

What is Interoperability?

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TUTORIAL

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What is Interoperability

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Introduction

Since the early days of building automation systems (BAS), one of the most difficult problems has been to get systems from different manufacturers to “work together”. Through accident or intent BAS has evolved into a collection of many systems and devices that are *proprietary* in nature. One could argue whether this was the result of some conspiracy, or just lack of planning, but the reality is that many products exist that have very similar requirements but no real way to work together.

In the mid-1980s BAS products had little or no way to work together, and owners were often faced with the terrible choice of continuing to use products from manufacturer X that did not meet their goals, or completely replacing X with different products from manufacturer Y, obviously a very expensive decision. Frustration about this problem and being “locked-in” to one manufacturer led many to question why it had to be that way. The international standard called BACnet® was created to solve this very problem. But even today, decades later, many remain confused about BACnet’s mission and about what progress has and has not been made.

Part of the confusion exists because of the sheer complexity of modern BAS, but perhaps more importantly because of different ideas about what “work together” means. This tutorial will explore some of these different ideas and explain how the past 33 years of standardization efforts have greatly improved the situation.

What is Integration?

In the context of BAS, Integration is a process of creating connections between things, in this case automation devices, that were never designed to be connected together. The purpose of trying to connect them is to accomplish one or more useful tasks. In practice, these connections may not be easy to achieve, and may not even be robust. In the best case, we can sometimes extend the functionality of those devices, usually with some compromises.

Owners who have BAS devices from more than one vendor have traditionally talked about “integration” as a process of trying to get some degree of useful interconnection between their devices. The key point is that interoperability is the desirable outcome, but integration can be a viable substitute for what they really want.

When I needed to reach a tight space in the corner of a ceiling, and couldn’t fit a ladder into the space, I was able to improvise a solution by taping a paintbrush onto a mop handle. This worked for a quick fix but wasn’t really a very good long-term solution. The tape wasn’t very secure and the angle I could paint with was limited.

This is a lot like many so-called “integration” solutions for BAS. They can sort-of work but fall short in terms of providing the flexibility and reliability we really want. Don’t paint brush vendors understand that we have these kinds of tight situations? Don’t they realize that everybody who paints has these same needs? Don’t they realize that everybody has mop handles from different vendors?



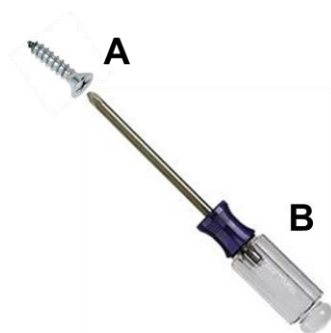
Well of course some of them are paying attention. They understand that what we really want is the flexibility to use more or less any paint brush, and to be able to securely hold the brush after many repeated uses, and to securely hold it at many different angles, and to be able to use their competitor's mop handles at the same time!



The first key idea here is that the paint brush and the yellow clamp and the mop handle need to inter-operate together. Some aspects of that interoperation are well known, such as the exact dimensions of mop handle screw fittings, while other aspects such as the size of the brush and its angle during use, need to have adjustability.

The second key idea is that interoperability is not a one-size-fits-all litmus test. In this example, the paint brush, clamp and mop handle have very specific roles. They don't drink beer together, they're not used to install drywall, or to pour concrete. There are very specific *interoperations* that we have in mind for them.

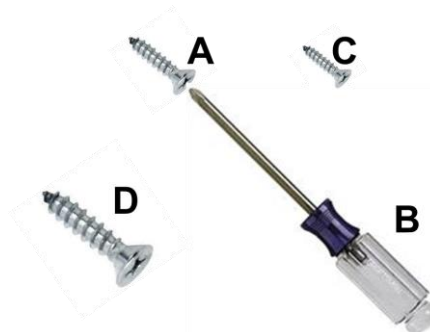
What is Interoperability?



Here is a very common object, a Phillips head screw we'll call A. We would say that it is interoperable with the Phillips head screwdriver B when it comes to two interoperations: screwing and unscrewing.

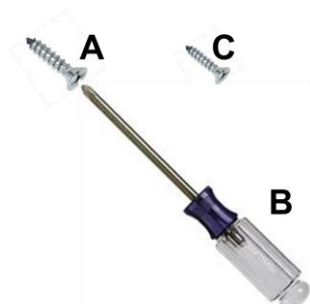
But having said this, of course we also realize that there are limits to what these two objects can do together.

Here are some additional objects, screws C and D. We would say that screwdriver B can interoperate with both A and C, but not D. How come? Because clearly B is too small (or D is too large) to interoperate reliably or even at all. We're going to need a larger screwdriver!



The point is that just because B interoperates with some Phillips head screws doesn't mean that it can interoperate with all Phillips head screws.

Interchangeability

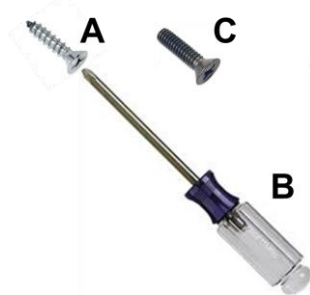


Even though screwdriver B can interoperate with both A and C, that doesn't mean that A and C are *interchangeable* for most applications. While related to interoperability, to be interchangeable implies additional criteria.

When you think about it, interchangeability is always based on criteria for suitability. In this example, A and C are both Phillips head screws, both the same length and size.

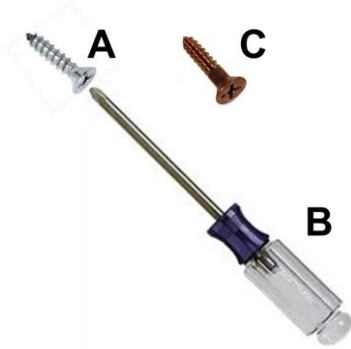
If size is the criteria, then A and C are interchangeable.

But if *finish and color* are the criteria, then A and C are not interchangeable.



Even when the interoperability is exactly the same, interchangeability is not guaranteed.

From screwdriver B's perspective A and C are the same and it can easily interoperate with either one. But obviously the business end of A and C are completely different, so they are in no way interchangeable.



It's also important to keep in mind that not all devices interoperate as well as others. Some "devices" are much better for some interoperations. Come on, admit it, you've tried this kind of interoperation before. Yes, you were able to "drive" the screw flush with a surface, but how well did screw A hold afterwards? Again, we realize that there is a quality aspect to interoperability and it's not just a yes/no thing.

Many people think that "standardization" by itself assures interoperability.



Here we have two "objects" A and C. They are both the same size and length, and both couldn't be more "standard".

But even when "standard" objects are used, interoperability is not guaranteed. In this example there is no way that screwdriver B can be used with C.

The standardization of A and C makes it likely that an interoperable screwdriver can be found for each one, but not all screwdrivers are suitable for all screws.



Some devices can interoperate with both standard and non-standard objects. Here we have a couple of "standard" screw types A and B, and a somewhat uncommon screw C. This screwdriver is very flexible and can interoperate with all three.



Who Cares?

The key point is that in order to get devices to work together, you need a set of rules for interoperability. Those rules can't possibly cover all possible combinations and applications. There is just no way to make every kind of BAS device be interchangeable with every other device.

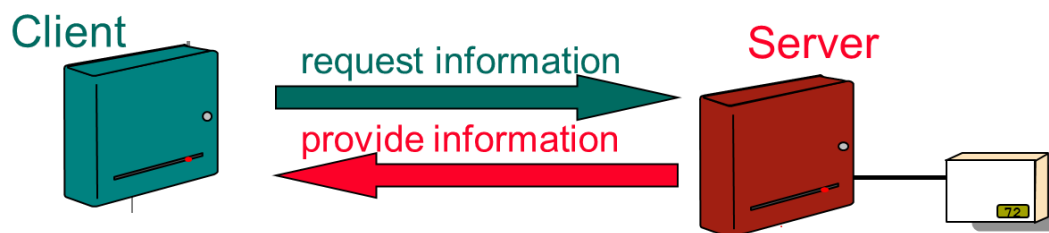
So, for interoperability to work, we must decide which devices need to interoperate with each other and in what ways. If you're going to make apple pie, you need to choose apples and not oranges in the fruit aisle!

Different Kinds of Interoperability

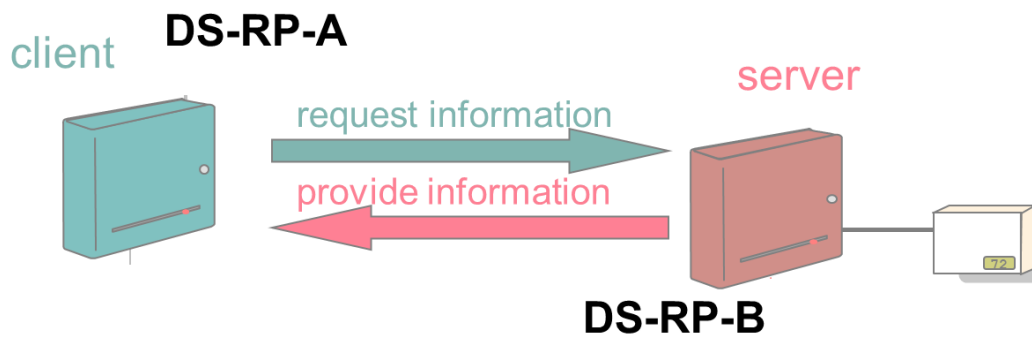
There are many kinds of application in BAS and that provides many opportunities to create interoperable solutions. To some people, the idea of interoperability needs to be part of the BAS itself. They have a need for some components or portions of the BAS to be able to use different vendors, and yet be part of a unified whole. In some cases, owners are looking to replace a portion of an existing system with components from another vendor with similar capabilities. In other cases, the owner is not necessarily trying to create a mixed vendor system but may be trying instead to use a single unified "front end". It may be that previously not integrated sub-systems such as lighting and HVAC, now need to be interoperable. It may be that the application is not BAS but, for example, building and facilities analytics. In that case, the interoperation is between an analytics package that has nothing to do with the actual BAS in the facility.

For all these examples, different kinds of interoperability are required.

One of the key ideas in BACnet is called a BACnet Interoperability Building Block (BIBB). BACnet defines many different BIBBs, each of which is a standardized name for a collection of *services* (interoperations between devices) and objects. As a rule, BIBBs come in pairs where there is a *client* BIBB known as the A or "asking" side and a *server* BIBB known as the B or "fulfilling" side. For device A to be interoperable with device B for a given feature, the A device must implement the corresponding A side BIBB and the B device must implement the corresponding B side BIBB.



One of the most common BIBBs involves *data sharing*. In this example the green client device needs to know a temperature value. It knows that the red server device has a temperature sensor and makes that temperature available as a property of one of its objects. The client's role is to request information and the server's role is to provide it.



The BIBBs are called DS (data sharing) – RP (read property) and A is the client and B is the server.

When one device says that it supports DS-RP-A, then it is interoperable with another device that supports DS-RP-B for the interoperation of reading object properties.

BIBBs provide standardized names for interoperability concepts that can then be used by humans to create matching relationships between components that have a need to perform particular interoperations.

The key concept is that support for each BIBB is device dependent. Just because a device implements BACnet doesn't mean that it implements all possible BIBBs. Also keep in mind that BIBBs have different levels of complexity. Support for some BIBBs is relatively easy, while some are quite complex.

Conclusion

There is an old joke about standardization that says "the good thing about standards is that there are so many to choose from." In BACnet's case, the standard has a long history of attempting to bring together a large number of seemingly different ideas and disciplines. This has been a crucial element in allowing "almost standard" devices to be adapted to BACnet.

In order to get real benefits from modern BAS you should be aware of and invest in interoperability. BACnet-based systems can provide these kinds of benefits, but there is a critical aspect of human choice involved in selecting and configuring components that provide the kinds of interoperability that you need. You can't just say "give me some BACnet".



Legal Stuff

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