GIG Performance Assessment Framework

Tony Modelfino
Stratogis Networks
tony.modelfino@stratogis.com

30 October 2007

GIG Performance Assessment Overview

- **Objective**
  - Develop process for assessing GIG E2E performance
  - Develop tools to enable GIG segment self assessment
  - Collect and share GIG component performance among developers, operators and users
  - Determine E2E GIG performance capability
- **History**
  - Initiated to support NCID development
  - Approach to identify and resolve GIG performance issues
- **Components**
  - Performance Assessment Whitepaper - Strategy
  - Performance Working Group – Community Buy-in
  - Performance Evaluation Tool (PET) - Tool
  - Integrated E2E Model –Validation
  - Pathfinder Pilot – Data Collection Process & Initial Segment Performance
  - Pilot – Large Scale Segment Performance Data Collection

Assessing GIG Performance is very difficult

- **GIG Use Cases are complicated, involve many components, are combinatorial, and …**
  - GIG programs are at differing levels of development
  - GIG programs use different performance metrics
  - GIG programs typically don't interact during development

- **Multiple approaches for categorizing segment performance**
  - Requirements Based
  - Modeling Based
  - Test (DT&E, OT&E) Based
  - Operational Monitoring

- **The Performance Assessment Framework (PAF) Strategy is—**
  - Practical - Builds on available measures and allow GIG programs to define performance using their metrics
  - Reasonable - Allows any of the four approaches for categorizing performance
  - Realistic - Provides a capability to self-assess a program's performance in an end-to-end context
  - Scalable - Supports the rapid evaluation of thousands of use cases
  - Supports each phase of DoD system development lifecycle

PAF provides solutions to address the gaps

Gap	Solution
GIG Performance Assessment is segment focused	PAF is E2E focused
Transport performance is packet focused	PAF focused on End-User application performance in a tactical edge environment; applications include both legacy and SOA; multiple service architecture implemented.
SOA performance is not tactical edge focused	
Significant lag time before GIG segment models are added to GIG M&S tools	PAF pathfinder effort focused on modeling next generation GIG programs
No model for combining disparate GIG segment performance	PAF includes all GIG segment types (Transport, C&I, Services/Apps)
Lack of Fast & "Accurate Enough" GIG performance model for System Engineering trades	PAF focused on developing interactive performance assessment capability, appropriate for GIG system engineering analyses
Different segment types have different performance metrics	PAF methods combine GIG segment metrics to produce end-user response
No approach for evaluating performance effectiveness	PAF compares E2E performance against end-user thresholds

The reality of the tactical world today

Application

Satellite

COTH

COTM

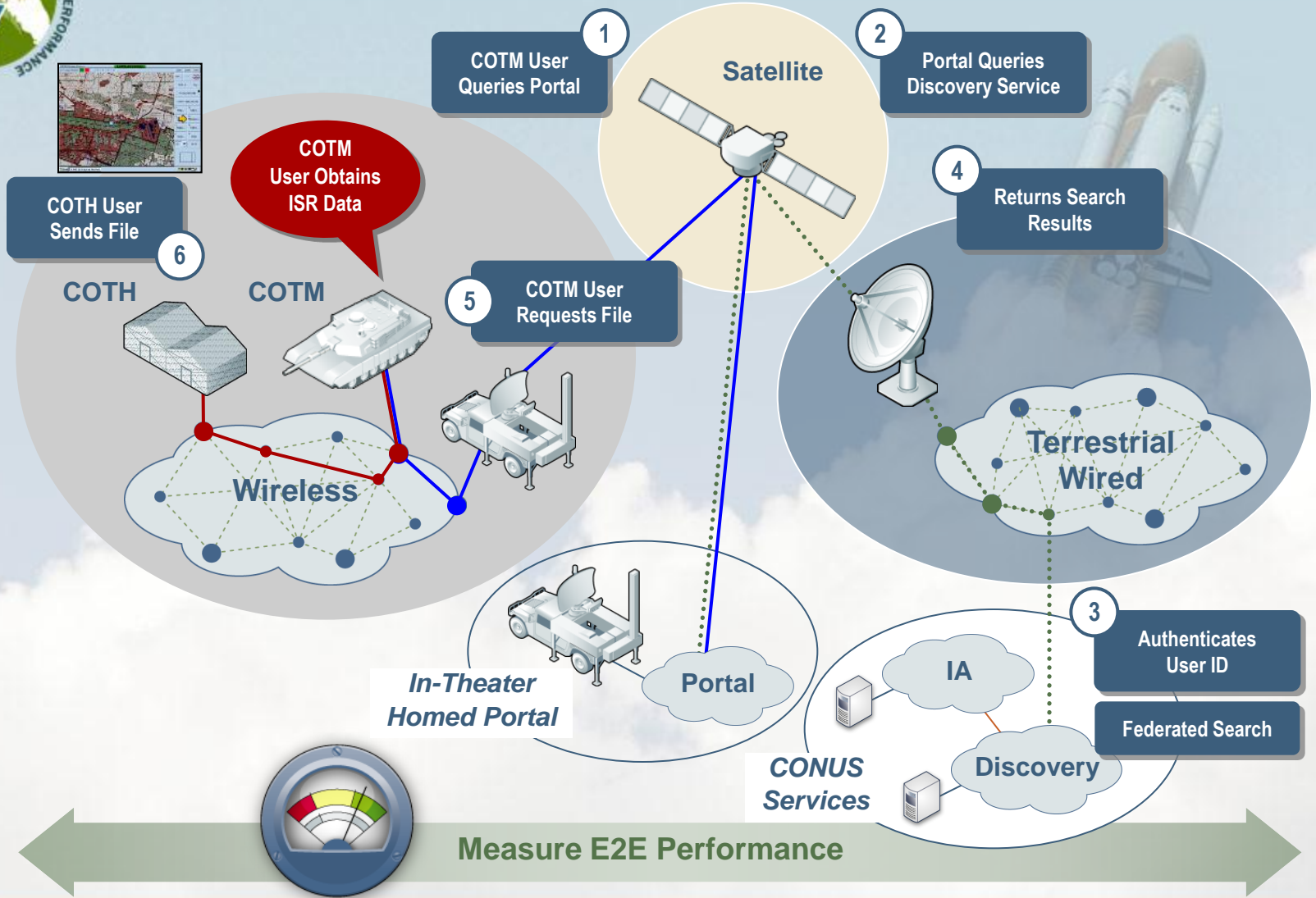**Wireless**

Terrestrial Wired
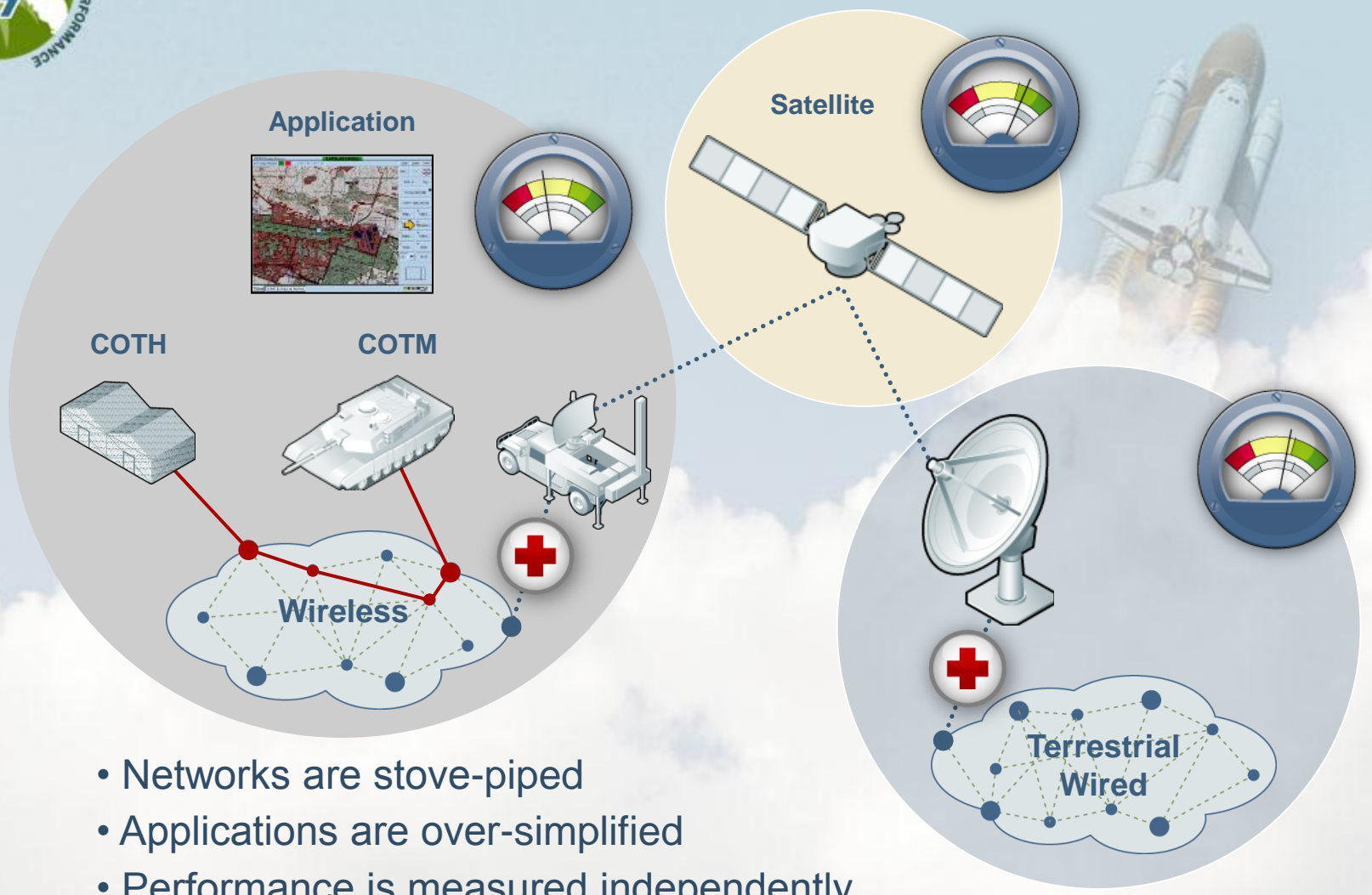
- Networks are stove-piped
- Applications are over-simplified
- Performance is measured independently

Reality of the tactical world of the future: it's very complicated, but necessary
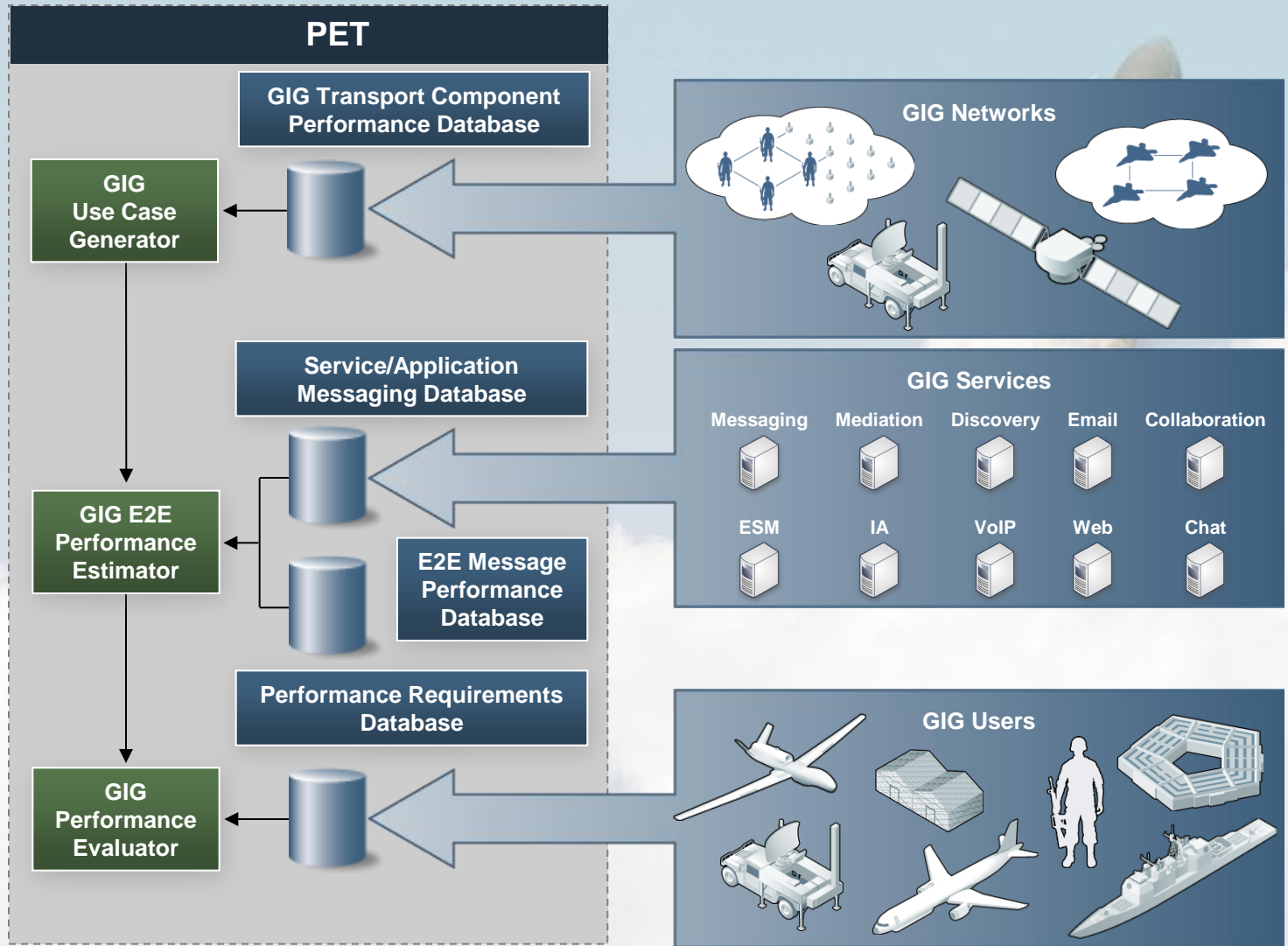

MILCOM 2007 — INTEROPERABILITY: POLICY TO PERFORMANCE

1 COTM User Queries Portal

2 Portal Queries Discovery Service

Satellite

COTH User Sends File

6

COTM User Obtains ISR Data

COTH   **COTM**

4 Returns Search Results

5 COTM User Requests File

Wireless

Terrestrial Wired

3 Authenticates User ID

Federated Search

In-Theater Homed Portal

Portal

IA

CONUS Services

Discovery

Measure E2E Performance

AFCEA · IEEE COMMUNICATIONS SOCIETY · HARRIS

Isolating & Resolving Interoperability Issues

GIG Apps

GIG Users

GIG C&I

GIG Networks

1,000,000's

GIG Architecture

10,000's

Force Structure

Operations

1,000's

PET Evaluation Funnel

Use Cases

100's

GIG Performance

10's

Performance Shortfalls
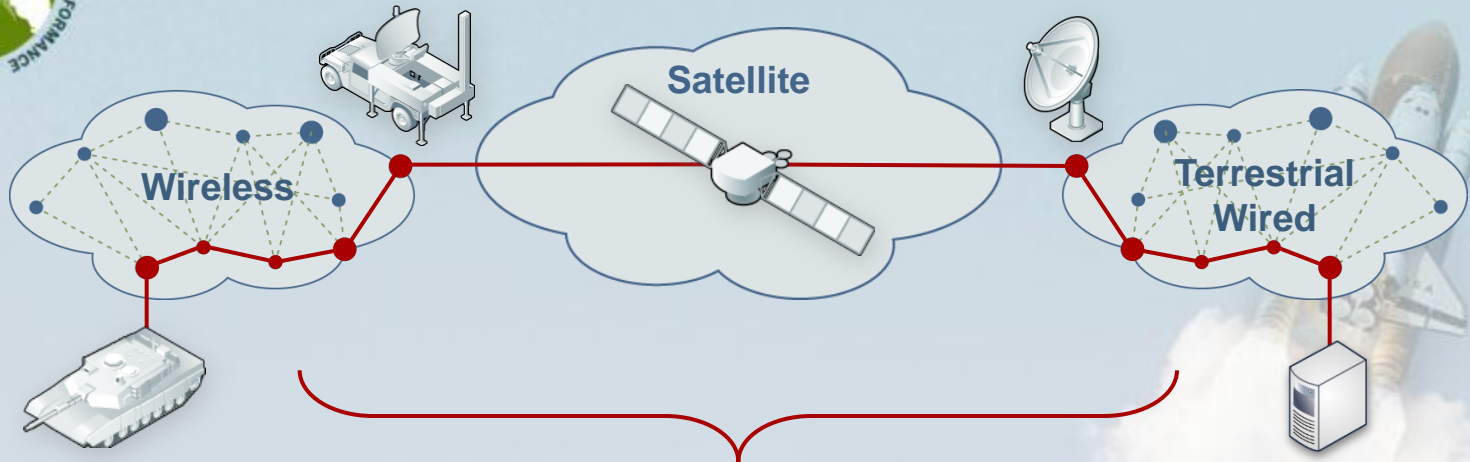
GIG Tech Design Issues

GIG Interoperability Requirements

Performance Evaluation Tool Components

Network Representation

Component	Type	Minimum (msec)	Mean (msec)	Std dev (msec)	Loss	Availability
COTM	Node	14	14	0	0.0%	99.0%
Wireless	Network	20	400	300	0.8%	98.0%
POP	Interconnect	60	60	0	0.1%	99.7%
Satellite	Network	538	1012	558	1.0%	99.9%
Teleport	Interconnect	60	60	0	0.1%	99.9%
Terrestrial	Network	20	50	20	0.1%	99.99%
Fixed	Node	3	3	0		99.9%
Total		715	1599	634	2.1%	96.4%

DAMA SATCOM Network Using IP Modems
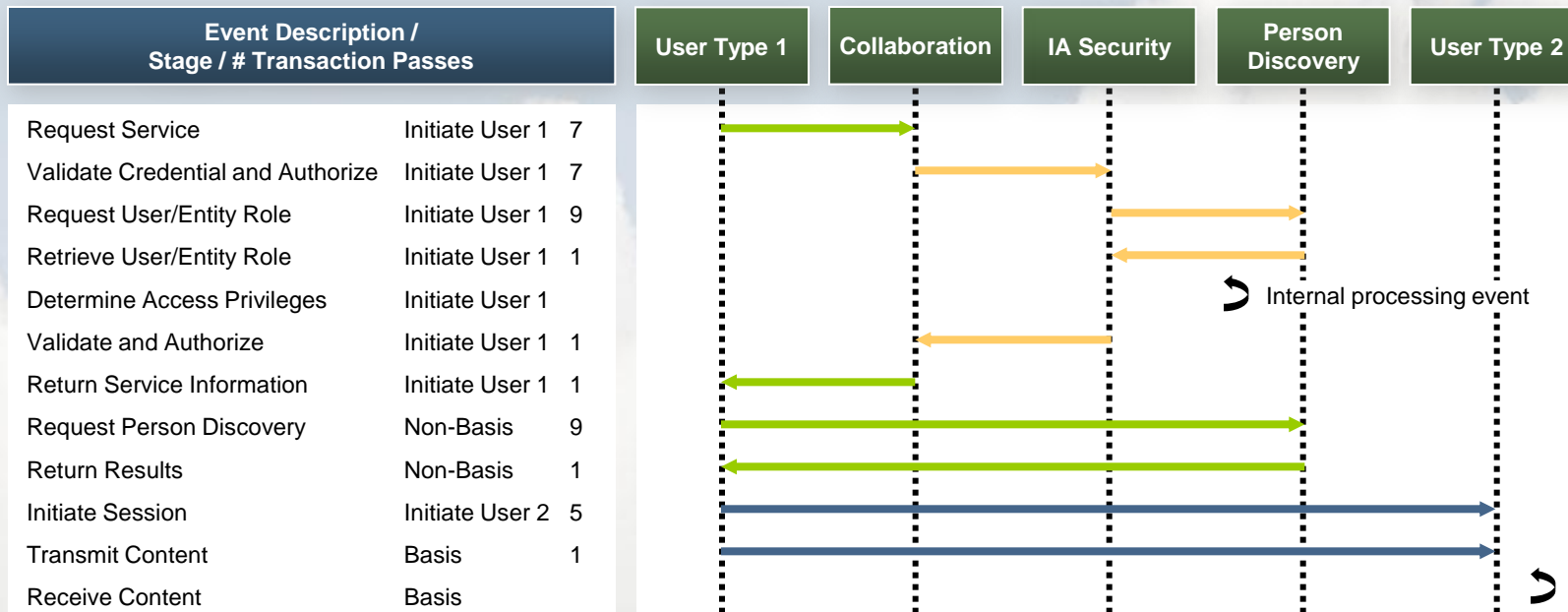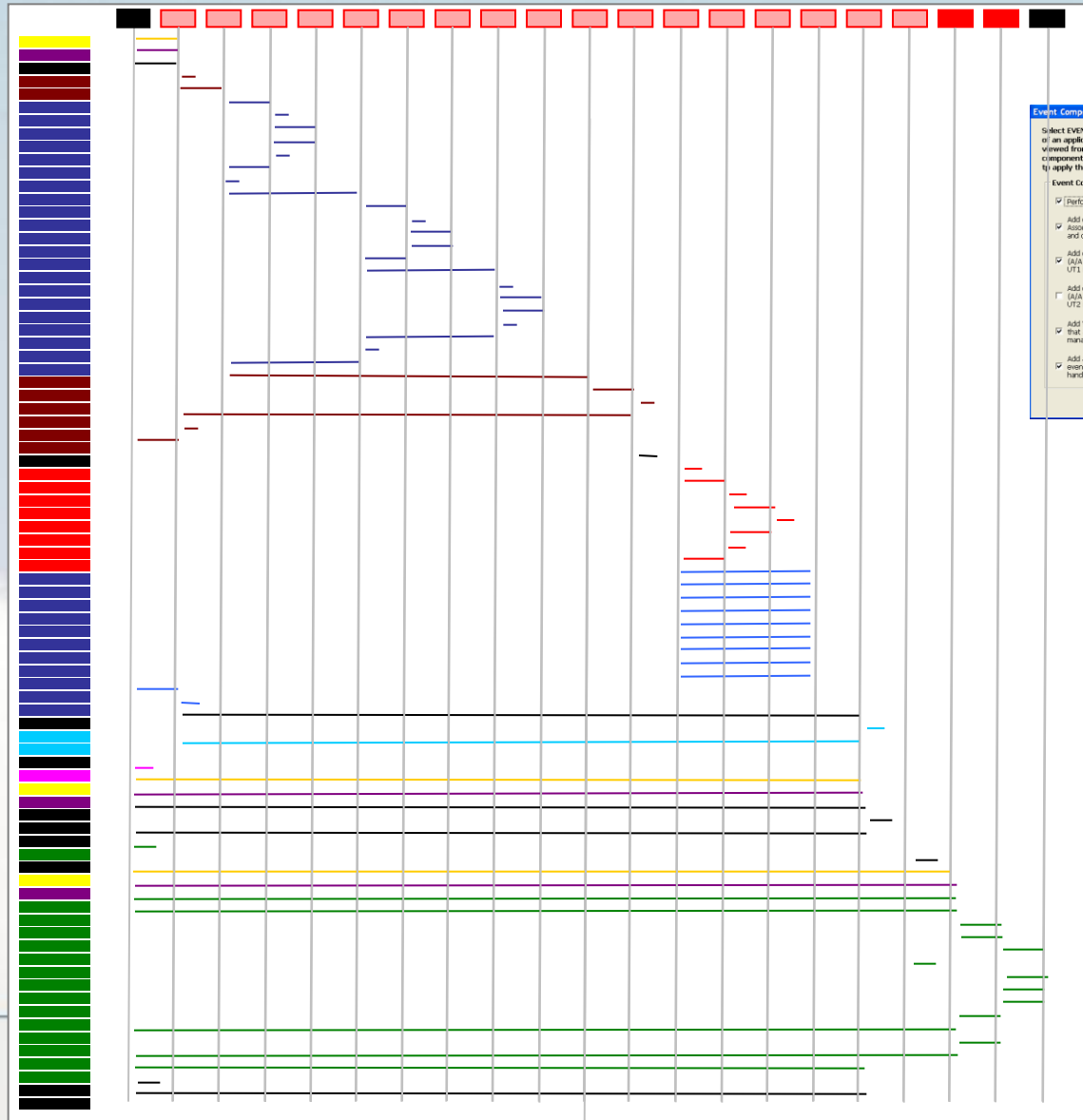
Application & Service Representation

- **Service or application decomposed into a series of building blocks**
  - DNS, HAIPE discovery, IA, Web Service, SIP, etc.

- **Each building block is decomposed in message or processing events**
  - Defined CoS, Size, client/server, process delay, etc.
  - Events can be serial or parallel

- **E2E response time is computed for each event**
  - Total E2E response time determined for service or application

Event Description / Stage / # Transaction Passes			User Type 1	Collaboration	IA Security	Person Discovery	User Type 2
Request Service	Initiate User 1	7					
Validate Credential and Authorize	Initiate User 1	7					
Request User/Entity Role	Initiate User 1	9					
Retrieve User/Entity Role	Initiate User 1	1					
Determine Access Privileges	Initiate User 1						
Validate and Authorize	Initiate User 1	1					
Return Service Information	Initiate User 1	1					
Request Person Discovery	Non-Basis	9					
Return Results	Non-Basis	1					
Initiate Session	Initiate User 2	5					
Transmit Content	Basis	1					
Receive Content	Basis						

Internal processing event

PET Incorporates a Wide Range of Messaging Components

Message Menu

Message Type

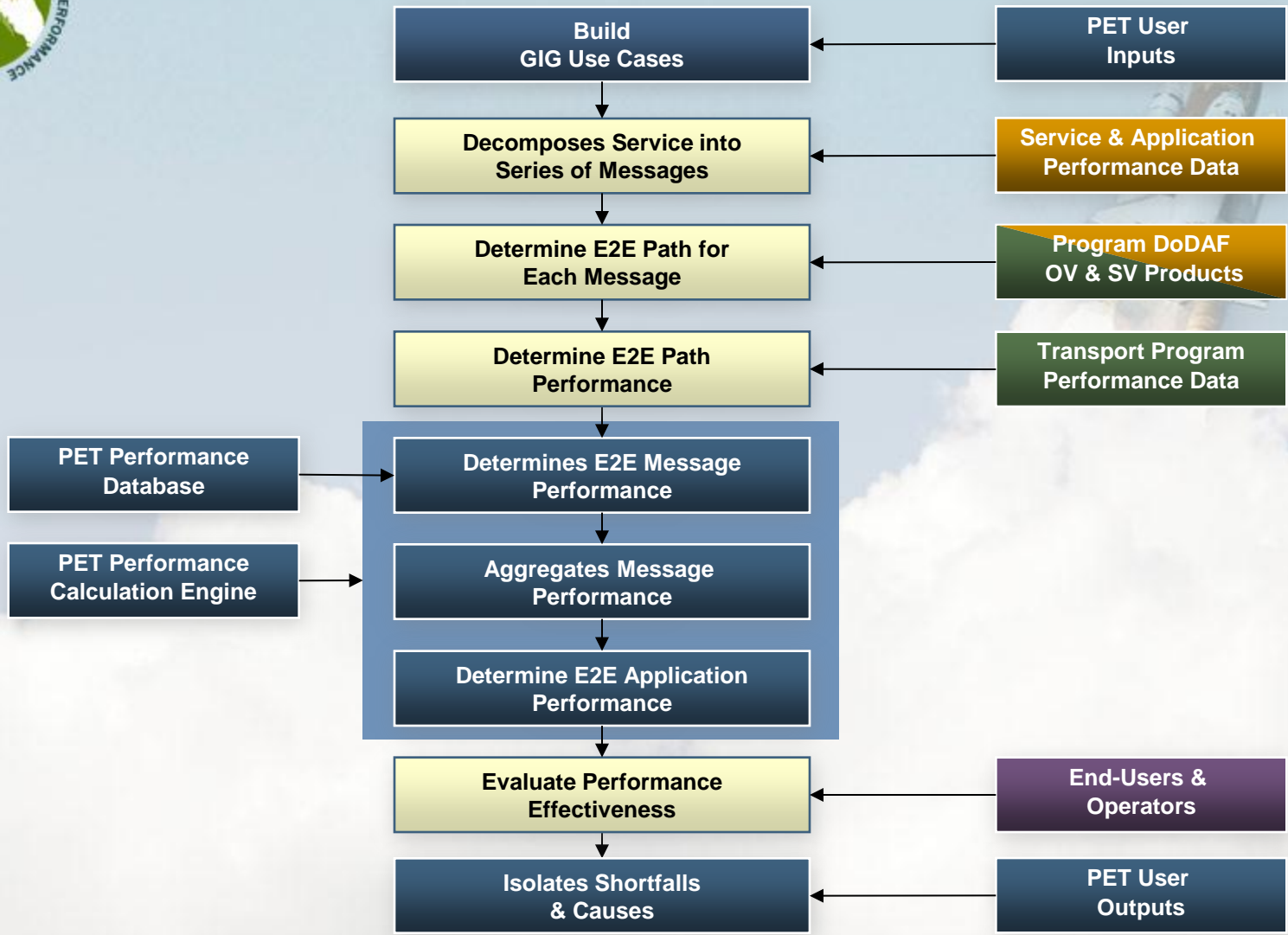| Core |
|------|
| DNS |
| TCP |
| TLS |
| WSI |
| AA |
| HAIPE |
| SA |
| SIP |

PET Tool Overview

- **PET is an EXCEL-based Model**
  - Requires EXCEL 10.0 or later - No new software to install
  - Download PET updates from password protected web-site
  - V3.2 released on September 21, 2007

- **PET Unique Input Interfaces**
  - Interactive GUI for Use Case specification
  - Repository for service, transport, C&I performance data
  - Database of packet simulation performance runs
  - Menus to add/subtract any GIG component

- **PET Outputs**
  - Use-Case based performance evaluation
  - E2E response time and service availability
  - Performance compared to predefined thresholds
  - Drill down (to message/packet level) for problem isolation

- **Real-time interaction for parametric performance analysis**
  - Single use case – seconds
  - All applications (one user) or All users (one application) – 5 minutes
  - All 10,000 use cases – 30 minutes

PET Data Sources

```
PET User
Inputs
        →  Build
           GIG Use Cases
                              ↓
Service & Application
Performance Data
        →  Decomposes Service into
           Series of Messages
                              ↓
Program DoDAF
OV & SV Products
        →  Determine E2E Path for
           Each Message
                              ↓
Transport Program
Performance Data
        →  Determine E2E Path
           Performance
                              ↓
PET Performance
Database
        →  Determines E2E Message
           Performance
                              ↓
PET Performance
Calculation Engine
        →  Aggregates Message
           Performance
                              ↓
           Determine E2E Application
           Performance
                              ↓
End-Users &
Operators
        →  Evaluate Performance
           Effectiveness
                              ↓
PET User
Outputs
        →  Isolates Shortfalls
           & Causes
```

PET Menu Driven GIG Analysis Options

Allows user to select appropriate menu for task

Show All Menus Option

PET Provides Flexible GIG Analysis

Range of Operational, Performance & Protocol Settings

Portfolio Manager Enables Easy E2E Network Selections

Flexible Use-Case Builder for 1 or 10,000 GIG Use Cases

Multiple Service Architectures Options

Flexible Service to Service Connectivity

Pathfinder GIG Programs provided the initial data behind PET

Component	Wireless	SATCOM	Terrestrial	Interconnects	Services	End-Users Req.
Pathfinder	JTRS SRW	TSAT	GIG-BE	Teleport	NCES	JIC
	JTRS WNW			Gateway		Program SoS

Component	Wireless	SATCOM	Terrestrial	Interconnects	Services	End-Users Req.
Legacy		TDMA/FDMA	Leased PTP		Legacy	ITU
		Mobile	NIPR/SIPR			
		IP DAMA				

Requirements Based	M&S Based	Standard Model	Monitoring Based	Place Holder

As more and more programs provide their data, PET results become even more accurate

SATCOM Network Validations

Transponded IP Modem Architecture

500 KB Message at 67% Load

Legend:
- COTP-E2E (red dashed)
- COTP-Cloud (red solid)
- COTM-E2E (blue dashed)
- COTM-Cloud (blue solid)

Y-axis: E2E Message Transfer Time (sec), from 0 to 180

X-axis: Percentile, from 0% to 100%

Based on E2E OPNET Simulations
Includes DAMA and DCM protocols
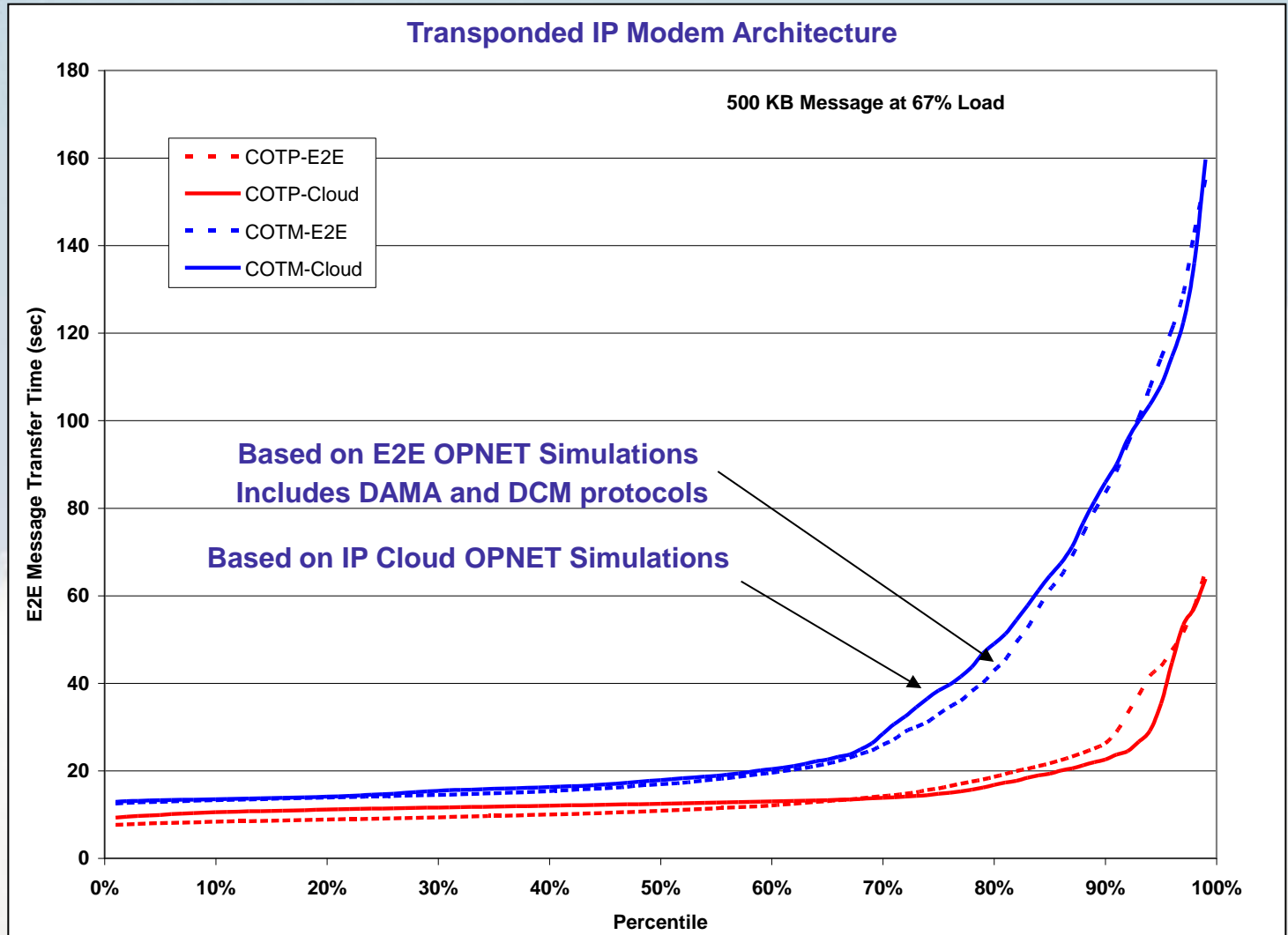
Based on IP Cloud OPNET Simulations

Wireless Network Validations

100 Node Wireless Network

50 KB Files

IP Cloud Model
I-E2E Model

Correlated delay assumption tends to overestimate tail performance

Y-axis: E2E Message Transfer Delay (Sec)
X-axis: Percentile
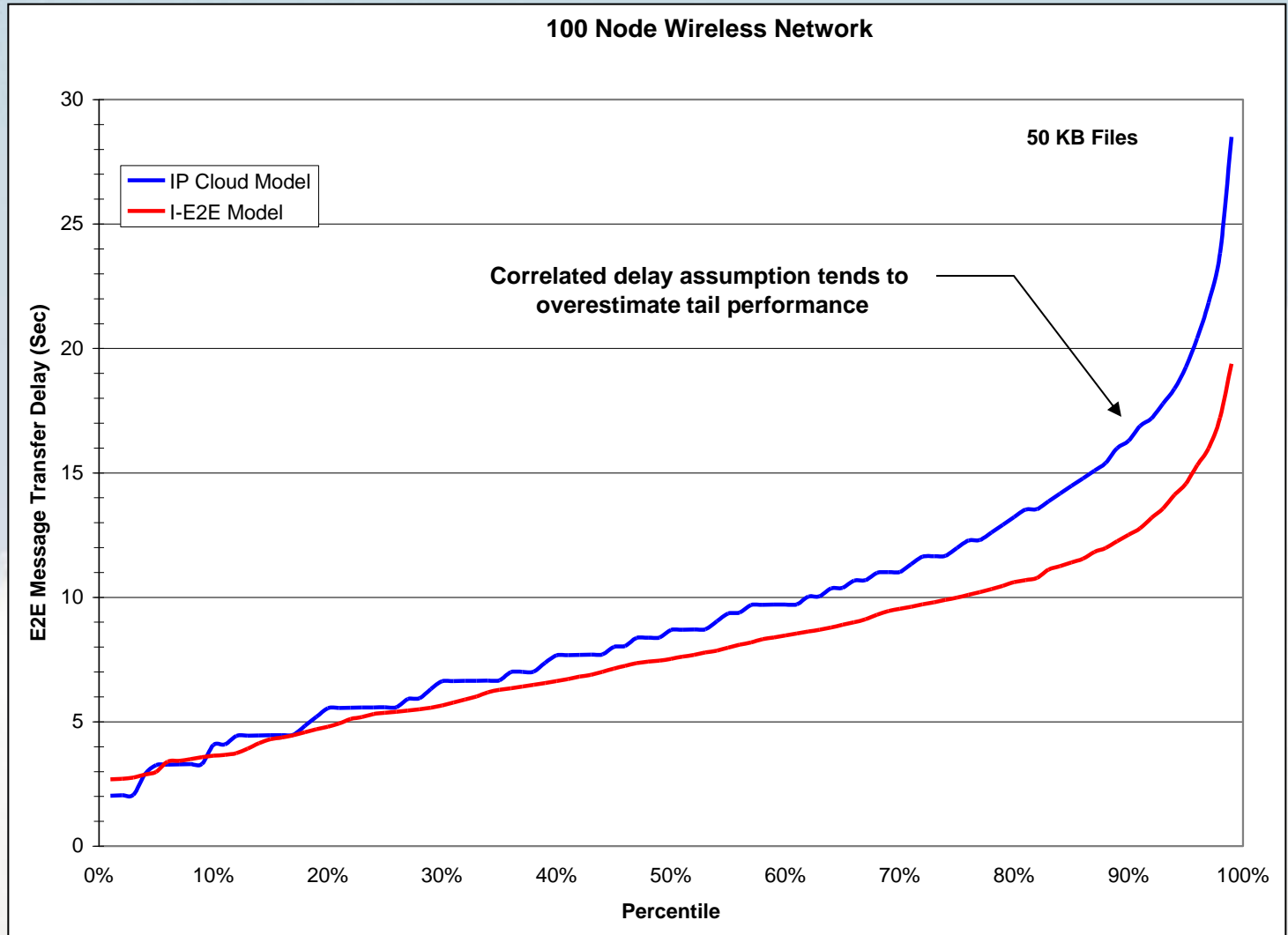
PET Developed to Identify Wide Range of GIG Performance

All 2.048 Mbps Links
90th Percentile Message Transfer Time

Delay (msec)	Packet Loss						
	0.0%	0.1%	0.2%	0.4%	0.8%	1.6%	3.2%
100	11.5	10.4	10.4	10.7	13.6	19.7	35.8
200	11.2	12.5	13.9	15.8	19.9	29.5	48.5
400	15.8	18.1	21.6	27.0	35.9	51.3	80.9
800	26.8	32.8	38.1	52.3	71.8	97.6	144
1600	51.7	62.1	75.6	100	136	184	271
3200	98.2	123	148	193	258	354	532

Legend: 0-50 | 50-100 | 100+
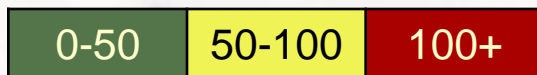
50:1 Performance Difference for an E1 Links

Summary

- **NII has developed E2E GIG performance model that**
  - Allows GIG segment developers to assess E2E impacts of segment design decisions
  - Allows GIG operators to assess impacts of architecture and component decisions
  - Allows end-users to evaluate E2E performance relative to warfighter needs

- **GIG Performance Model and Framework are**
  - Fast and Accurate
  - Comprehensive (legacy & next generation)
  - Designed for system engineer not modeling expert
  - Available to GIG developer, user and operator communities

- **NII is initiating a Pilot effort in FY08 to expand networks, applications, services and architectures included in PET and PAF**