

Arnold Engineering Development Center



U.S. AIR FORCE

AEDC MODULAR DATA SYSTEMS

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Program Manager
Test Systems Sustainment*

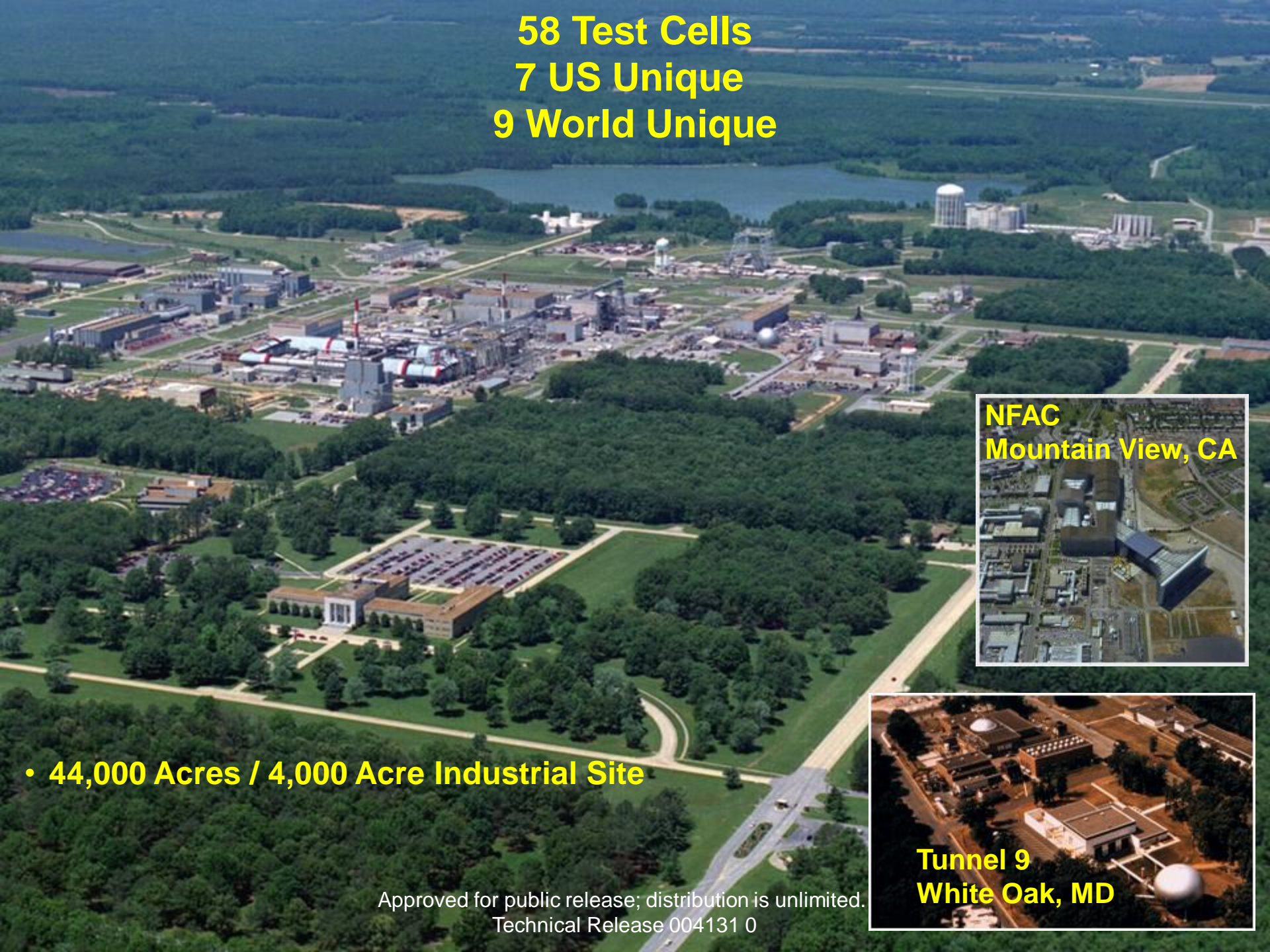
***The Test Instrumentation Workshop
2012
Las Vegas, Nevada***

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Outline

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- **Overview**
- **Core Architecture**
- **Typical Devices**
- **Process**
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- **Cost Savings**
- **Future**
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**58 Test Cells
7 US Unique
9 World Unique**



**NFAF
Mountain View, CA**



**Tunnel 9
White Oak, MD**

• 44,000 Acres / 4,000 Acre Industrial Site

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AEDC

Our Vision:

Be the nation's best value ground test and analysis source for aerospace and defense systems

Our Mission:

Develop, test and evaluate weapon, propulsion, aerodynamic and space systems at realistic conditions for the nation through modeling, simulation and ground test facilities

AEDC

- Arnold Engineering Development Center, located at Arnold AFB, TN.
- It is most advanced and largest complex of flight simulation test facilities in the world.
- Facilities can simulate flight conditions from sea level to 300 miles and from subsonic velocities to Mach 20.
- It has contributed to the development of practically every one of the nation's top priority aerospace programs.
- Customers include the Department of Defense, Army, Navy and Air Force organizations; the National Aeronautics and Space Administration, both domestic and foreign private industry, allied foreign governments and educational institutions.

AEDC

- Before WW II, US military air technology lagged behind civil aeronautical research
- At this same time Japan and Germany were actively pursuing technological advantages
- In 1944, Gen Hap Arnold set in motion a plan to establish US military air and space superiority by technological R&D
- Theodore Vón Karman's 1947 report "*Toward New Horizons*" served as the Air Force's R&D blueprint for the next 50 years
- On June 25, 1951 President Harry Truman dedicated AEDC to Gen Arnold's memory



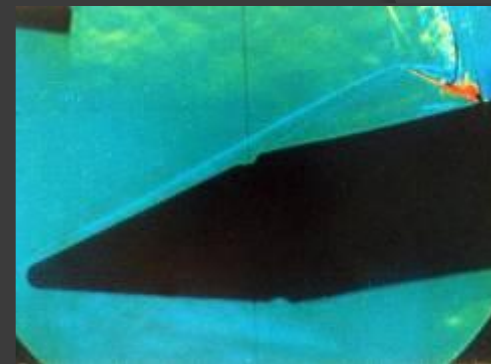
AEDC's Primary Work is Testing



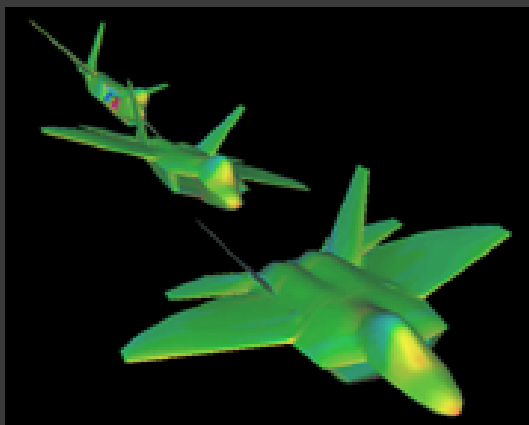
Aeropropulsion



Aerodynamics



Hypersonics



Modeling & Simulation



Rockets



Space

Background

- Data is the main product the AEDC provides for its customers.
- Temperature, voltages, and pressure measurements account for a large percent of this data.
- Equipment in the facilities has extended beyond its intended life cycles.
- With the reduction of available funds to maintain instrumentation, a new system approach was required.

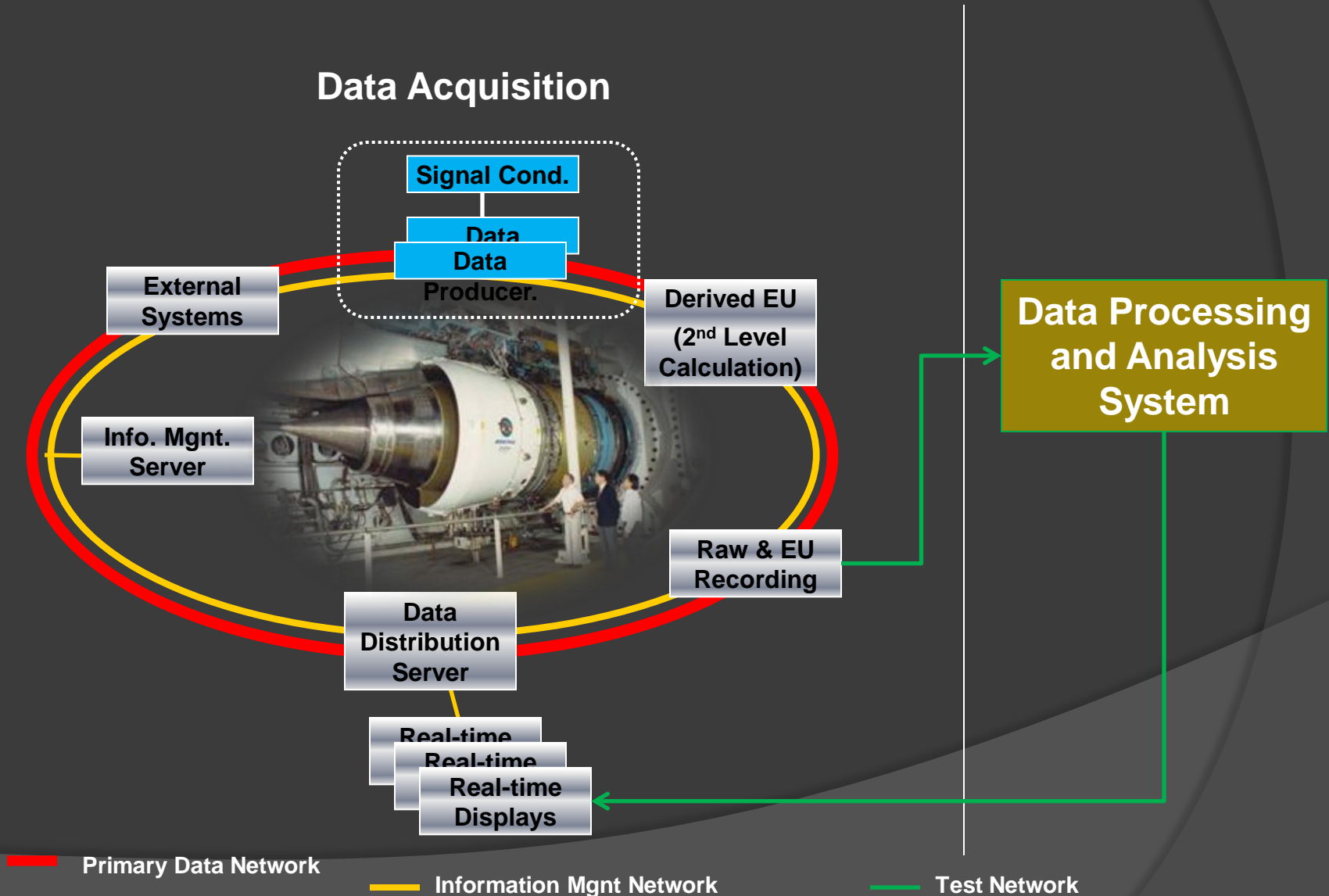
Overview

- AEDC continually evaluates its instrumentation facilities for upgrade through an Improvement & Modernization Program
 - Maintenance Avoidance
 - Life cycle costs
- Review advances in technology
 - Instrumentation
 - Smart Sensors
 - Open Standards
- Establish a collaborative approach with customers

Overview

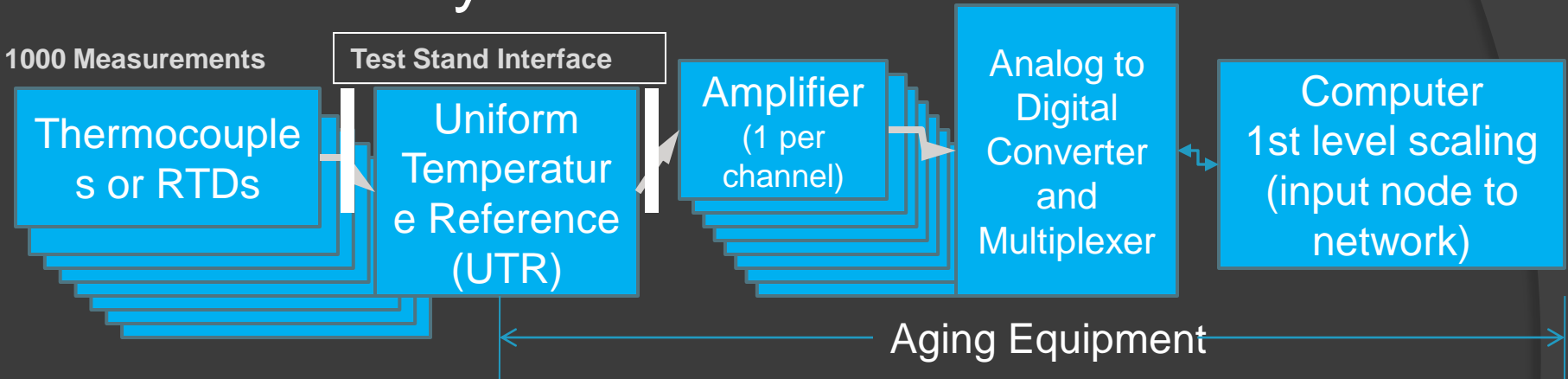
- Reduce cost of testing
 - Simplify test article/test facility instrumentation infrastructure
 - Reduce traceability cost to NIST standards
 - Reduce Infrastructure

Core Architecture

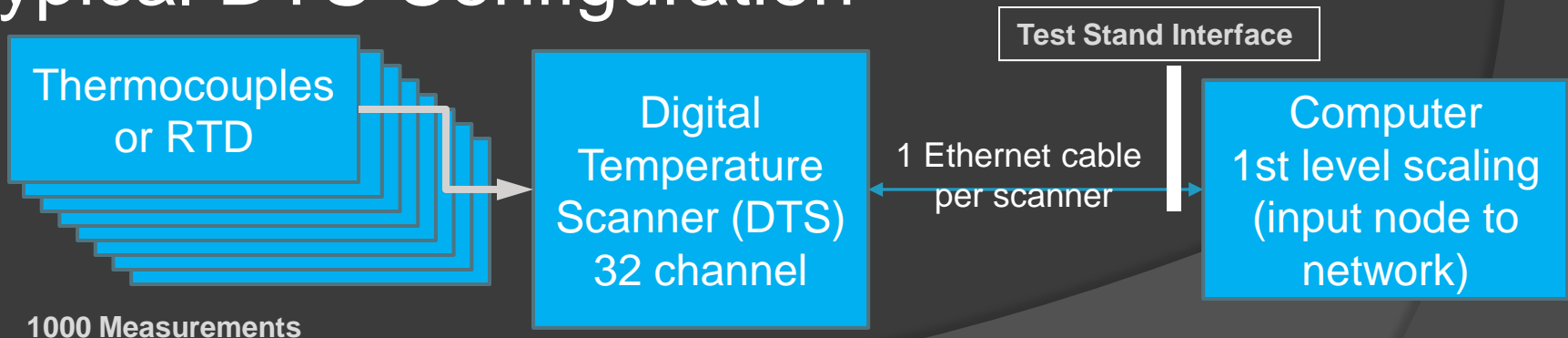


Typical Temperatures

Traditional System

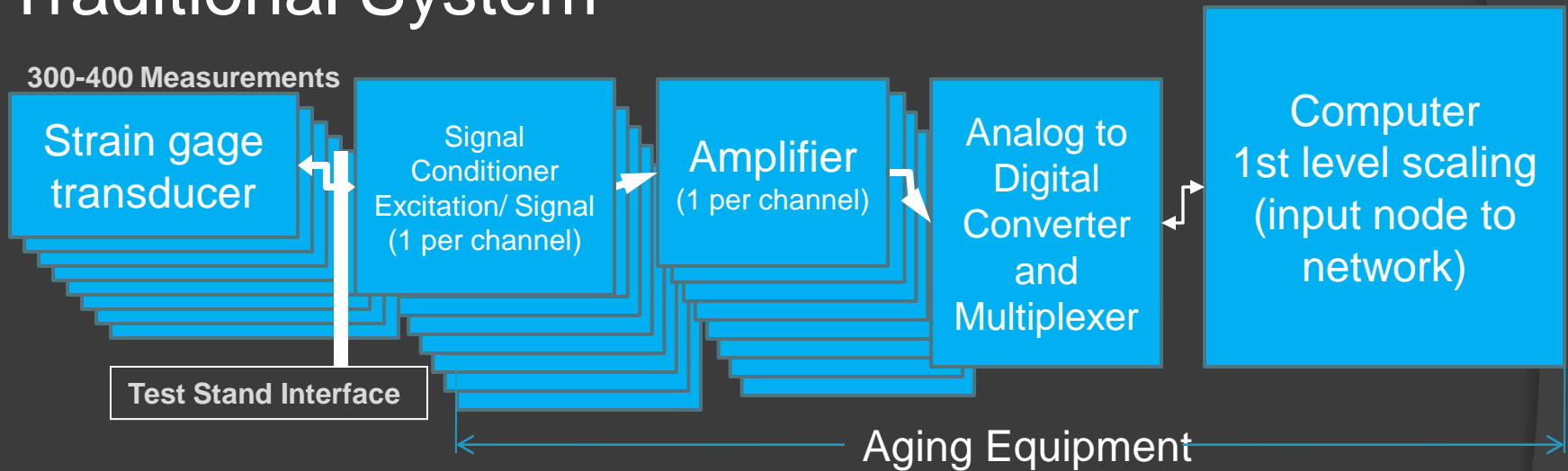


Typical DTS Configuration

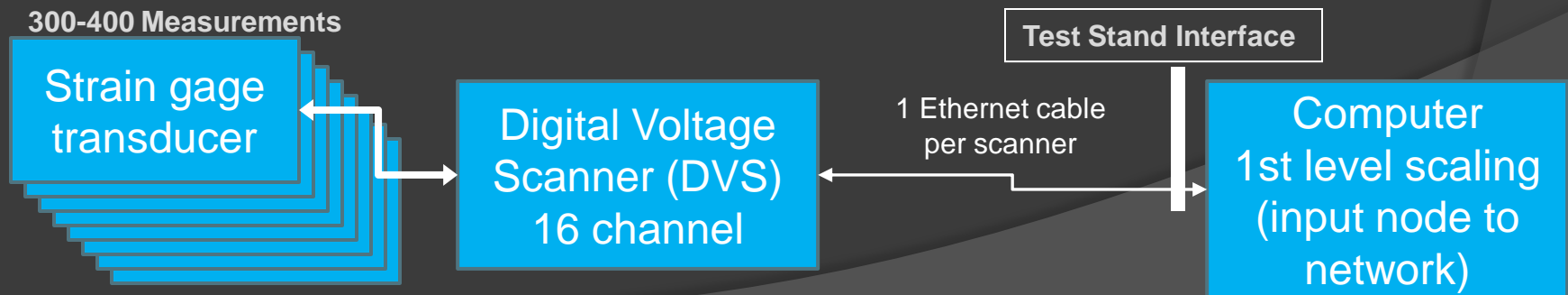


Typical Voltages with General Purpose Signal Conditioning

Traditional System

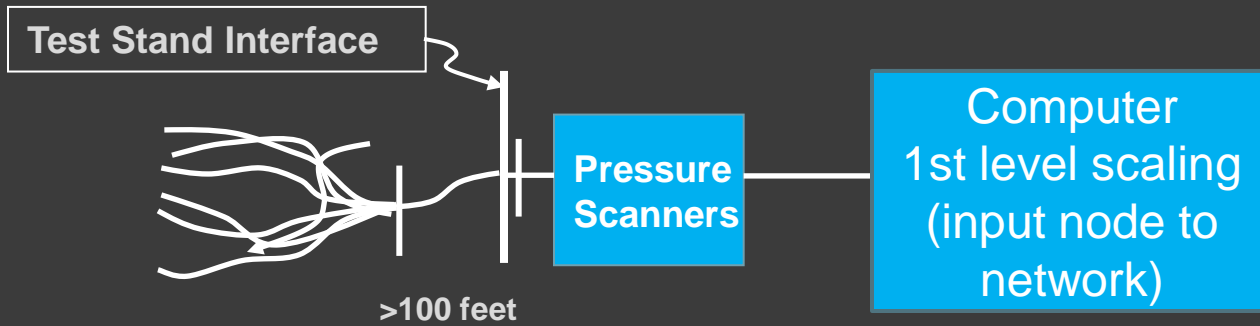


Typical DVS Configuration

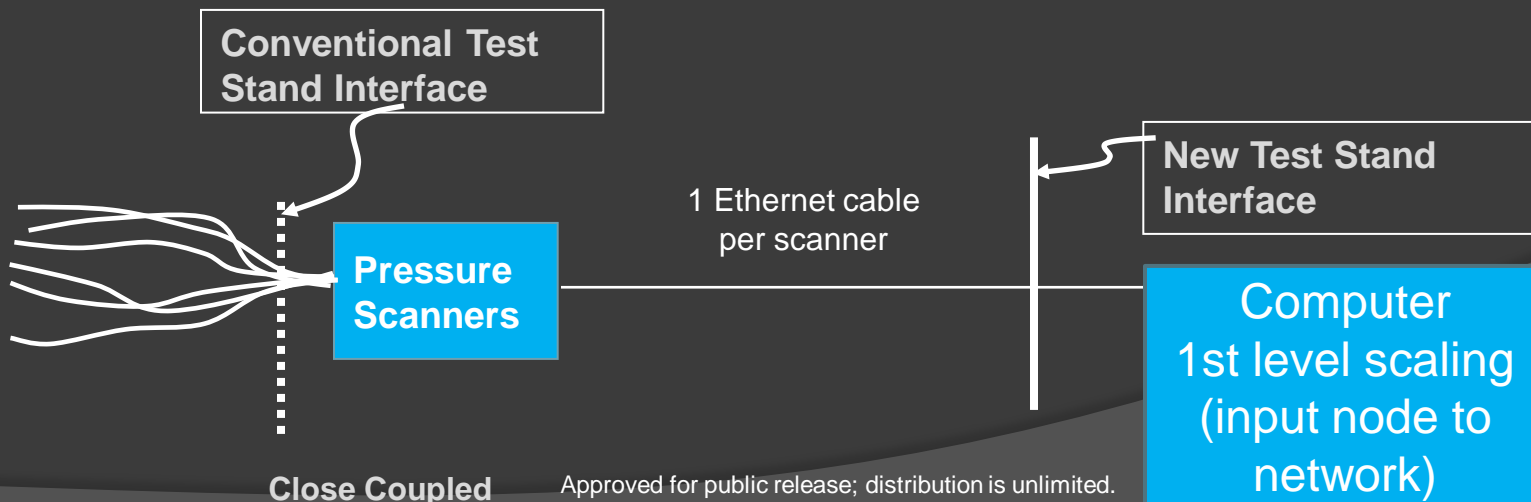


Typical Pressures

Traditional System



Typical Pressure Configuration



System Validation Process

1. Performance Measurements Evaluation Lab
2. Simulation Lab
3. Test Cell
4. Performance Measurements Evaluation Lab
5. Acceptance
6. Installation

Performance Measurements Evaluation Lab

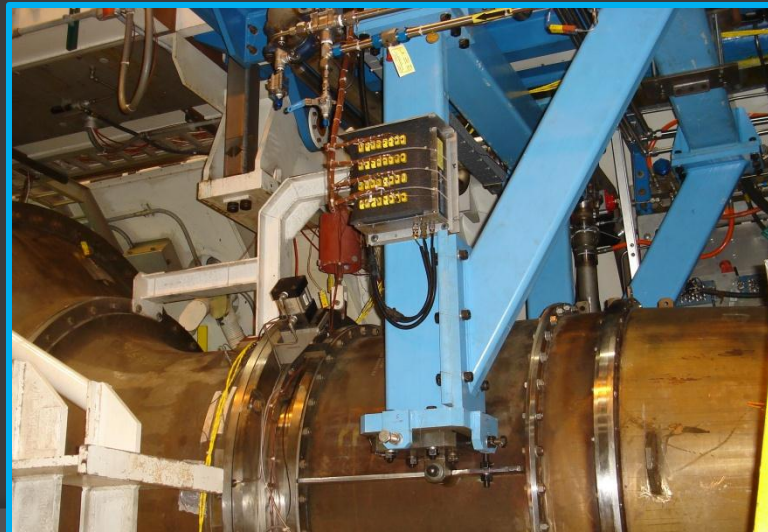
- Precision Measurements Evaluation Lab
 - Compares each unit against its manufacturer's specs
 - Exposes to a wide range of temperatures and pressures
 - Checks accuracy of measurements
 - Ensures AFMETCAL compliance
 - Provides traceability to NIST standards

Lab

- Simulation Lab
 - Software/Hardware Integration and Validation Testing
 - Prove System is mature and ready to install in test cell
 - Tested new displays and health monitoring for inaccuracies
 - Supports modification and revalidation

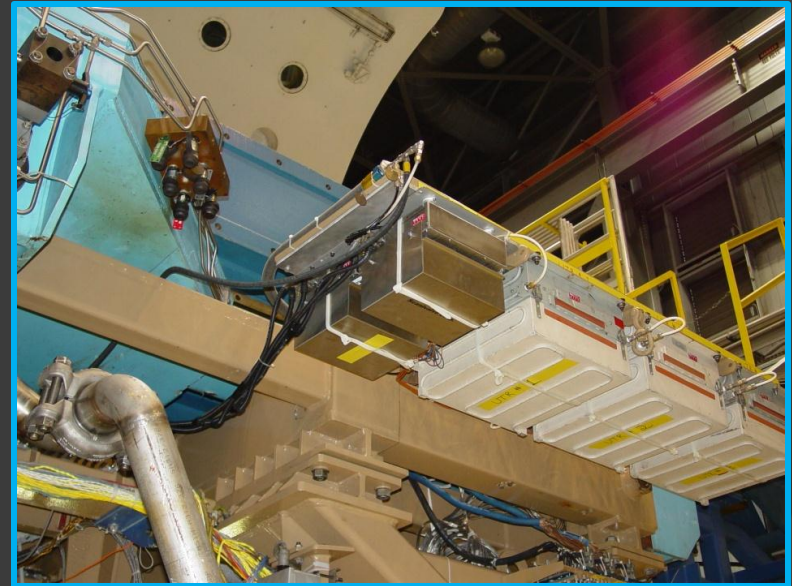
Test Cell

- Expose Units to Real Test Environment
- Parallel measurements
- Over 1000 hours of Run Time
- Over 200 hours of On-Air Test Time



Modularity

- **Modular design of the new data systems, reduces energy cost, you power only what you need.**
- **The new data sources have no test cell-specific components. Replacements and expansions can be pulled from a common pool of components.**
- **Many facility infrastructure components are eliminated. The new data sources convert the sensor signal to computer-readable data over Ethernet in one box.**
- **Modular design allows system to be mounted on the test article.**



Modularity

- Test article interface capabilities are not fixed
- Measurement capabilities in test cell are more efficiently managed
- Shared resources during non-occupancies
- Infrastructure maintenance cost simplified
- Data Acquisition is more closely coupled to measurement point

Cost Savings

- Reduced Instrumentation Cost
 - Digital Voltage Scanners are 30% less expensive per channel as compared to a signal conditioner & General Purpose Analog to-Digital
 - Digital Temperature Scanners are 55% less expensive per channel as compared to a reference junction and Analog-to-Digital

Future

- **AEDC is moving forward**
 - **Reducing AEDC I&C infrastructure**
 - **Reduces instrumentation cost and cycle time**
 - **Avoiding re-instrumentation when test articles are moved between test facilities**
 - **Improving data accuracy**

Summary

- Sources underwent extensive testing in the lab & test cell
- Sources were exposed to the real world environment
- Technical issues were discovered and resolved
- Sources matured well beyond any previous instrumentation systems to ensure their problem free operation
- A modular system is the new future of data acquisition at AEDC

