

GAUGE EMULATION: a cost-effective solution for tank gauging upgrade projects

Modern tank gauging systems make it possible to replace mechanical equipment with electronic devices within the same bus system. This is an opportunity to avoid problems connected with outdated equipment

Most tank storage facilities existing today have had many years of service. This often also applies to their tank gauging systems, which may have started to become less reliable. As safety and environmental protection is a growing concern, this could present an unacceptable risk for the facility.

Most suppliers of tank gauging equipment in the past only had one bus alternative for communication between the control room and the gauging equipment on the

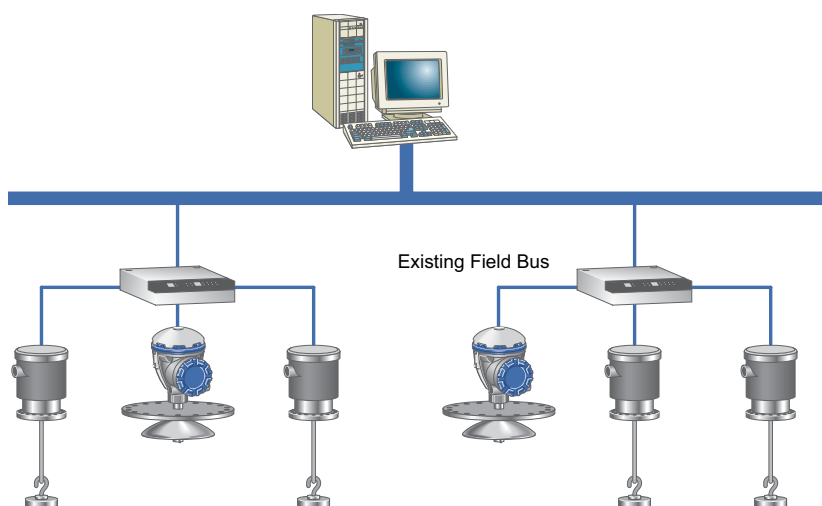
tank. This electrical interface and protocol software was more or less specific to one manufacturer. Level gauges or temperature devices from another manufacturer could therefore not be connected to this bus. If the user wanted an extension of the system, a partial upgrade or an exchange of a number of tank gauging units, the only practical alternative was to purchase them from the same supplier as before. To install equipment from another supplier required separate

costs, poor performance and unreliable measurements from these systems instead of exchanging them to modern radar based gauges. The reason for this is often that the cost is too high for exchanging the whole system, and that a partial exchange creates bus compatibility problems.

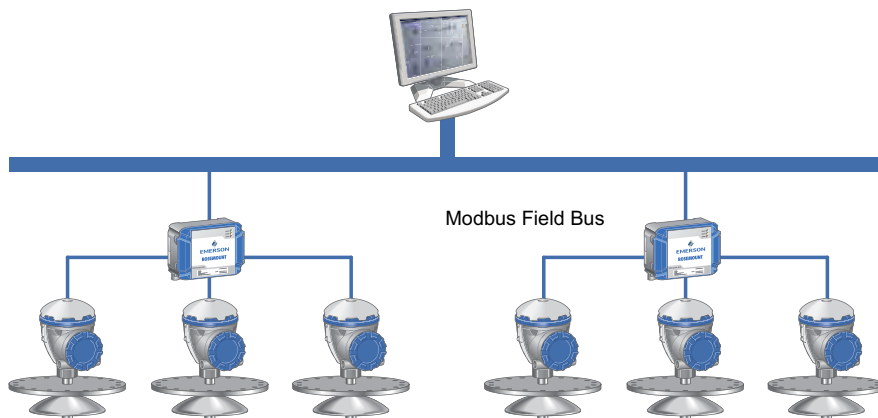
To replace a complete tank gauging system for all storage tanks on a refinery or a big tank terminal is a major project. The first obstacle is to get a budget for a complete exchange, especially if some of the units in the existing system have been upgraded recently.

Another issue that could make a user hesitant to change the entire gauging system, is that this change takes too much time.

During this period it may be necessary to have a large number of tank gauges out of operation while waiting for the new system bus to be commissioned. This situation requires special effort from the operations department including an extensive period using manual tank gauging, which can



With Rosemount 5900 it is possible to quickly upgrade your system



Change to the standard radar level gauge field bus without additional cost

of course be a safety issue if not handled with care.

In many instances, the data from the tank gauging system is also transferred to other high-level computer systems. These can be accounting systems, inventory/loss control systems, DCS systems etc. The exchange to a new system may in these cases also mean that the data transmission protocols between the old gauging system and the high level computer have to be established for the new gauging system as well. If the existing high-level computer system is slightly out of date, it may be costly to connect the two systems. Often, it proves to be quite expensive to modify protocols for older DCS or administrative computer systems. It can be more economical to leave the tank gauge master unit as it is, use the already working connection to the high-level computer system and instead exchange it the day a major

change is made on the hardware and software of the high-level computer. During the purchasing process of the new computer system it is easy to require the supplier to have a modern interface/protocol to the tank gauging system, which will cost a fraction of what a special programming in an old computer system would cost.

These aspects are just a few reasons why a user may prefer his old level gauge system and therefore accepts having unreasonably high maintenance costs. For some old mechanical systems it may even be extremely difficult to get spare parts, and the service costs offered by the local supplier may be unreasonably high, since there is the belief that there is no alternative.

The 'gauge emulation' migration path

This unsatisfactory maintenance situation does

not have to be accepted as there are tank gauging devices available that can easily solve the entire problem described. By using 'tank gauge emulation' it is possible to make an easy

and cost-efficient upgrade of these systems. Emulation means that an existing tank gauge installed on a tank can be exchanged by another totally different type of gauge. After this exchange, the existing tank gauging system will not see any difference between the new emulating level gauge and the old level gauges. A number of aspects have to be considered when doing this exchange:

1. The emulating level gauge should be electrically compatible with the existing system field bus. Poor compatibility could cause the old system to malfunction, even if the emulating gauge works well.
2. The emulating level gauge should be software compatible with the existing system. There may be software commands sent out from the tank gauge master, which are not relevant for the emulating device. For

example, a radar gauge emulating a servo gauge might receive the command 'raise the displacer to top'. This is obviously not relevant for a radar gauge which has no displacer, but the gauge must still give a proper response back

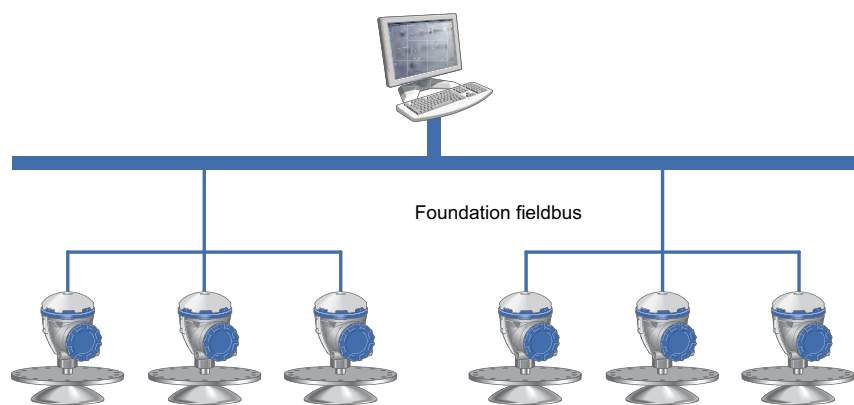
to the tank gauge master unit, otherwise an alarm message could occur.

3. The software compatibility can often be on different levels for various emulation applications. The most common is emulation that is only supported for measurement data. This implies that all measured data, such as level, temperature and pressure alarms will be sent from the emulating gauge to the tank gauge system master. Initial configuration of the emulating level gauge cannot be performed from software in the tank gauge system master, but has to be made from some other unit (e.g. a laptop PC or hand held terminal).
4. All measured data that the tank gauge system master expects to receive from the level gauges must be supported. If, for example pressure, density, flow rate or some other data is measured by the existing system, then the emulating level gauge must be able to produce the same measurement data.

Which types of tank gauges can be emulated?

There are still a large number of older float and servo gauges of various types being used today. They are from several suppliers and have a number of solutions for field bus communication. The level gauges from these suppliers are generally suitable for emulation, since they have over the years used the same field bus hardware, and the software protocol has changed very little.

Not very many suppliers on the market offer the possibility to emulate other tank gauge types. One example is Emerson with the Rosemount 5900, a modern radar based level gauge, which has put emulation in focus. The 5900 gauge is



The system is designed to meet future demands for standardised field buses

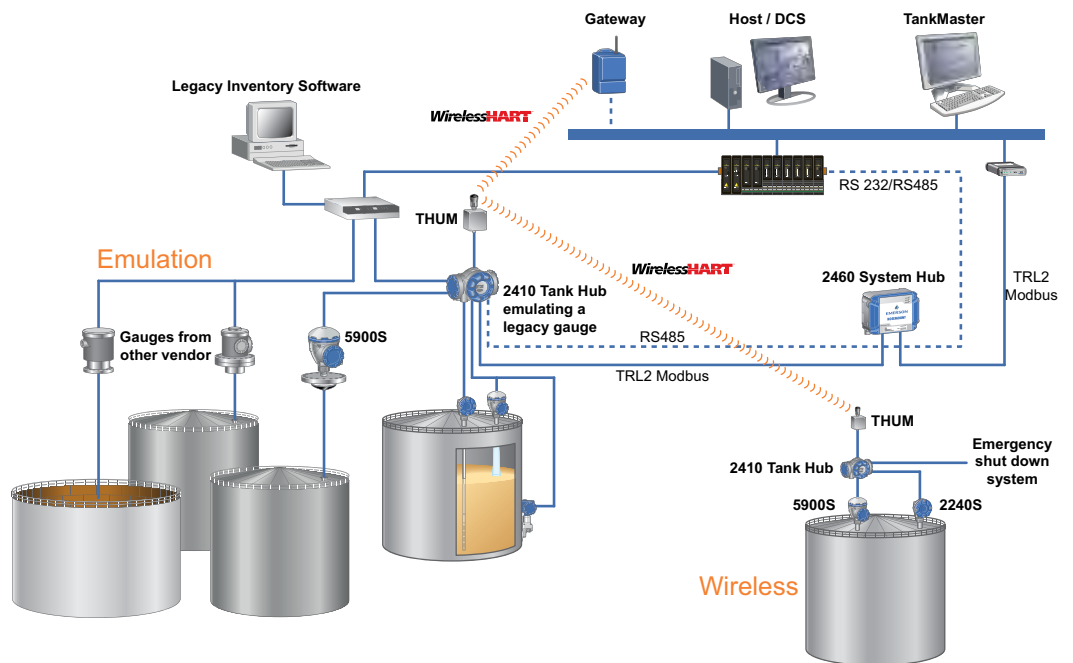
tank gauging

actually a series of different level gauge types designed for different tank types.

Also Emerson, like all other tank gauge suppliers, has its own type of field bus, but in addition the modular design allows for emulation of a large number of other types of level gauges. In particular all major old types of mechanical level gauges can be emulated.

The modular design field bus selection is not limited to emulation of level gauge types as above. Instead of selecting an emulation module, the user can select some other type of the common standardised field buses such as Foundation fieldbus or Modbus. This allows a user to change the selection of the field bus in the future. If a policy decision is taken to use Foundation fieldbus later on, for example, the level gauge system can be rearranged for this at a low cost. A real life situation could be:

1. A refinery needs a partial upgrade of a limited number of level gauges. The company then selects modern radar-based level gauges with the emulation function that corresponds to the existing old tank gauge system.
2. Over a certain time period the refinery stops spending excessive maintenance on the old level gauges. Instead of spending the maintenance budget on old equipment, it is used for buying a few new emulating radar gauges. The facility still uses the old tank gauge master system. When budget is available the company decides to switch to a fully radar-based system. At this time the company can also switch to the standard radar level gauge field bus, without any additional cost. The reason for this is that the gauges used for emulation in the old



Configuration of emulating level gauges in an existing system

system are equipped with the standard radar level gauge field bus as well. It can be activated at any time. With the standard bus, all facilities for configuration service etc are available for the user.

3. After some years, a major decision is taken by the refinery to use Foundation fieldbus for the tank farm area as well. In this case the system can be converted to Foundation fieldbus communication without exchanging the whole level gauge unit. The refinery has then easily and quickly managed to convert the existing tank gauge system to Foundation fieldbus communication



High precision parabolic radar antenna for fixed roof tanks

at a very low cost. The example above illustrates a very typical situation for a refinery or tank terminal. Decisions can be taken without ruling out other possibilities, and further expansion possibilities are not excluded. It should be emphasised that the user in the example can also reverse his decision, so if he for any reason wants to return back to the old selected tank gauge field bus, he can do that without any costs involved.


An emulation example

The figure above shows an example of emulation in practice (in this case combined with wireless transmission of measurement data). When the emulating level gauge is connected to an old servo based level gauge system, the existing PC-based tank gauge software accepts the emulating gauge as a servo gauge. Typically, tank data like level, product temperature, alarms and status information (level gauge performance) is sent out and passes the tank hub before entering the legacy system. Data will appear on the screen as normal and the type of gauge will not be

made visible to the operator. In this particular application wireless transmission is used as an alternative communication path for a remote tank.

Conclusions

Today, users of a tank gauging system have the option to mix various types of level gauges from different suppliers without having bus incompatibility problems. There is no reason to accept high maintenance costs and poor performance on old existing mechanical level gauges. It could in most cases be far more economical to spend maintenance money on purchasing an emulating radar level gauge instead of spending it on worn out mechanical equipment.

Project implementation can be far easier with a minimum of operational disturbances by doing a gradual exchange of an existing tank gauging system based on emulation. When full exchange has been achieved, the user has the option to select the type of field bus that he prefers at a minimum cost. 

For more information:

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