ROHILL

Whitepaper

Power saving innovations

TetraNode

Preface

With the current concerns on climate change and energy resources, it is more important than ever to stimulate the development and deployment of energy-efficient solutions for telecommunication networks. In addition to the environmental concerns, using “green technology” also significantly optimises the Operating Expenditure (OPEX).

Rohill has taken this challenge by developing a third-generation TETRA base station that is highly optimised in terms of power consumption and at the same tolerant to a wide temperature range, reducing the need for heating and/or air conditioning. Unique innovations include, amongst others, dynamic “sleep” and power reduction modes that are further reducing the already low power consumption in active mode.

This paper describes the principles of operation, benefits, applications, and real cost and CO_2 emission savings enabled by the Rohill third-generation TETRA Base Station.

Principle of Operation

Every TETRA Base Station needs to deliver a significant amount of RF output power to provide wide area coverage. Most base stations for large networks are dimensioned to deliver 25 Watt of output power per carrier (transceiver per frequency) to the antenna, which requires even higher RF power before antenna combining. The TETRA modulation requires highly linear amplification, further reducing the efficiency of the total base station solution. A two carrier TETRA base station typically requires 700 Watts for 25 Watt of output power per carrier, which is a power efficiency of just 7%.

A well-known power saving method is to turn off unused transmitters. As soon as one TETRA timeslot is allocated for a speech or data call on a transmitter that is turned off, the transmitter will be activated for all timeslots. Often this is done in a pro-active way, already turning on and calibrating an additional carrier when the traffic is almost reaching the maximum traffic capacity of active carriers in the TETRA base station. This reduces the benefit of this power saving method.

Rohill has significantly improved this generic power saving method by turning on and off the transmitter on a per-timeslot basis. This results in additional savings when not all timeslots are allocated on a carrier in the TETRA base station. For the first carrier with the control channel, a reduced power level can be applied instead of switching off the transmitter during unused timeslots, making this solution also work for multi-site networks, for which roaming and handover requires a fully active transmitter. The real-time activation and power control per timeslot also eliminates the need for pro-active control of carriers, further reducing the power consumption compared to existing solutions.

The standby and operating power consumption is furthermore optimised by using modern components in the TETRA Base Station, providing a much higher degree of integration and improved performance per Watt. In fully active state, the Rohill TETRA Base Station consumes 25% less than the best available Base Station from alternative suppliers for the same level of RF output power.

Benefits

Low power consumption and extended operating temperature the base station delivers many benefits. To name a few:

- Lower energy consumption, resulting in lower energy bills;
- Real contribution to CO_2 reduction;
- Less heat production, reducing the need for air conditioning capacity;
- Reduced need for battery backup capacity;
- Lower pollution levels caused by manufacturing and disposure of smaller batteries;
- Possibility to power TETRA base stations from solar energy;
- Higher reliability, while components in lower temperature conditions are less susceptible to failures.

These benefits come with no cost impact on TETRA Base Station technology; the Capital Expenditure (CAPEX) will be even lower due to the reduced need for air conditioning (if needed at all), reduced battery capacity and solar cells (if applicable).

Applications

The advanced power saving features were included in the third-generation Rohill Base Station System (BSS), introduced in 2010. Although every network owner using this third-generation BSS technology will benefit from these innovations, two applications are most relevant.

The first applicable market segment are **medium-sized or large networks for government and public safety**. Coverage of a large region or country requires a large amount of base stations with varying capacity, depending on the location (urban or rural) and spare capacity required for incidents and backup. Mission-critical availability and capacity requires proper dimensioning of base stations, which results in at least one extra carrier per base station for redundancy and loading when incidents occur in the coverage area of the base station. The most applicable benefits of “green technology” are lower operating cost due to lower energy bills, reduced battery backup capacity, and higher reliability. A calculation example of cost savings for a 250-site network is provided in the next section.

The second applicable market segment is **railroads for transport of raw materials from mines, and oil pipelines in rural areas**. Electricity from the grid is often not available on these site locations, or very expensive to provide. Solar panels or generators are an alternative, but the cost for investment increases almost linear with power consumption. The most applicable benefits are thus the reduced need for battery backup capacity, and the possibility to power TETRA base stations with solar energy.

Real cost and CO_2 emission savings

Although climate change and limited resources is a concern for all people on our planet, real cost savings are often the driving force to adopt green technologies.

To illustrate the benefits in both cost and carbon emission of green technology, the following realistic scenario of a regional network for government / public safety is analysed:

- 250 base stations with 2 carriers each;
- 25 Watt of output power per carrier frequency on the antenna;
- Average 40% of traffic capacity required during the day and evening (16 hours);
- Average 20% of traffic capacity required during the night (8 hours);
- Air conditioning requires 100% of BSS power consumption;
- Energy cost in first year of € 0.26 per kWh;
- Energy cost for 12 years, based on 7% inflation of energy cost (trend for last 20 years);
- Carbon emission of 525 kg CO_2 per 1000 kWh (average for UK electricity sources).

The following table compares energy consumption and operating cost for a Rohill BSS compared to the closest competitor delivering the same RF output power, both without and with power saving enabled.

Metric	**Rohill BSS2**		**Best available alternative BS solution**	
Power saving enabled	**No**	**Yes**	**No**	**Yes**
Average power consumption in Watts	490	130	640	400
kWh per site, per day, base station only	11.76	3.12	15.36	9.6
kWh per site, per day, A/C included	23.52	6.24	30.72	19.2
kWh for whole network, per year	2146200	569400	2803200	1752000
Energy cost in K€, 1st year of operation	558	148	729	456
Energy cost in K€, 12 years of operation	9982	2648	13038	8149
CO_2 emissions in tons, 12 years of operation	13521	3587	17660	11038

To summarize, adopting advanced power saving features in TETRA networks results in significant OPEX savings of M€ 8.149 - M€ 2.648 = M€ 5.501 or 5.5 million Euros during the lifetime of the network, even compared to existing base stations with power saving enabled. This will increase to more than M€ 13.038 - M€ 2.648 = M€ 10.389 or 10.4 million Euros when compared with base stations without power saving.

In terms of CO_2 reduction, the Rohill BSS2 saves 7450 tons of CO_2 compared to an existing base stations with power saving enabled, and at least 14073 tons of CO_2 compared with base stations without power saving.