WHY the DAC Monitoring and Control System

is the

Best Choice

for

Your Network

DIRECT ANTENNA CONTROL:
REAL TIME, EVERYWHERE, ON-LINE

DAC System SA

Empire State Building NY: structural height 381m overall height 443m

1 The DAC System Value proposition

1.1 What is the issue?

Broadcast service for Radio and TV distribution is a well-known technology and used since 100 years to reach efficiently and convenient a large numbers of consumers. After a long period of none innovation broadcasting got new impulse through digitization and related new features and higher quality.

Critical Infrastructure Supporting Your Countries Broadcast Services

Figure 1: Typical broadcast towers (Europe and USA)

In current installation the rf-system parts (rf: Radio Frequency) in the broadcast towers are not monitored. A typical rf-system outside the transmission building, to broadcast 1 or several channels (each channel has one frequency) consists of:

- Cable (up to 100’000 Watt, feeder and distribution cables)
- Connectors (up to 6” size depending on the transmission power)
- Power splitters/dividers (one power signal from the transmitter is divided several times to serve several radial organized antennas (bay)
- Antennas (the antennas are mounted for radial transmission on several levels)

A tower is **hosting several systems** for analog and digital radio and TV channels in different frequency bands (up to 100 antennas in one tower). Currently the rf-system in the tower are not monitored.

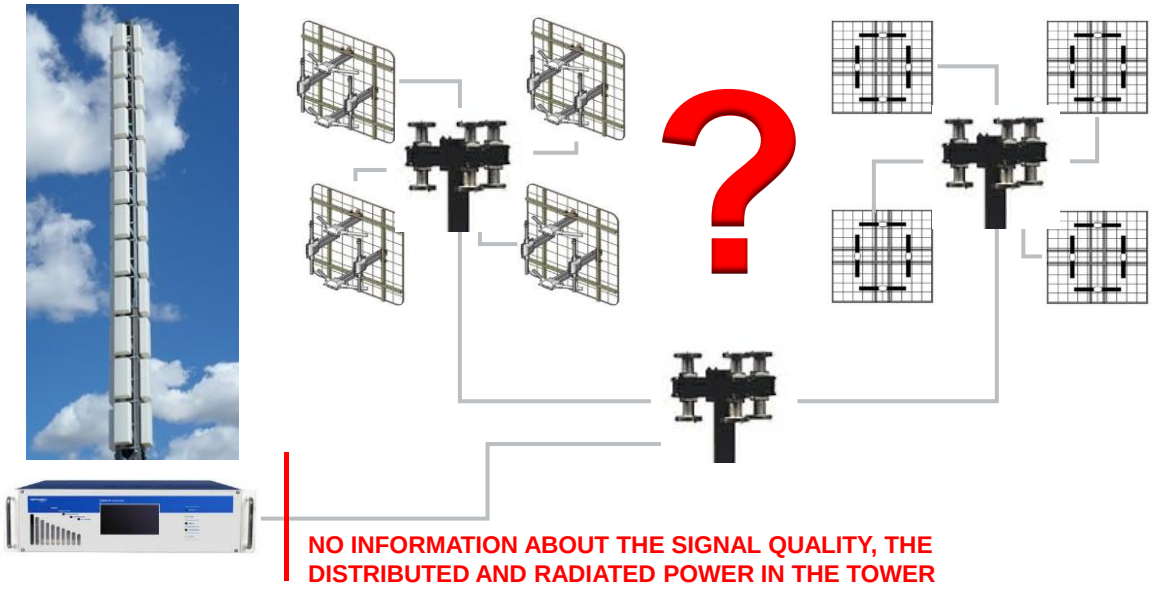


Figure 2: No monitoring of the system in the tower

This situation results in the following consequences:

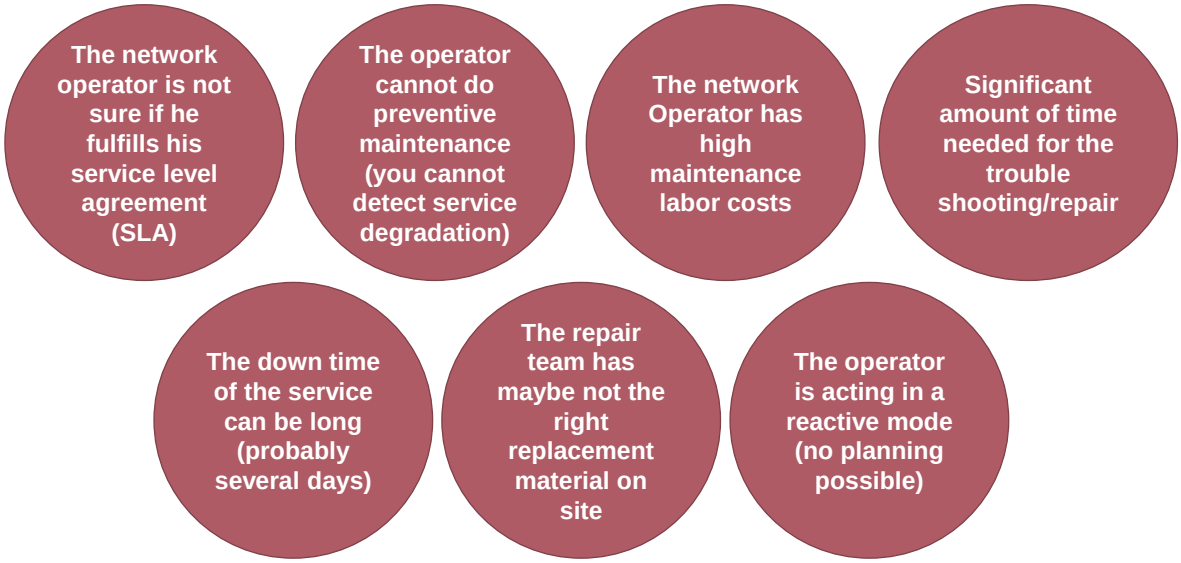


Figure 3: Consequences of malfunction in the tower rf-system

The **cost pressure** on the broadcast tower operators is increasing because of:

- Increased competition (market liberalization, new technologies)
- Age of the infrastructure and higher probability of failures
- Higher labour costs (smaller and central operation teams)
- Limited access to skilled people (out-sourcing)
- High penalties in Service Level Agreements
- Restructuring of the industry (colocation, shared infrastructure, out-sourcing)

These changing factors drive the operators to further increase the quality of the broadcast service and drive the maintenance costs down.

A weak element in the end to end chain for the service delivery is the installation of the rf-system in the broadcast tower, see Figure 4.

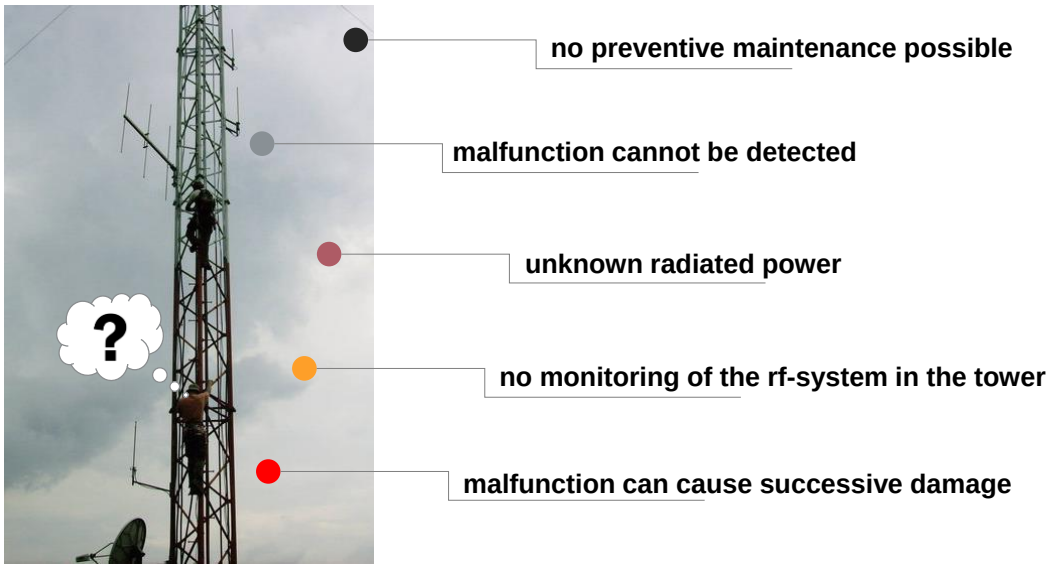


Figure 4: Problem situation for the broadcast tower operator

1.2 DAC System solution

Through the innovative sensor technology and monitoring idea (patent granted), it is possible to detect failure location and monitor rf-system degradation.

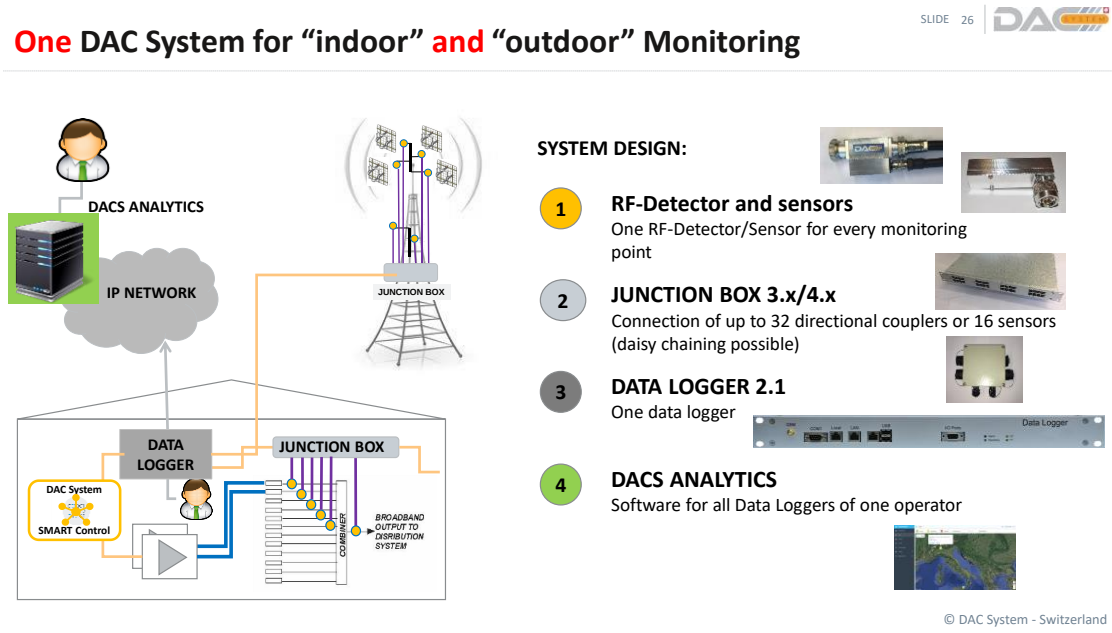


Figure 5: DAC system solution, monitoring the overall rf-system, indoor and outdoor

With the DAC System, the operator has the ability to bring transparency into his installation and monitor the overall rf-system:

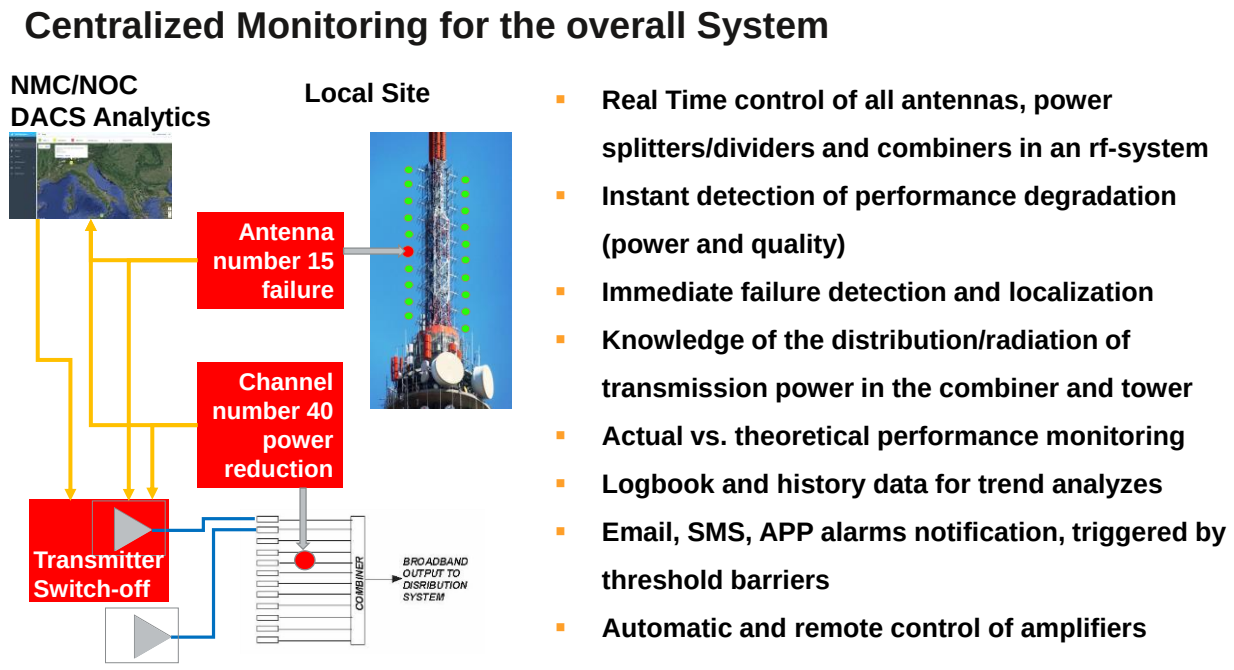


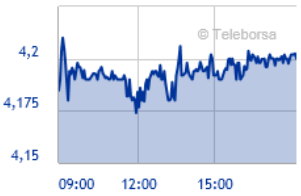
Figure 6: DAC System features

With the DAC System, the broadcast tower operator is now able to:

- do preventive maintenance and prevent from partial/total system failures
- minimize SLA violation caused by “slow death” effects (like water in the system, mechanical abrasion)
- safe time and cost for failure detection because of direct failure localisation
- safe time and costs to repair because the correct spare material is on site
- safe fixed costs because of central dispatching and optimized maintenance team assignment
- Increase the safety for the broadcast tower and switching of amplifiers in case of tower damage (prevent from fire and further cable damage)

Some first calculation has shown that the operator can benefit from **operation cost savings** through fast failure detection and shorter repair time, if the DAC system relevant incident interval per tower is smaller than 3 years (the model considers the investment into the DAC system). The other economic benefits are very hard to estimate and different from case to case.

In Figure 7, the added value for the operator is summarized. The features of the DAC System allow to **safe costs, offer a higher quality of service and increase the security** of broadcast towers.

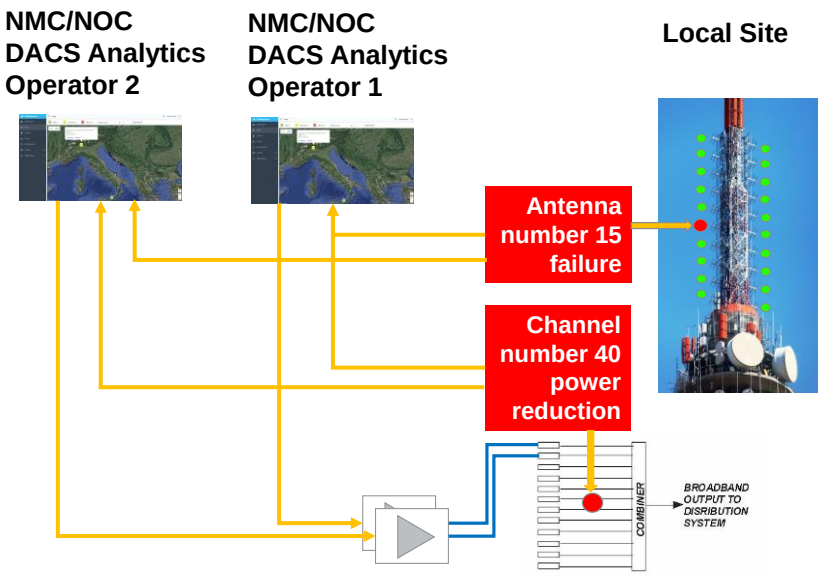


Moscow, Ostankino

Netherland, Hoogersmilde

- **Prevent downtime of broadcast services**
- **Reduce costs and mean time to repair by estimated 50%**
- **Reduce fix and maintenance costs**
- **Increase the security of broadcast towers (prevent from fire and successive failure damage)**

In addition the operator can offer Monitoring as a Service (MaaS) to third parties, manage co-location and SLA situation as well as outsourced operation and maintenance.



- **Offer Monitoring as a Service (MaaS) to third parties**
- **Prove SLA compliance**
- **Manage out-sourced operation and maintenance**

Figure 7: Added value for the broadcast operator

The Operator can save significant costs with the DAC System. The business case identifies 3 cost blocks which can be reduced:

- SLA violation
- Operation costs
- Maintenance costs

In specific the broadcast operator are able to lower its costs in the following areas:

Operator cost blocks	**Added Value DAC System** **Benefit to the tower operator**	**DAC System features**
SLA violation	Minimize SLA violation caused by “slow death” effects (like water in the system, mechanical abrasion).	In case of rf-system degradation, the DAC System escalates an alarm. The operator can repair the rf-system **before a total failure** occurs.
Operation costs	Reduce maintenance costs and time to repair by 50%. Depending of the number of relevant failures, the operator can save millions per year.	Through the direct failure indication of the DAC System: • the right spare material (connectors, cables, and antenna) can be provided with the first maintenance action. • Long failure search is eliminated. • External repair teams can be better controlled.
Maintenance costs	Normally operators perform frequent tower inspections every year or every second year. These inspections can be either totally eliminated or reduced (no tower climbing required anymore). Depending of the number of towers, the operator can save millions per year.	In case the rf-system performance degrades or a total failure occurs, the DAC System immediately raise an alarm. This makes regular maintenance visits in the tower obsolete.

Table 1: Operator business case

2 Tower operation

For the broadcast tower operators the key issue is that the operation shall be guaranteed 7x24h. No downtime is allowed; otherwise SLA penalties can come into action. Uptime guarantee is therefore the main goal.

Currently the installations in the tower are **not permanently monitored** these results in 3 effects:

- A malfunction is only detected if it results in partial or total system failure
- If there is a malfunction (no or little radiated signals) the failure location is not known
- No pro-active action can be taken in case of a severe damage in the tower, affecting the power radiation which could cause fire and further damage (cable, amplifiers)

The causes for the malfunctions are manifold and tied to the rough environmental conditions.

- **lightning- short circuits and blowouts**
- **water and humidity infiltration**
- **burning or insulation failure**
- **exceeding maximum power limits**
- **mechanical-electrical damage**

Figure 8: Cause for rf-system malfunction

Today, it is virtually impossible to prevent an antenna breakdown and, even worse, once the failure happens, it is impossible to know - remotely or onsite - which of the several antennas that are installed on a tower are damaged.

There is only one possible path for the resolution of the fault: bringing a team of technician's onsite, switching off the transmitting system and let technicians manually check each one of the antennas installed on the tower.

This situation is a great motivation for an operator to install the DAC Monitoring System and is addressing his critical needs:

Target	Critical Needs
Broadcast tower operators	1. reducing cost of repair / maintenance in case of failure 2. reducing time for recovery in case of failure 3. preventing downtime 4. Increase broadcast tower security 5. remote and real-time monitoring of towers' performance 6. Offering enrichment (upselling) guarantees of service

Table 2: Critical need of broadcast operators

The DAC System can address these critical needs and be deployed in 2 different ways:

Retrofit: Existing tower installations are upgraded with the DAC System. The installation time for the whole system is about 1h/sensor.

Enhancement, new towers: DAC System are mounted to the antennas or splitters before the installation at the tower. In this case the installation time is virtually zero.

With the DAC system, the broadcast tower operator is now able to address, his critical needs (see Table 2).

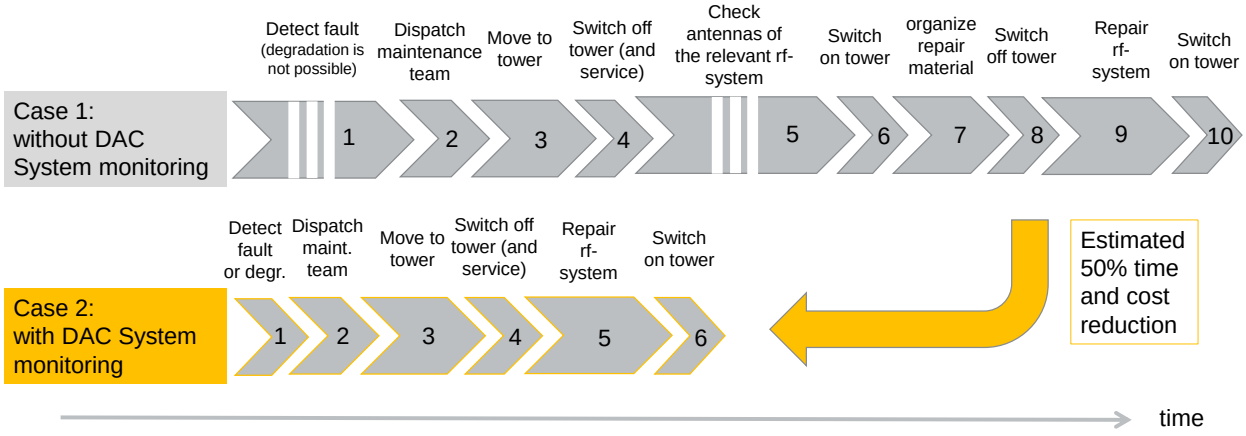
Benefits for the operator with the DAC System	DAC System functionality
Do **preventive maintenance** and prevent from partial/total system failures.	Measurement data are logged and a trend curve per value is visible. Defined break point barriers raise an alarm with different severity.
Minimize SLA violation caused by "slow death" effects (like water in the system, mechanical abrasion).	In case of preventive alarm (system degradation), operation can initiate a maintenance task in due time, but controlled and scheduled.
Safe time and cost for failure detection because of direct failure localisation.	The measurement values gives clear indication which path (antenna/cable) is affected. The detailed value of Tx/Rx gives further information if the problem is in the antenna or in the feeder cable. Based on this information also external maintenance teams can be more efficiently controlled.
Safe time and costs to repair because the correct spare material is on site.	Through the direct failure indication the right spare material (connectors, cables, and antenna) can be provided with the first maintenance action.

Safe fixed costs because of central dispatching and optimized maintenance team assignment.	The operator can dispatch maintenance teams planned because of the degradation information of DAC Sensors and reduce the “emergency” actions costs.
Increase the security of the broadcast tower, in case of rf-system failure in the tower, the operator can switch of the amplifier (FM – up to 80 kW)	DAC System is monitoring the transmission power. The operator can take pro-active action in case of failure detection, i.e. he can switch of the amplifier. DAC System could support that from remote through I/O ports at the Data Logger, either automatically or manually.

Table 3: DAC System added value

3 Business Case

Figure 9 compares a typical incident procedure with and without DAC System. It comes clear that with the DAC System the mean time to repair (and with that the service down time) will drastically reduce.



Principle illustration: time blocks are not proportional to the used time, e.g. detect fault in task No. 1 in case 1 could take very long, in case 2 it is immediate. The same issue for task No. 5 in case 1, depending on the size of the tower this task could be over proportional long.

Figure 9: Comparison repair process: with and without DAC System

Based on first installations and initial feedback of broadcast operators we calculated the costs benefit with the DAC Monitoring System. To make the cost comparable for different operators and different cost levels, we display relative figures (%). We assume that this moderate view gives a valid indication for the savings for the 2 cost blocks conditions (see Figure 10: Cost benefits with the DAC System):

- Operation costs → act on incidents, failure, malfunctions, degradation issues, etc.
- Maintenance costs → tower inspections, preventive maintenance (optical and electrical tower inspections)

Table 4: Operator cost blocks, gives an overview on the main costs blocks related to the DAC Monitoring System, its added value and impact for the operator.

Operator cost blocks	Added Value DAC System Benefit to the tower operator	DAC System enables the operator to:
SLA violation	Minimize SLA violation caused by “slow death” effects	repair the rf-system **before a total failure** occurs
Operation costs	Reduce maintenance costs and time to repair by 50%.	have direct failure indication: • the right spare material is on site • Long failure search is eliminated • External repair teams can be better controlled.
Maintenance costs	Reduce or eliminate regular tower inspections drastically.	have immediately on-line data on system degradation or failure

Table 4: Operator cost blocks

The calculation includes the depreciation of the DAC System, but does not include penalties or fees through Service Level Agreement (SLA) violation (reduced performance, service interrupt).

Conclusion: In any case the operator has a cost benefit with the DAC Monitoring System, the benefit is largely dependent on the number of incidents appearing in the network. It is also visible that in case of “New Installations” the benefit is bigger because the installation costs are very small (sensors are mounted before antenna/splitter installation in the tower).

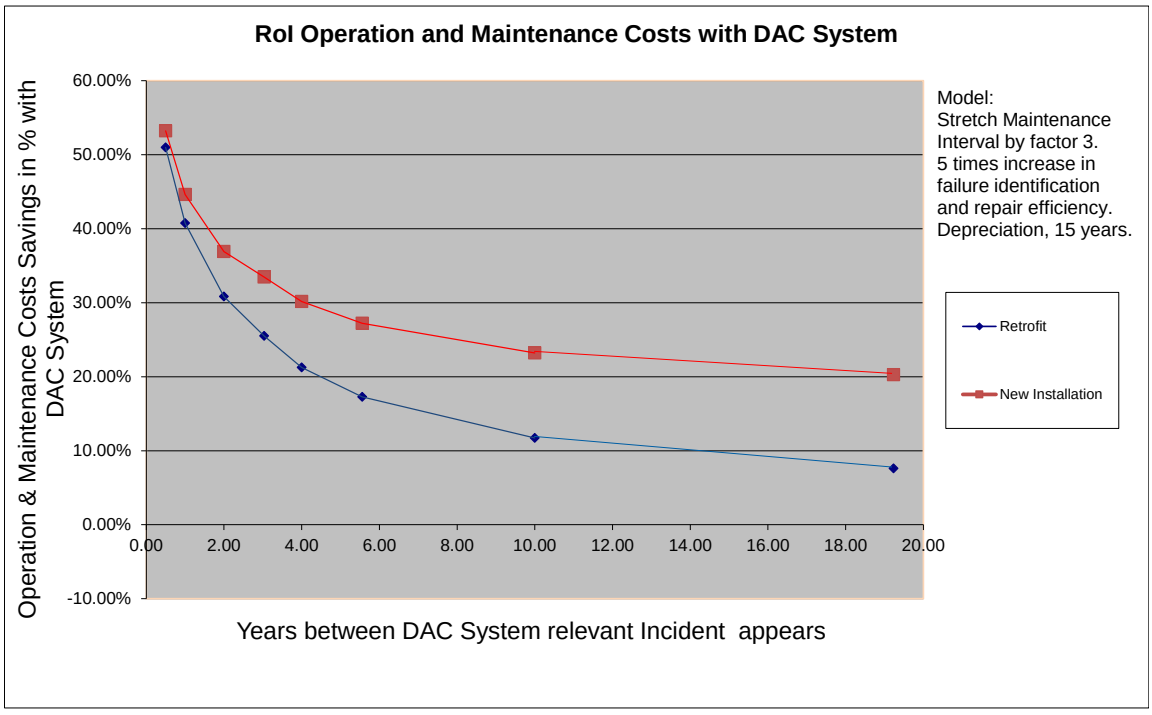


Figure 10: Cost benefits with the DAC System