Getting the most out of your avionics’ built-in diagnostics capabilities.

Once viewed as the “cure-all” for avionics troubleshooting problems, technicians are finding that with the right knowledge and training, the built-in diagnostics in current generation systems are coming a lot closer to delivering on the promise.
To truly appreciate how far built-in diagnostics capabilities have come, we have to take a short trip in the ol’ “wayback” machine to the early days of component self-monitoring and testing. “Diagnostics themselves go way back,” explained Dave Smith, director of product management for Rockwell Collins’ Business and Regional Systems Group. “Some of the first were called ‘fault balls.’ They used different colored balls that would flip over when a unit failed and they would stay that way until the box was tested and reset. Unfortunately, the biggest problem was that diagnostics circuit was probably the least accurate and reliable one in the box. “That’s the way it was with a lot of those early systems,” he continued. “The older diagnostics tended to be very complicated, so if you had a fault, a lot of the times you didn’t know if the problem was really in the box or with the diagnostics themselves.” “Back when each unit stood alone, troubleshooting was fairly easy,” Pat Scott, technical manager for Honeywell Avionics’ new Primus Epic system added. “If a flight director broke, that was your problem. You could just change that box and you’d probably get it right. But, when you move up to the days when you started to place multiple processor cards into an avionics cabinet and each processor began to serve several functions, troubleshooting suddenly became infinitely more difficult.”

So, driven by the rapid growth in avionics sophistication and the corresponding need to provide ever-increasingly more reliable information to technicians, component manufacturers have consistently evolved and refilled their system’s diagnostics capabilities.

That was then, this is now.

“The intent of today’s diagnostics capabilities is to enable a technician to find a problem, fix the problem and get the airplane returned to service as quickly as possible.” — Dave Smith, director of product management for Rockwell Collins’ Business and Regional Systems Group

On-board diagnostics for Honeywell Primus Epic integrated avionics system display unit showing present leg faults.

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form initiated tests, perform rigging procedures and view data the Member Systems transmit via the Avionics Standard Communications Bus (ASCB).

“Our new Primus Epic system truly introduces the most advanced integration that we’ve ever done on business aircraft,” Scott explained. “And because of that, a technician has no chance of troubleshooting the system’s distributed architecture without the help of a computer that can track the built-in test (BIT) and show them what’s going on.”

**Just tell me where it hurts.**

While the avionics manufacturers have continually evolved the built-in diagnostics capabilities of their products to provide technicians with more and better troubleshooting information, one area where they haven’t been quite so successful in is creating a common “language” that the technicians and BITE computers can use to communicate.

“In earlier generation systems, when a technician would run the ground maintenance tests or integrated maintenance test sequences and if a fault was found, it would give you a set of what were basically hex-codes to help troubleshoot the problem,” explained Dave Coleman, manager of customer services for Honeywell Avionics. “The only thing is, you needed a ‘secret magic decoder ring’ to decipher them.”

Scott added that he has his own way of describing how the “language” of BITE has developed over the years: “The earlier maintenance systems were designed by BITE-heads for BITE-heads,” he said. “Basically, everything was put in engineering language and we’re still dealing with that problem today.”

“Most technicians see a diagnostics display and say, ‘What the #@!& is that supposed to mean?’,” Scott continued. “We’ve kind of spring loaded most technicians into believing that there isn’t very much value in what these things tell them because we haven’t developed terminology they understand.”

While we’re on the subject of things that technicians don’t like about current-generation built-in diagnostics systems, we have to mention the “cascade” effect. What that is, is one box having a fault and because other boxes need that input they too display faults because their data is incomplete.

“Because of the downstream way boxes are tied together, one box can have a fault and the technician can end up with 20 or more fault messages on the display,” he added. “The technician looks at the daunting list of 20-plus faults on it and he has to work his way through it one-by-one to turn the airplane—so most times, he turns to guessing. That’s another thing we’re working hard to make better.”

**Knowledge is key.**

While the availability of built-in diagnostics and system self-testing capabilities have led many people to think today’s avionics are practically “self-maintaining” the truth is they’re not. “A lot of operators are under the impression that you can have someone other than an experienced avionics technician troubleshoot these systems,” Smith explained. “But the truth is you can’t. You still need a technician who is trained on electronics and avionics because he is going to get a lot of information from the diagnostics displays that he’s going to have to interpret. Remember, diagnostics can’t give you the answers, they can only point you in a direction.”

That was the sentiment shared by all of the people interviewed for this story by Avionics News—the more sophisticated the systems are, the more critical training and experience becomes to achieving timely and efficient troubleshooting.

“In fact, what we’re finding out is that a lot of today’s diagnostics are so complicated that if the technician doesn’t know the system really well—better than he or she used to have to know it—they won’t know how to sift through all the engineering-level language to understand what the diagnostics are really telling them,” explained Craig Aldrich, maintenance training counselor for FlightSafety’s Gulfstream Learning Center. “In fact, type specific training is probably more important now than ever.”

“The principal of the diagnostics capabilities are to give the technicians the ability to quickly narrow down their search for a problem into a smaller
explained. "Autoflight systems are
tem, and you have the autopilot, which
is the "muscle" of the system. And the
ground. You have to use the diagno-
sing. Somewhere along the line, they
got the belief that these systems will
understand how the autoflight system
works in order to ask the appropriate
questions and run the right diagnos-
tics, but more importantly, you have to
provide no data."

Twin sons of different mothers.

Another way training, or in particu-
lar, model specific training can be a
great benefit to technicians are the vast
differences found in the way avionics
systems are engineered from manufac-
turer to manufacturer and model to
model. They may look alike, but
they’re not created the same and those
differences can be bewildering to an
untrained technician.

While there are just a few standard
avionics manufacturers and they sup-
ply the same basic systems to all air-
craft makers, there are a lot of differ-
ences between one installation and
and another that makes a big differ-
ence in how you troubleshoot a sys-
tem," added John Jordan, director of
maintenance training at FlightSafety’s
Citation Learning Center. “You may
see a Primus 2000 avionics package in
a Citation X and you may see the ‘same package’ in a Falcon or
Challenger. But even though they’re
the same avionics, they’re different.”

Jordan explained that this common-
ality leads to problems because the air-
craft manufacturers use different sets
of parameters to install their avionics.
“Things that turn one thing on in the
Citation may turn it off in the Falcon,”
he said. “There are many different
ways of achieving inputs. One may
use a logic module. Another may use a
PC board somewhere to provide throt-
tle data and the next may use some
kind of digital-to-analog converter to
get the same information.”

So what’s a technician to do?
“Here’s another situation where train-
ing is very important,” Aldrich added.
“Technicians see an unfamiliar air-
plane has an SPZ 8000 system and
expect it to be the same as what they’ve seen before. It’s not. System
knowledge is critical to successful
troubleshooting. It all goes back to
training to know what’s really causing
what in each system. Without it you’re
just going to end up beating your head
against the wall.”

Another benefit to having a wealth
of system knowledge is the ability to
sense when the diagnostics may be
sending you down the wrong path.
And it does happen. Today’s systems
are very good but they’re not fool-
proof and a technician needs to know
when the readings they’re getting are
just wrong. It all goes back to training
because a system’s built-in test is not
going to always be a tell-all solution.

Technicians also have to keep in
mind that each avionics vendor only
creates diagnostics capabilities for
their avionics systems and today’s air-
craft have multiple types of systems in
each installation. “Even though it’s a
Honeywell equipped airplane it proba-
bly also has a Universal, Garmin or
Global FMS,” added Ward. “No mat-
ner what system it has, the in-depth
diagnostics will only support the pri-
mary supplier’s products. It can look
for inputs from the other components,
but it can’t support their diagnostics.
So the technician still has to rely on
experience to identify these situations
and not just randomly pull a box
because the diagnostics identify it as
providing no data.”

For example, Ward said, consider the
Universal UNS-1D that’s in the
Citation Excel. It only has an ARINC
429 databus to the Primus 1000 avion-
ics system. If that data isn’t present,
the system’s display will just say,
“Sorry, we don’t get a bus from the
Universal box” but it won’t say why.
“It could be a box failure, a connector
failure or a bad wire,” he said. “And
there’s no way of knowing until you
get down inside the system and trace
the bus. The diagnostics won’t do it
for you.”

It’s not my fault! really!

Providing advanced training for
avionics technicians cannot only help
operators cut troubleshooting times, it

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can also be a major contributor to cut-
ting spares and replacement parts costs
especially when you want to eliminate
the costs of no-fault-found.

“As an OEM we get beat up by
operators because of the high number
of boxes that get sent in for repair but
get diagnosed as ‘no-fault-found,’”
Coleman added. “But when we go
back and analyze the actual data, we
find that the majority of it’s happening
because the users haven’t taken the
time to train their people in the right
way to troubleshoot their systems.”

“I think entry-level technicians tend
to rely too heavily on what the box is
telling them and not enough on what
experience should be telling them,”
Jordan said. “So instead of going
through and doing the thorough trou-
bleshooting program they will just go
in and do what they call ‘shotgunning’
the system. They go in and replace all
of the boxes that could possibly cause
the problem.” Then they send the
boxes back to the OEM to let them fig-
ure it out—a big waste of everyone’s
time and money.

“But as long as the parts are covered
by a warranty, the technicians don’t
have to worry about making
the right decision,” he continued. “But
once the warranty is off, the pressure
is on whether or not they spend 30-
or 40-thousand dollars on a
new box. This is where the experi-
enced and well-trained technicians
separate themselves from the box-
changers.”

FlightSafety’s Ward went on to
explain the lengths one avionics OEM
has gone to, to force technicians to go
beyond what the diagnostics may tell
them and do more in-depth trou-
bleshooting before a box is removed
and sent back to the factory. “One
OEM has put out, in their current doc-
umentation, the following statement:

‘Under no circumstances do you
replace one of the boxes in the aircraft
because the diagnostics say that is the
problem,’” he said. “Because many
times the problem is actually an input
to the box and not the box itself. You
don’t want to go replacing a forty-
thousand dollar box when the problem
is really a twenty-dollar switch.”

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