

**Boeing's Evaluation of
AP238
(STEP-NC)
For Advanced Machining
Processes**

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Present Situation - “The Old, Wild West”

- NC machining has been used in production for approximately 50 years.
- Traditional data flow provides only low-level information to the NC machine tool.
- A lack of strong standards results in incompatibilities
 - Machine
 - Control
 - CAM

Problems with “The Old, Wild West”

- **Not Portable**
 - Unique data must be generated for each machine control combination on which the part is to be run
- **Not Adaptable**
 - No information is provided to the machine to help it adapt to real-time changes in machining dynamics and machine tool alignment.
- **Not Bi-directional**
 - No standardization for in-process data generation

A Solution: “Smart, Standard CNC”

- Cutter movement data, instead of axis movement data is sent to the CNC.
 - Allows the data sent to the CNC to be machine independent
- High level information about the part features, materials, cutters, and dimensional tolerances can also be sent to the CNC.
 - Allows the CNC to make smart decisions in order to optimize manufacturing
- A standard method can be used to transmit in-process data
 - Simplifies and increases possibilities for closed-loop machining

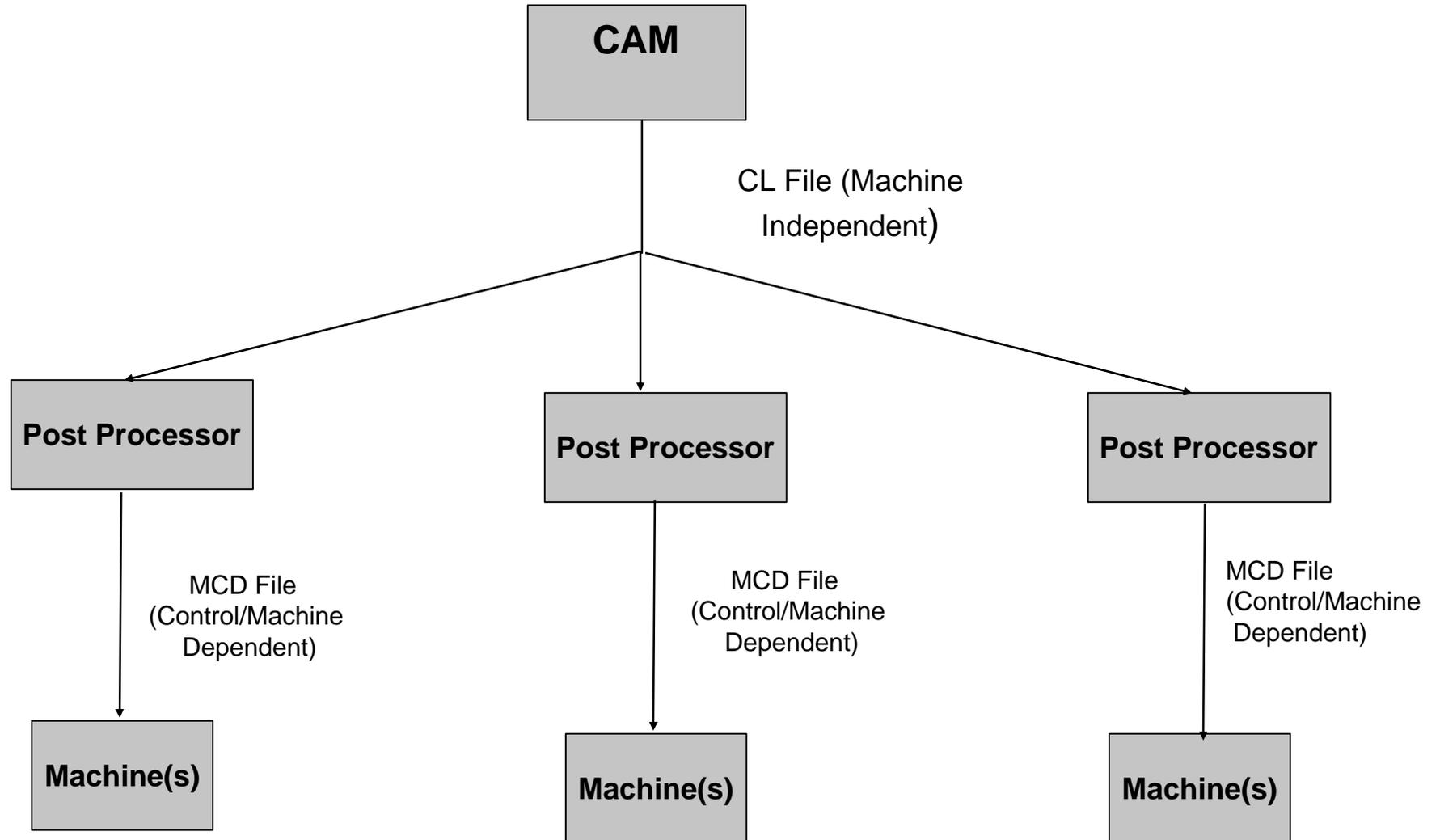
Smart, Standard CNC Benefits: Portability

- Cutter motion data is “machine neutral” and may be used directly by machines with different geometries
- Separate post-processors are not required for each unique control/machine combination
- Direct portability between machine tools/controls is possible (within reason)
- Process data collection can be commanded using a standard format
- Process data can be recovered using a standard format

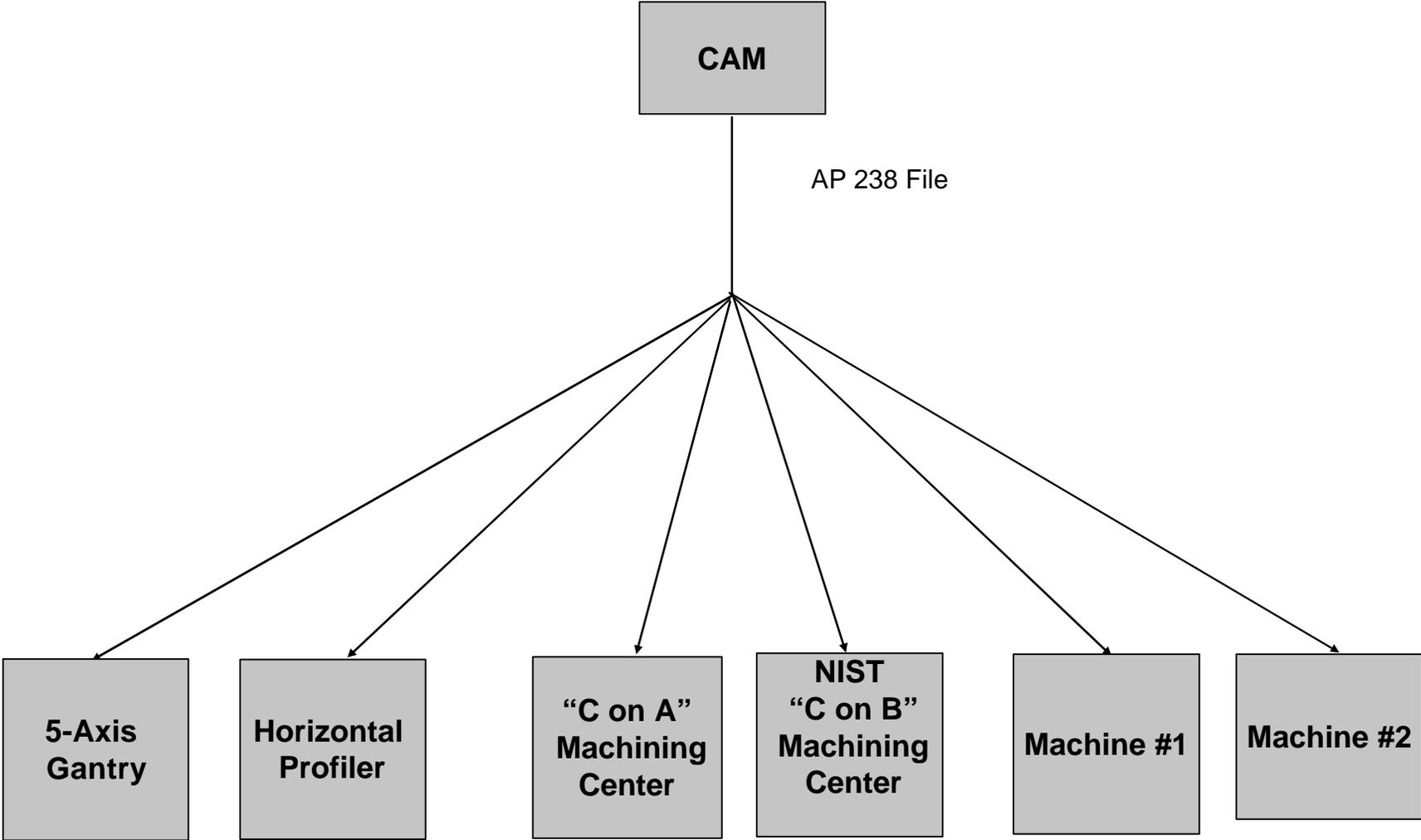
Portability Issues

- Data that is presently sent to a CNC is not portable for two main reasons:
 - No standard format followed (a bad reason)
 - Machine geometries vary (used to be a good reason)
 - Machine auxiliary functions are not implemented in a consistent, standard manner
 - No consideration has been made for the standard collection of in-process data

“Traditional CNC” Data Flow



Smart, Standard CNC Data Flow: Final



A Wide Data Path

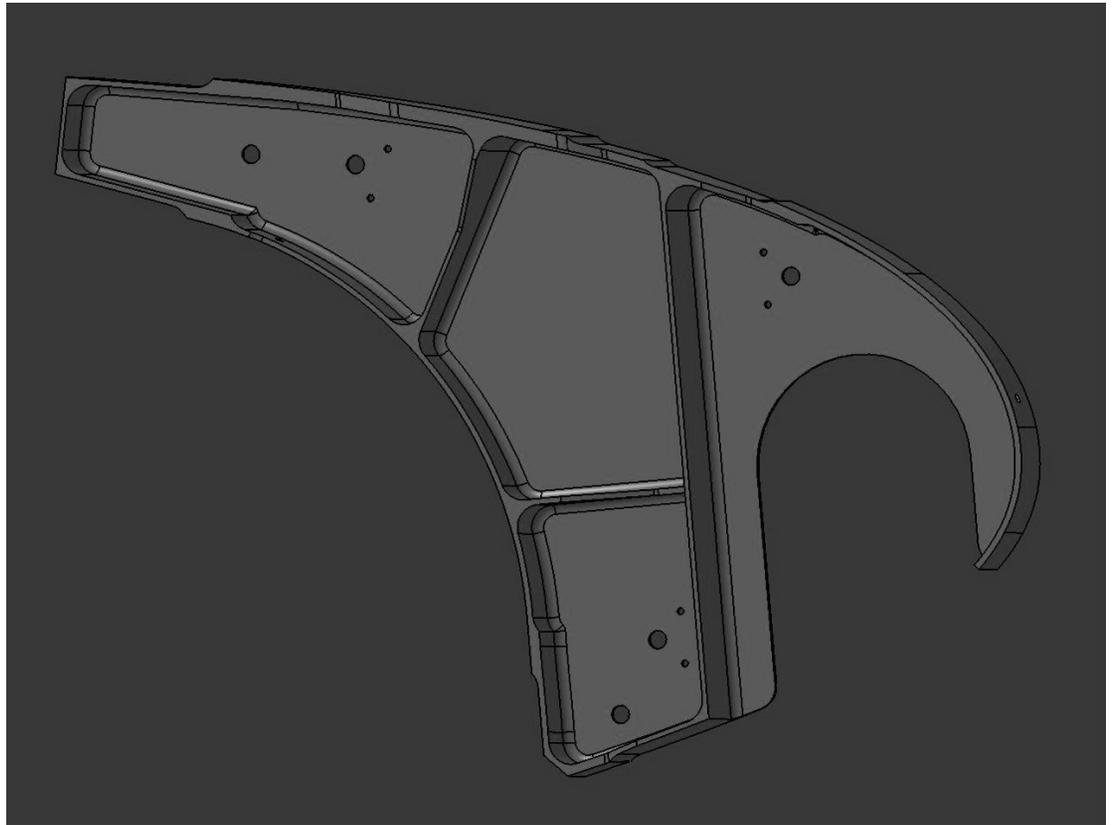
- Other information about the part can be transmitted using AP238
 - Fixtures
 - Material
 - Cutters
 - Tolerances
 - Part Geometry
 - NC Data

Demonstration: “Real World” Practicality

- The practicality of using AP238 to define and produce a complex, 5-axis, “real-world” part was unproven
 - Are file sizes reasonable?
 - Is processing time reasonable?
 - Can the required software be produced?
 - What other problems will be encountered?

Test Part for Demonstration B

5-axis
Aerospace Part



Caveat

- AP238 allows DATA portability. It does not guarantee PROCESS portability.
 - Machine work envelope
 - Spindle capability
 - Machining philosophy
 - Cultural Issues
- Presently, in-process data collection functionality is incomplete

Questions?