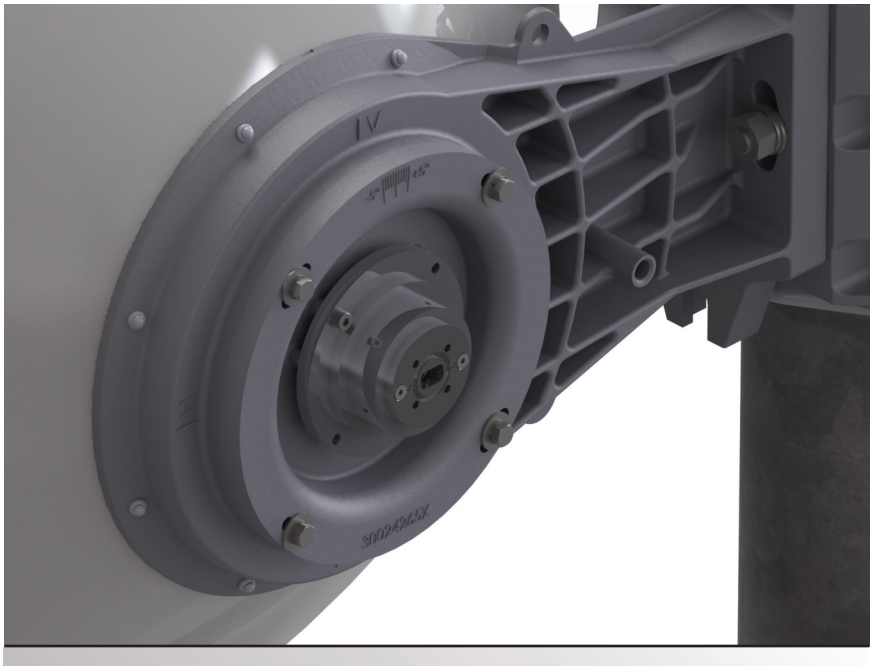

Figure 1 The assembled view of flexible feed system

Flexible Feed Design

Components of Flexible Feed

There are three different components of a flexible feed system:

1. A Basic Feed

The basic feed is a "backfire feed" that feeds the specific frequency radio waves to the rest of the antenna structure, or in receiving antennas collect the incoming radio waves, convert them to electric currents and transmit them to the receiver.

A basic feed is the standard RFS interface to connect with:

- Standard single pol interface
- Standard double pol interface
- Customer specific interface
- Orthogonal mode transducers

Figure 2 A Basic Feed

2. A Mounting Ring

A mounting ring is an aluminum casting that is used to mechanically fix an outdoor unit (ODU) to the antenna.

Figure 3 A Mounting Ring (Mechanical Interface)

3. A Mounting Plate (Vertex)

A mounting plate (vertex) is used for RF transition between the feed and the ODU, and for transition from circular waveguide to rectangular waveguide.

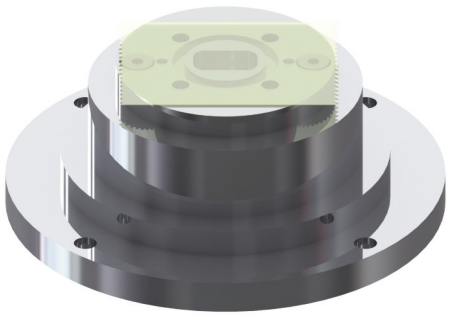

Figure 4 A Mounting Plate (RF Interface)

Flexible Feed Design

How Flexible is Flexible Feed?

The flexible feed's adaptable design facilitates easier in-field upgrades when changing parameters on an antenna. The following explanation shows various alterations, which can be accomplished without changing the overall antenna. Only the colored parts in the following images must be changed to obtain the respective upgrades.

- **Upgrade from Single Pol to Dual Pol**
  The modular design of the flexible feed eases capacity enhancement without replacing the antenna. The single pol antenna can be upgraded to a dual pol by introducing Orthogonal Mode Transducer (OMT) in the feed system for integrated antennas, or using a combiner for non-integrated antennas. The dual polarization antenna can be further upgraded to four ports OMT without any mechanical conflicts. This upgrade is a simple process where the mounting ring and mounting plate (shown in red) are replaced by an OMT (shown in green), as shown below:

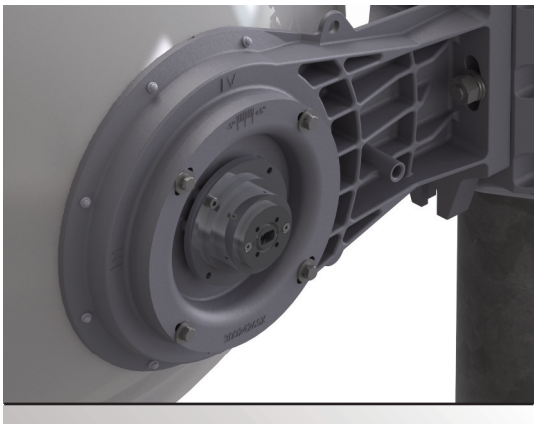

Figure 5 Step 1

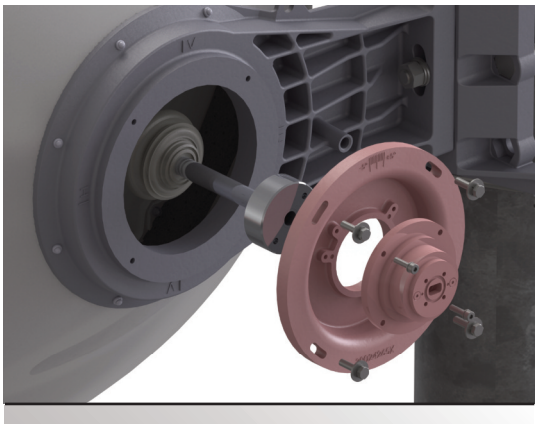

Figure 5 Step 2

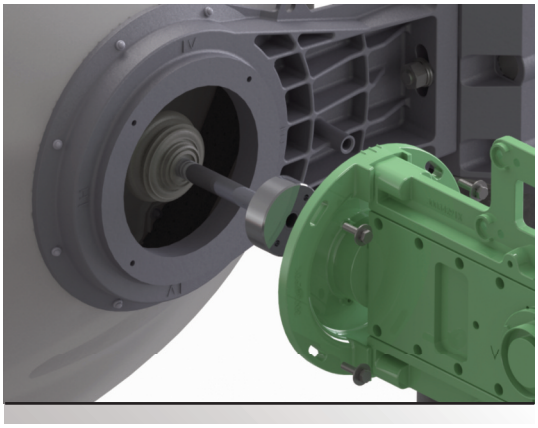

Figure 5 Step 3

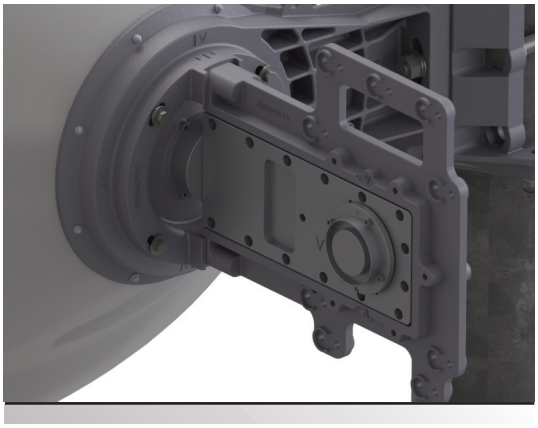

Figure 5 Step 4

ADVANTAGES

- In-field upgrade & quick installation.
- Reduces the risk of improper installation.
- Cost saving by a factor of 5 (considering the cost of a new antenna and Installation costs).

Flexible Feed Design

How Flexible is Flexible Feed?

- **Change from Radio A to Radio B**
  In the field of network backhaul, ever-growing service requirements drive escalating technology evolution of network components. The adaptability of flexible feed design enables easier and less costly radio interface upgrades than buying a new antenna. The following images show the steps involved in changing the radios by replacing one type of mounting ring and mounting plate (shown in red) with another type (shown in green). The final assembly after modifications has the same mechanical stability and robustness as the original antenna. On the contrary, the non-flexible feed antennas lose mechanical robustness and stability due to the addition of an extra unit to change the radio interface.

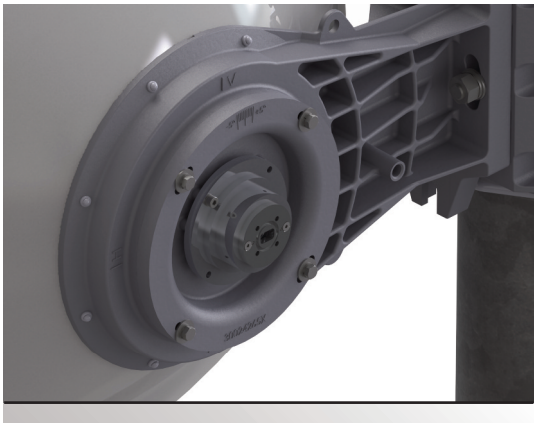

Figure 6 Step 1

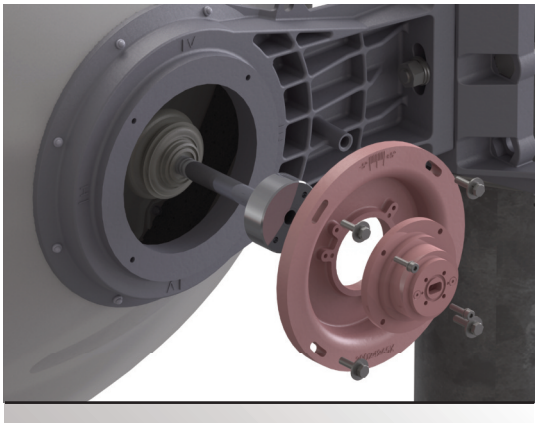

Figure 6 Step 2

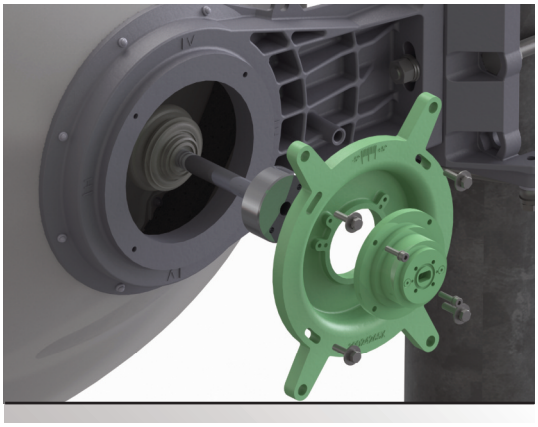

Figure 6 Step 3

Figure 6 Step 4

ADVANTAGES

- In-field upgrade & quick installation.
- Reduces the risk of improper installation.
- No effect on mechanical robustness and stability after changing the radio.

Flexible Feed Design

How Flexible is Flexible Feed?

- **Change of Frequency or Late Frequency Differentiation**
  The specially designed wideband radome and flexible design make it possible to change antenna frequency by simply changing the RF interface and the basic feed of the existing RFS antenna. This adaptability is also useful if antenna frequency is decided or changed at the last moment. It enables operators to finalize the remaining antenna specifications, and to stock the parts with longer lead times. The basic feed system can be economically air-freighted and fixed easily in an installed antenna, saving costs, time and labor.

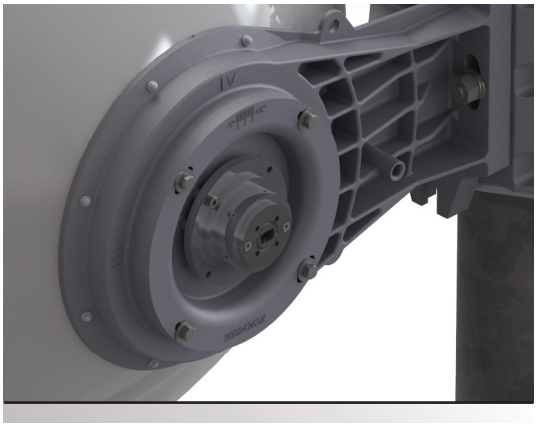

Figure 7 Step 1

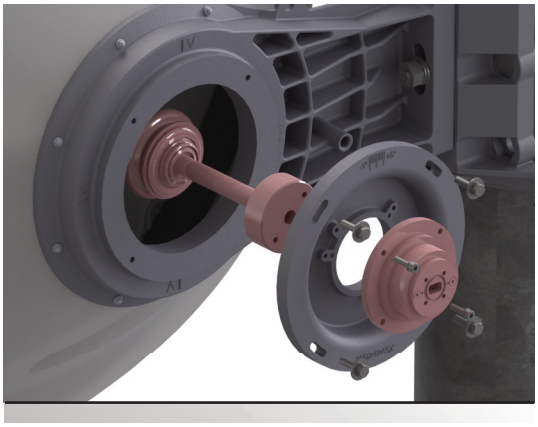

Figure 7 Step 2

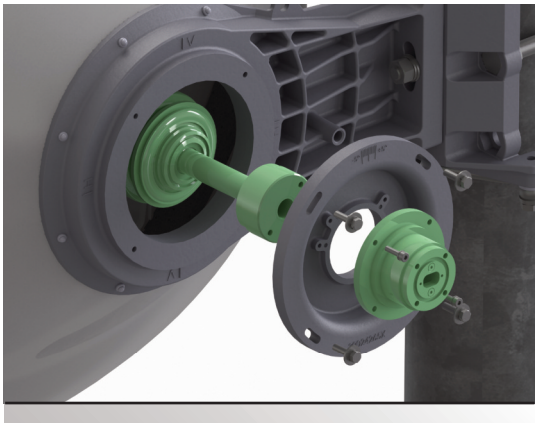

Figure 7 Step 3

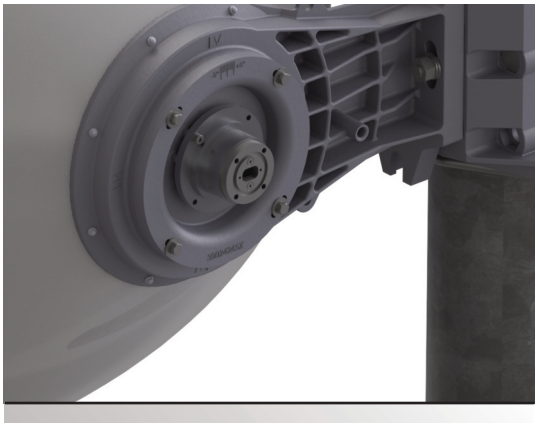

Figure 7 Step 4

ADVANTAGES

- In-field upgrade & quick installation.
- Reduces the risk of improper installation.
- Up to 50% cost saving in comparison of buying a new antenna. (Depending upon the frequency of the feed)

Flexible Feed Design

Comparison between Flexible & Non-Flexible Feed

Operation	Flexible Feed Design Process	Non-Flexible Feed Design Process	Advantages
Upgrade the antenna from Single Pol to Dual Pol	Using Orthogonal Mode Transducer (OMT) (Fig. 5)	Change the overall antenna	• In-field upgrade & quick installation • Reduces the risk of improper installation. • Cost saving by a factor of 5 (considering the cost of a new antenna and installation costs).
Change the Radio (ODU) from one variant to another	Change mounting plate and the mounting ring (Fig. 6)	Add extra (add-on) interface for compatibility with other radio variant (ODU)	• Reduces the risk of improper installation. • No effect on mechanical robustness and stability after changing the radio.
Change the Frequency (e.g., 7 GHz to 23 GHz)	Change the basic feed and mounting plate (Fig. 7)	Change the overall antenna	• In-field upgrade & quick installation. • Reduces the risk of improper installation • Up to 50% cost saving compared to buying a new antenna, depending upon the feed frequency

Flexible Feed Design

RFS' Product Portfolio of Flexible Feed Antennas

Radio Frequency Systems offers the flexible feed design for its CompactLine® and CompactLine® Easy antennas, ranging from 1 ft. to 6 ft. in diameter and 6 GHz to 80 GHz frequencies in both single and dual polarizations (through OMT) as listed in the table below.

Frequency Range (GHz)	Sizes (m)	Sizes (ft)	Model Name (Single Polarized)	Model Name (Dual Polarized)
5.925-7.125	0.9	3	SC3-W60[1]	SCX3-W60[1]
	1.2	4	SB4-W60[1]	SBX4-W60[1]
	1.8	6	SB6-W60[1]	SBX6-W60[1]
7.125-8.5	0.6	2	SC2-W71[1]	SCX2-W71[1]
	0.9	3	SC3-W71[1]	SCX3-W71[1]
	1.2	4	SB4-W71[1]	SBX4-W71[1]
	1.8	6	SB6-W71[1]	SBX6-W71[1]
10-11.7	0.6	2	SC2-W100[1]	SCX2-W100[1]
	0.9	3	SC3-W100[1]	SCX3-W100[1]
	1.2	4	SB4-W100[1]	SBX4-W100[1]
	1.8	6	SB6-W100[1]	SBX6-W100[1]
12.7-13.25	0.3	1	SB1-127	SBX1-127
	0.6	2	SC2-127	SCX2-127
	0.9	3	SC3-127	SCX3-127
	1.2	4	SB4-127	SBX4-127
	1.8	6	SB6-127	SBX6-127
14.2-15.35	0.3	1	SB1-142	SBX1-142
	0.6	2	SC2-142	SCX2-142
	0.9	3	SC3-142	SCX3-142
	1.2	4	SB4-142	SBX4-142
	1.8	6	SB6-142	SBX6-142
17.7-19.7	0.3	1	SB1-190	SBX1-190
	0.6	2	SC2-190	SCX2-190
	0.9	3	SC3-190	SCX3-190
	1.2	4	SB4-190	SBX4-190
	1.8	6	SB6-190	SBX6-190
21.2-23.6	0.3	1	SB1-220	SBX1-220
	0.6	2	SC2-220	SCX2-220
	0.9	3	SC3-220	SCX3-220
	1.2	4	SB4-220	SBX4-220
	1.8	6	SB6-220	SBX6-220
24.25-26.5	0.3	1	SB1-250	SBX1-250
	0.6	2	SC2-250	SCX2-250
	0.9	3	SC3-250	SCX3-250
	1.2	4	SB4-250	SBX4-250
27.5-29.5	0.3	1	SB1-280	SBX1-280
	0.6	2	SC2-280	SCX2-280
31-33.4	0.3	1	SB1-320	SBX1-320
	0.6	2	SC2-320	SCX2-320
37-40	0.3	1	SB1-380	SBX1-380
	0.6	2	SC2-380	SCX2-380
40.5-43.5	0.3	1	SB1-420	SBX1-420
	0.6	2	SC2-420	SCX2-420
51.2-52.6	0.3	1	SB1-520	NA

[1] Wideband model

Flexible Feed Design

Conclusion

The current era of the telecom industry is witnessing high demand of capacity, quality of services, and pressures to reduce the cost of telecom infrastructure. The flexible feed design of RFS' CompactLine® and CompactLine® Easy antennas satisfies these requirements by significantly reducing the re-design, upgrades or optimization costs, without compromising quality or performance. The flexibility to change various parameters on an antenna without dismantling the overall antenna provides a much needed benefit, which is instrumental in upgrading the backhaul infrastructure with minimum cost and labor.

Flexible Feed Design

Company Profile

Radio Frequency Systems (RFS) is a global designer and manufacturer of cable, antenna and tower systems, plus active and passive RF conditioning modules, providing total-package solutions for wireless infrastructure.

RFS serves OEMs, distributors, system integrators, operators and installers in the broadcast, wireless communications, land-mobile and microwave market sectors.

As an ISO compliant organization with manufacturing and customer service facilities that span the globe, RFS offers cutting-edge engineering capabilities, superior field support and innovative product design. RFS is a leader in wireless infrastructure.