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IP Telephony Gotchas:
From Despair to Repair to Prepare

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INTEROP®
LAS VEGAS | APRIL 30–MAY 5, 2006

The Quality Perspective

- Quality encompasses most of the "-ities"
  - Reliability
  - Usability
  - Manageability
  - Scalability
  - Supportability
  - Security
  - Availability
  - Performance
  - Extensibility
  - Maintainability
- These are attributes of a system; they do nothing by themselves
- Best built in from the start; testing is crucial

Common Pitfalls and Issues during IP Telephony Deployment

- Lack of organizational readiness
  - Need for Infrastructure and Application responsibilities
- VoIP is “just another application on the network”
  - Provide staff cross training and tools
- Expecting telephony-grade support
  - Plan to test and system management
- Depending on single-shot network assessment
  - Test with actual VoIP traffic to detect misconfigurations
- Focus on infrastructure only, not applications
  - Focus on Packet-Level, Call-Level, Application-Level testing
- Lack of lifecycle view
  - View deployment as set of concrete phases

VoIP Quality in General – still a moving target

Main Quality Focus Areas for VoIP today

⇒**Ensuring security**

⇒**Ensuring voice quality**

⇒ **Ensuring that new applications perform smoothly on VoIP infrastructure.**

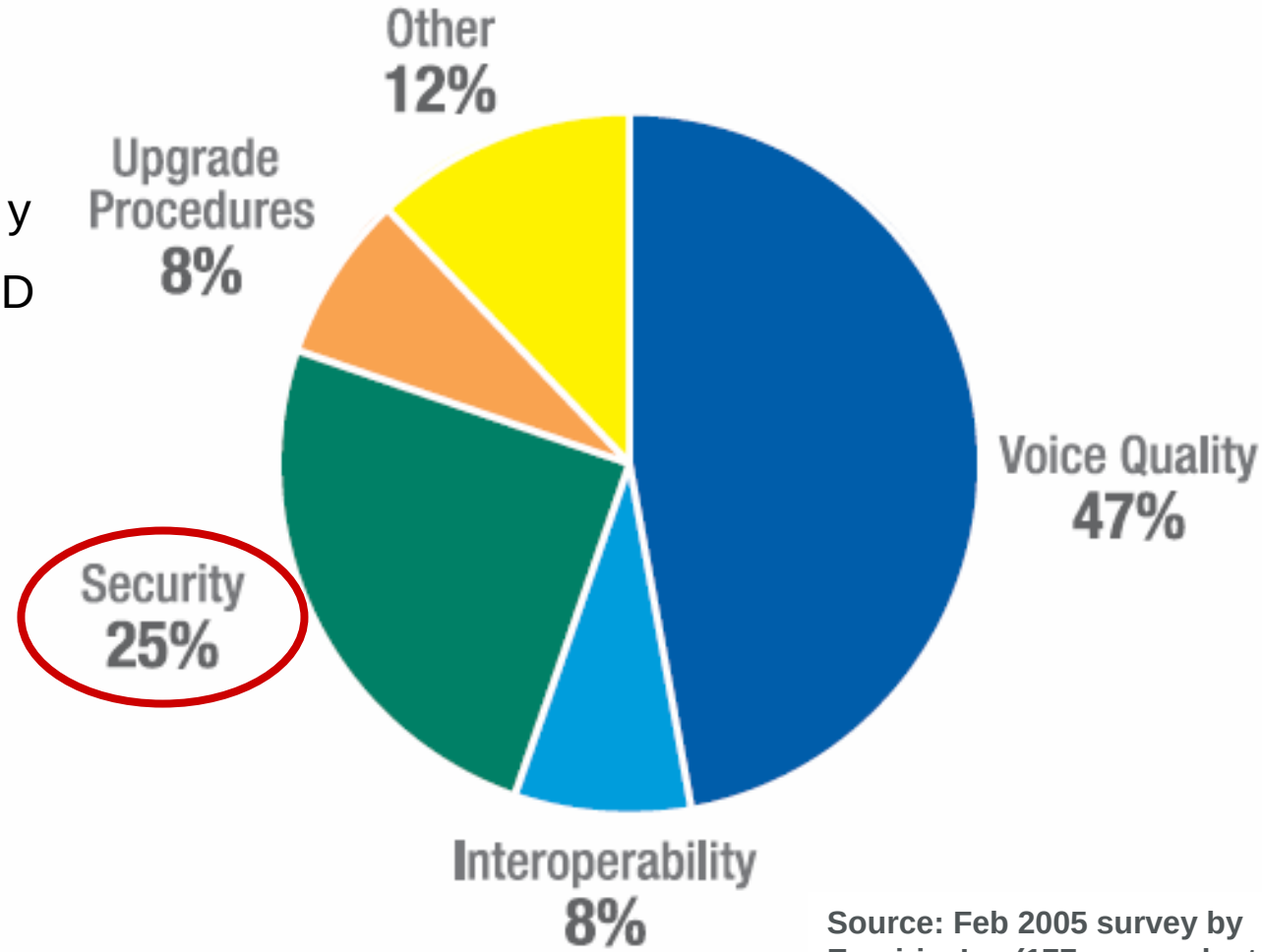
A Disruptive Hack

- A farm equipment manufacturer was accustomed to leaving “live” RJ45 plugs in empty cubicles for hoteling -- to make user mobility and provisioning simpler – until an internal hacker used one of them to disable the company’s IP PBX.

- Moral: Safeguard your IP Telephony system at all levels. Don’t cut corners on implementation, network monitoring or written documentation. If you decide to keep live jacks, determine how quickly you can respond to and isolate the additional causes of trouble that they may bring (along with their convenience). If you use crossover cables, make sure they are color-coded and readily identifiable.

Top Quality Concerns about VoIP Implementations

- Security concerns growing rapidly
- Significant FUD
- Lack of awareness of VoIP threats/ vulnerabilities

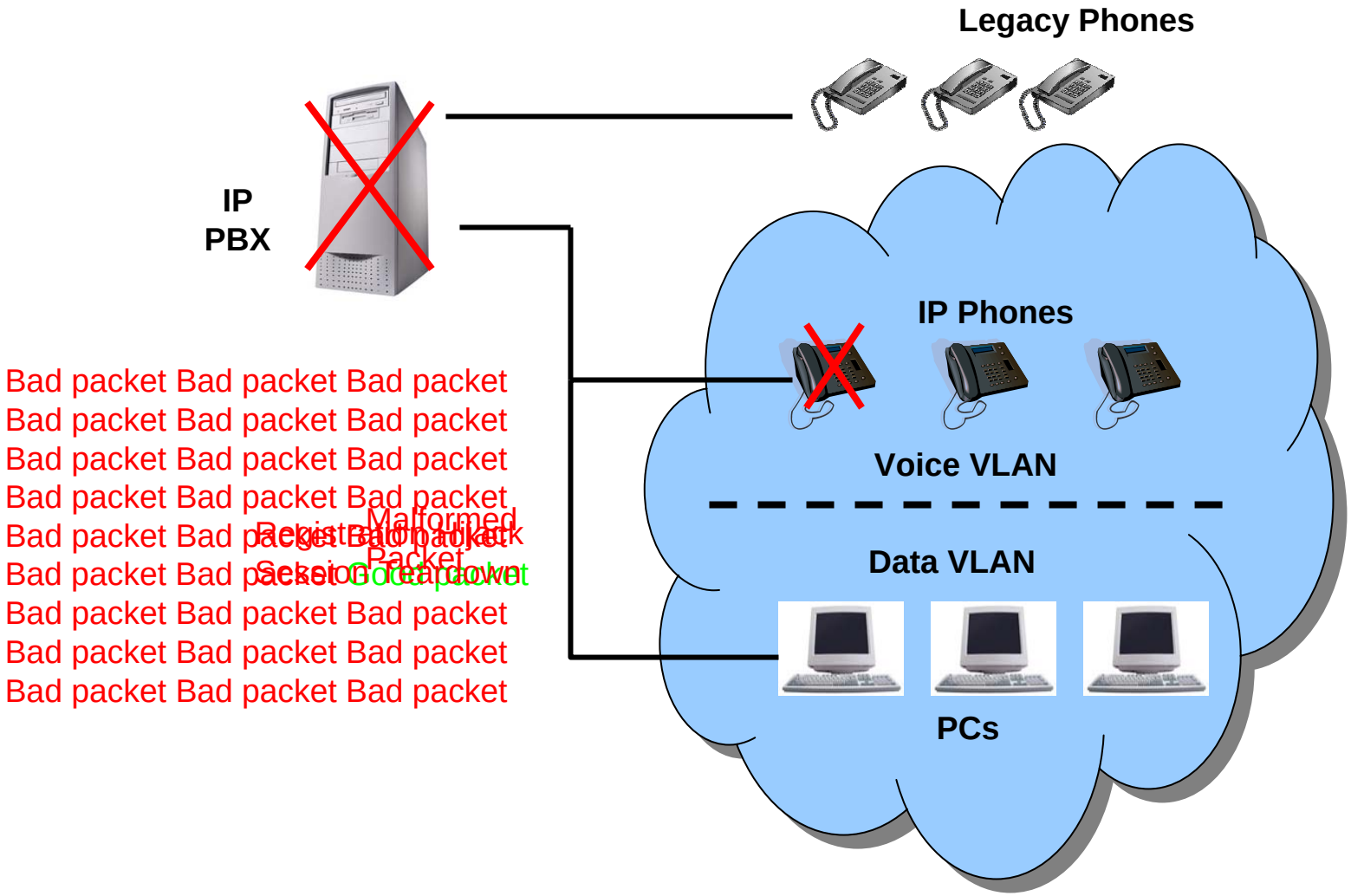


Source: Feb 2005 survey by Empirix, Inc (177 respondents)

Evolving threats

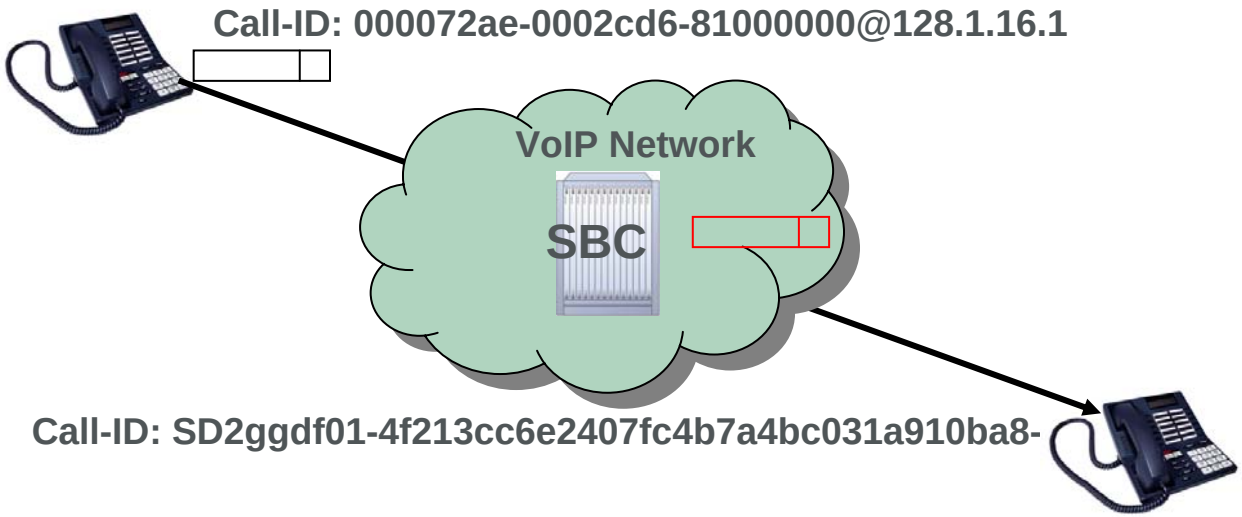
- Denial of Service (DoS)
  - Primarily target signaling
  - Malformed messages, floods, application attacks
- SPAM over Internet Telephony (SPIT)
  - Unsolicited voice calls
  - Real-time and Voice Mail
- Access to public VoIP
  - “Open” connection to IP-PBX
- Peer-to-Peer (P2P) VoIP
  - Can be “supernode” without consent
  - Tunnel through firewalls
  - No central control

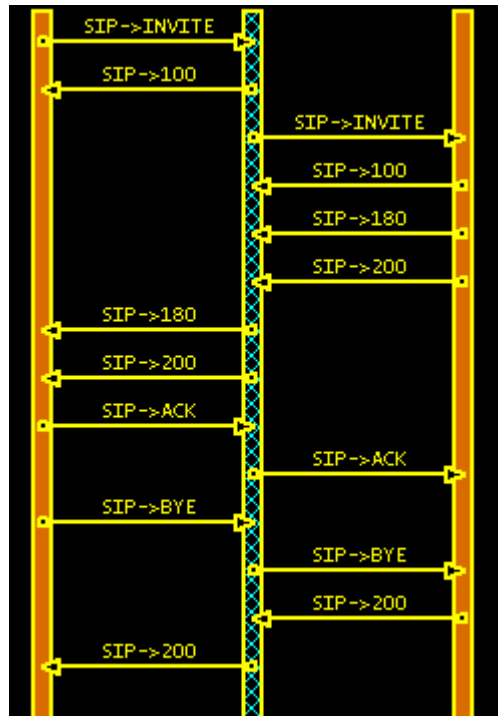
How VoIP DOS attacks work



Troubleshooting

- **Tracking calls across SBCs, ALGs, and Firewalls is important**
  - **Call ID changes across boundaries, where many problems occur**
- **Inspection can identify some security issues**
  - **cleartext passed when not intended**
- **Interoperability issues show up in protocol exchange**





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Coping with Congestion

- A major retailer deployed VoIP at one of its main outlets as the first part of a substantial multi-site rollout. During the planning phase, the project team had underestimated the amount of traffic that would traverse the network. When they hit major issues with network congestion, the team had to redesign and upgrade the network mid-stream.
- This unplanned effort incurred substantial unanticipated costs and caused a flood of complaints from both voice and data users over a four-month period.
- **Moral: Confirm capacity planning assumptions with live testing. A load test should exercise all elements to planned peak capacity and beyond.**

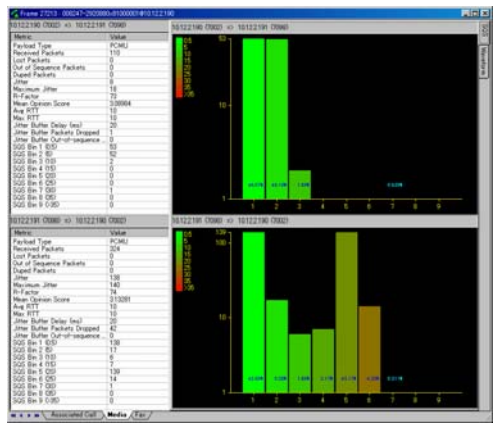
Still a critical need for enterprises

- Look at all the metrics of RTP exactly as transmitted on the network
- Understand the end user's experience
- Become proactive about problem prevention

Metric	Value
Payload Type	PCMU
Received Packets	324
Lost Packets	0
Out of Sequence Packets	0
Duped Packets	0
Jitter	138
Maximum Jitter	140
R-Factor	74
Mean Opinion Score	3.13281
Avg RTT	10
Max RTT	10
Jitter Buffer Delay (ms)	20
Jitter Buffer Packets Dropped	42
Jitter Buffer Out-of-sequence ...	0
SQS Bin 1 (0.5)	138
SQS Bin 2 (5)	17
SQS Bin 3 (10)	6
SQS Bin 4 (15)	7
SQS Bin 5 (20)	139
SQS Bin 6 (25)	14
SQS Bin 7 (30)	1
SQS Bin 8 (35)	0

- Packet Loss ?
- Jitter?
- Delay ?
- Voice Quality?

MOS and R-Factor



Jitter distribution graph

Measurement is critical for problem resolution

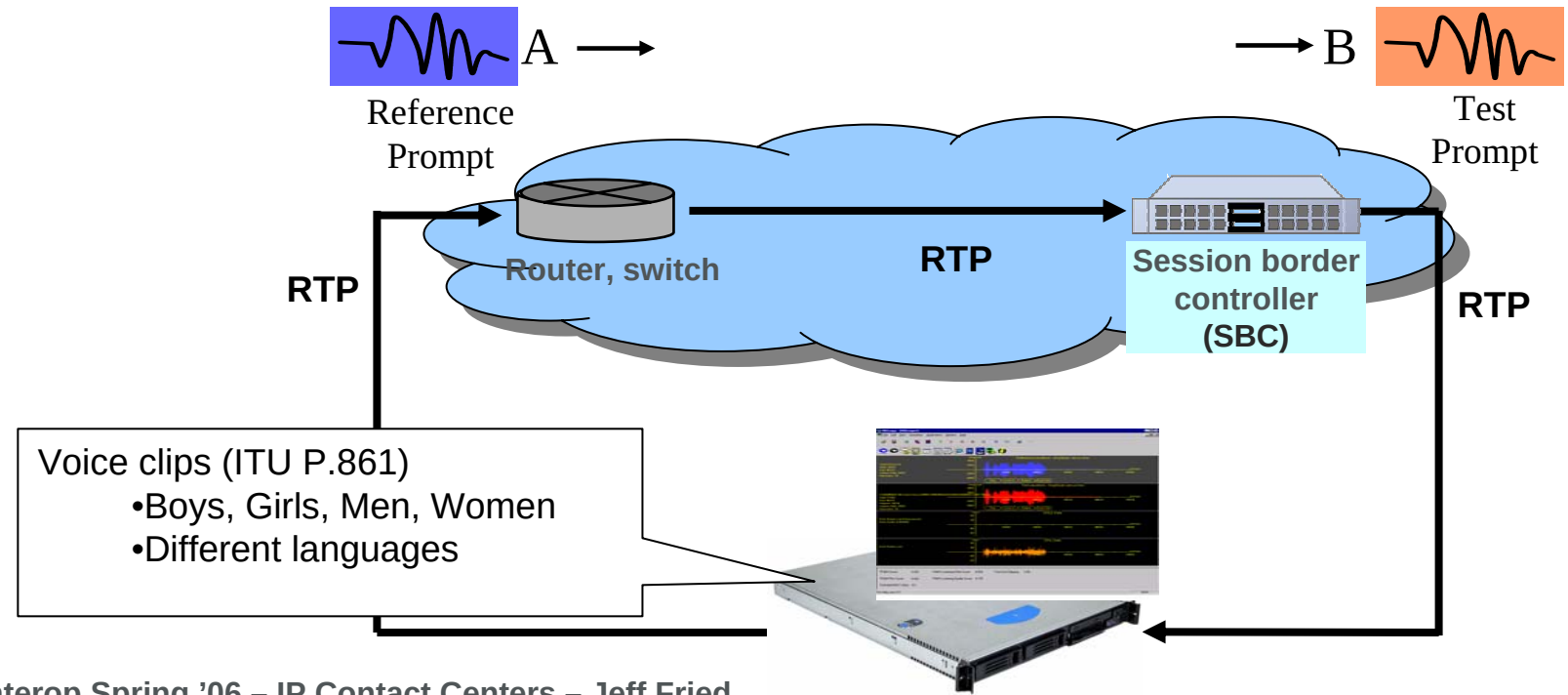
Devices that can affect a User's "VoIP Experience"

- IP PBXs
- IP Phones
  & VoIP endpoints
- Media Gateways
- IVR / Voice portals

- SBCs (Border Controllers)
- Media Servers
- Firewalls/ALGs
- Messaging Servers
- Conference Bridges

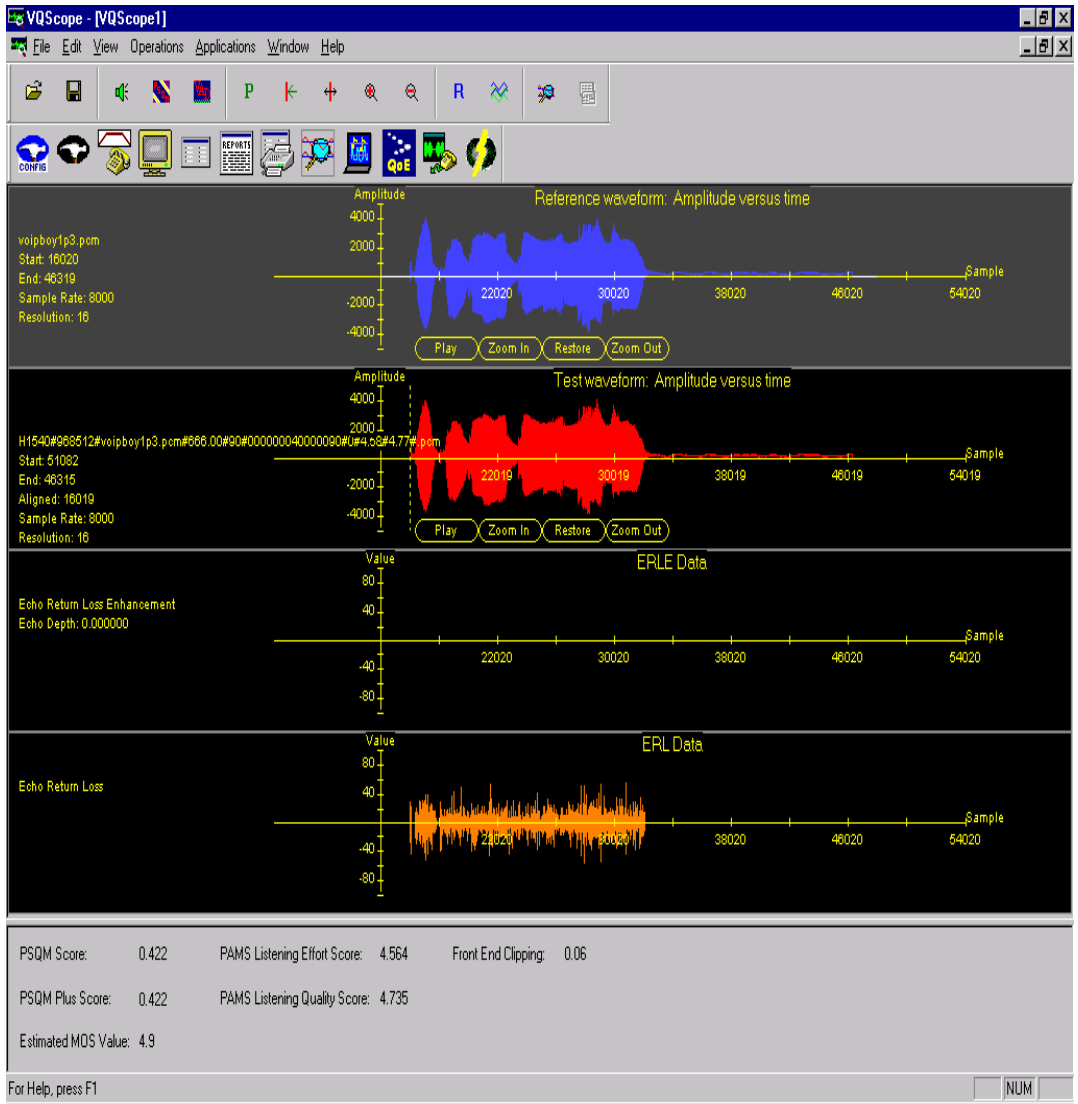
QoS Testing – Network readiness/benchmark
Voice Quality Measurement

- See contents of voice packets (RTP payload).
- Play reference voice clip → Traverse Network → Record clip
- Compare played and recorded clips, and measure impairment
  - Reassemble voice packets and compare hearable waveforms
  - Emulated Jitter buffer loss to allow “what-if” settings
- Loop-back driver enables loop-back test with one chassis
- Remotely installed multiple chassis can be integrated



Optimizing Real World VQ Performance

- Perform in-depth degradation analysis by comparing prompt sent to prompt received
- Zoom in on portion of prompt for more detailed analysis
- Overlay test and reference prompts for simple visual comparison
- Re-score prompts following manual realignment
- Reports front-end clipping and echo measurements



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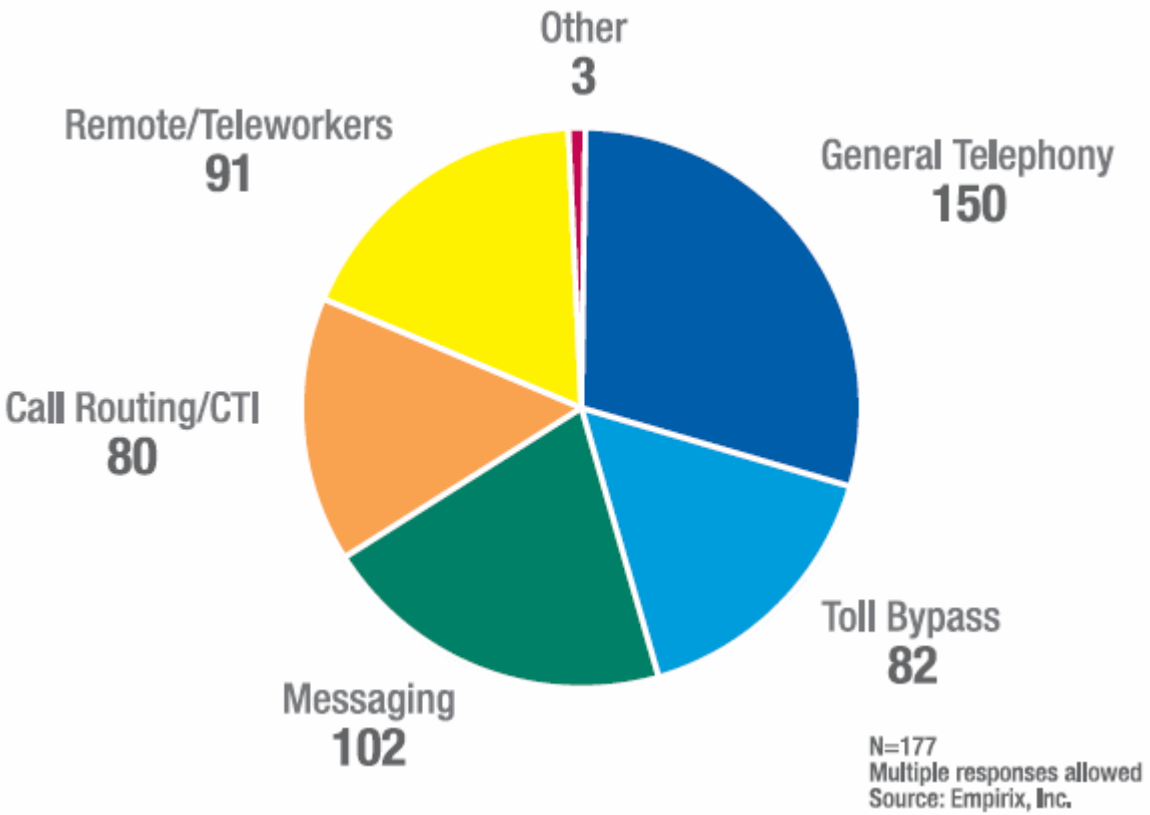
Cleaning Up a Big Mess

- A major consumer product company deployed 1,000 endpoints over an 18-month time period
  - Discovered midstream the need to upgrade the network
  - Sporadic phone reboot issues traced to firewall issues – took a month to isolate
  - Adding a 24x7 call center put pressure on upgrades/fixes – no maintenance windows
  - Left with an “internal PR” nightmare

- Morals: Prepare thoroughly for network issues, troubleshooting and patching. Communicate with business units to avoid surprise changes. Get the network ready, and have the proper tools and processes in place early on, ideally during pre-deployment and pilot phases.

Applications are Driving VoIP Deployments



Top VoIP Applications cited:

- Voice Mail/Unified Messaging
- Remote/Teleworkers
- Call Routing/CTI
- Conferencing
- Call handling/forwarding
- Integrated Contact center application
- Call log
- Directory lookup
- Find me/follow me
- Meeting scheduler
- Customer service alerts
- Video conferencing
- Emergency lookup
- Personal calendar
- Instant messaging

Are IP Contact Centers driven by New Applications?

SAME OLD applications, made more practical and more real:

- Routing
- Reporting
- Dialing
- Recording/Logging
- Disaster Recovery
- IVR & Speech
- CTI
- CRM
- Remote Agent
- Click-to-talk
- Tapping non-agents
- Multi-channel
- Unified Messaging
- Collaboration with callers
- Video
- Wireless Agents
- Presence / IM / personal rules
- . . . . .

Actually new:

- Presence from callers
- "Situational" Logging
- Location ("breadcrumbs and geofences")

Dramatically changed

- Multi-site contact centers
- Outsourcing, Homesourcing

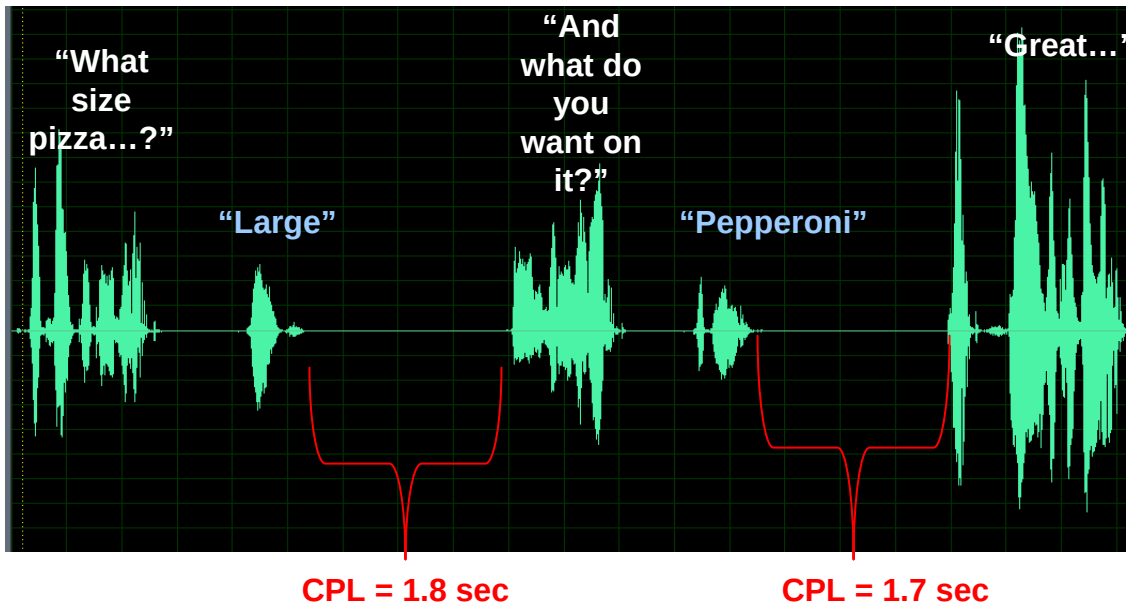
- Costs and Complexity

Common application test areas

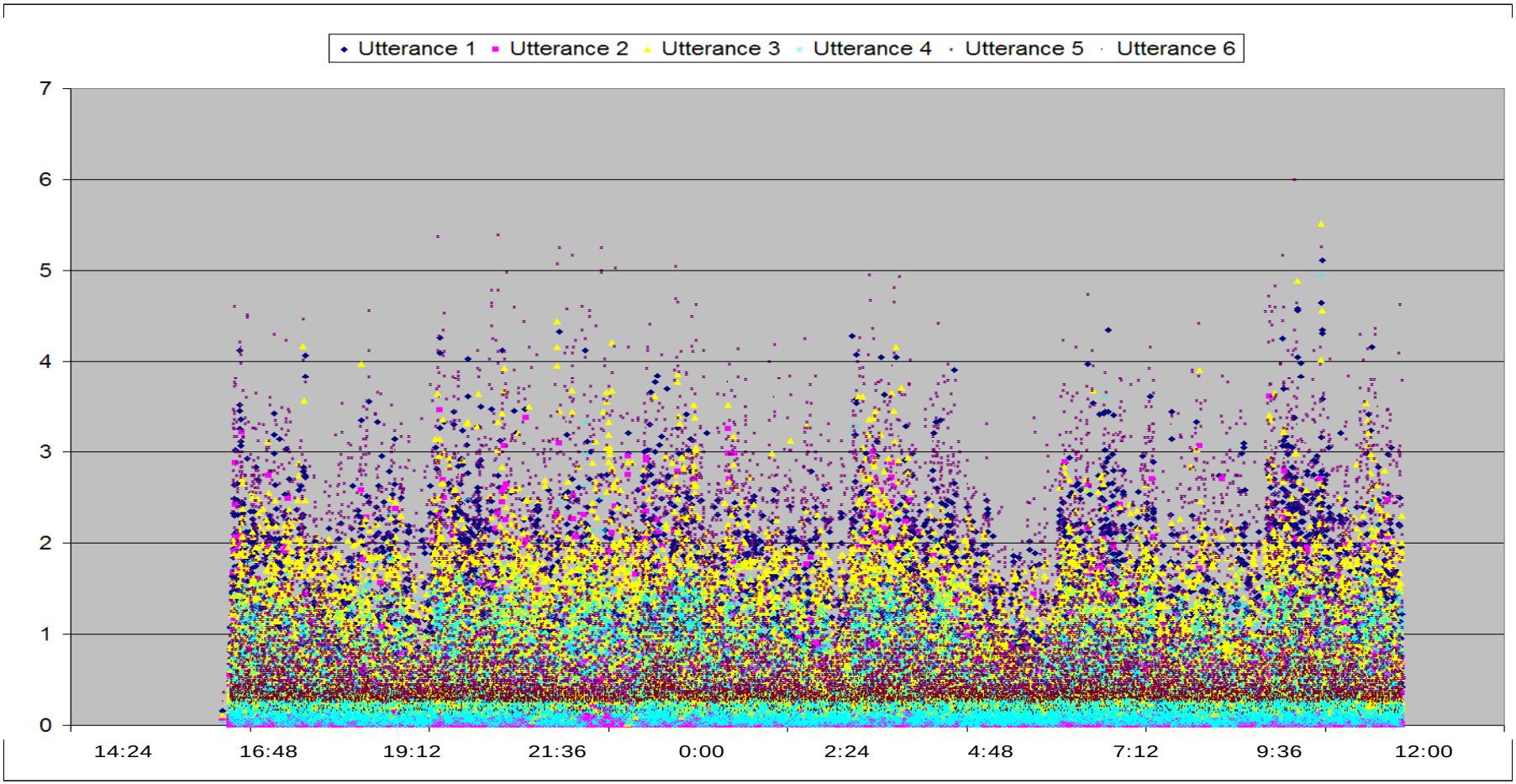
- Signaling latency (speed of dial tone, speed of call transfer, etc.),
- Reliability of application information delivery (screen pops, information elements used for routing, etc.),
- Application performance (IVR responsiveness, Application performance under load, etc.)
- Impact of VoIP on applications (speech recognition accuracy with packet loss, conference bridge loudest-speaker detection, etc.)
- All-paths testing (correct configuration of all forwarding, hunting, routing, voice mail and messaging configuration, etc.)

An Important Metric: Customer Perceived Latency (CPL)

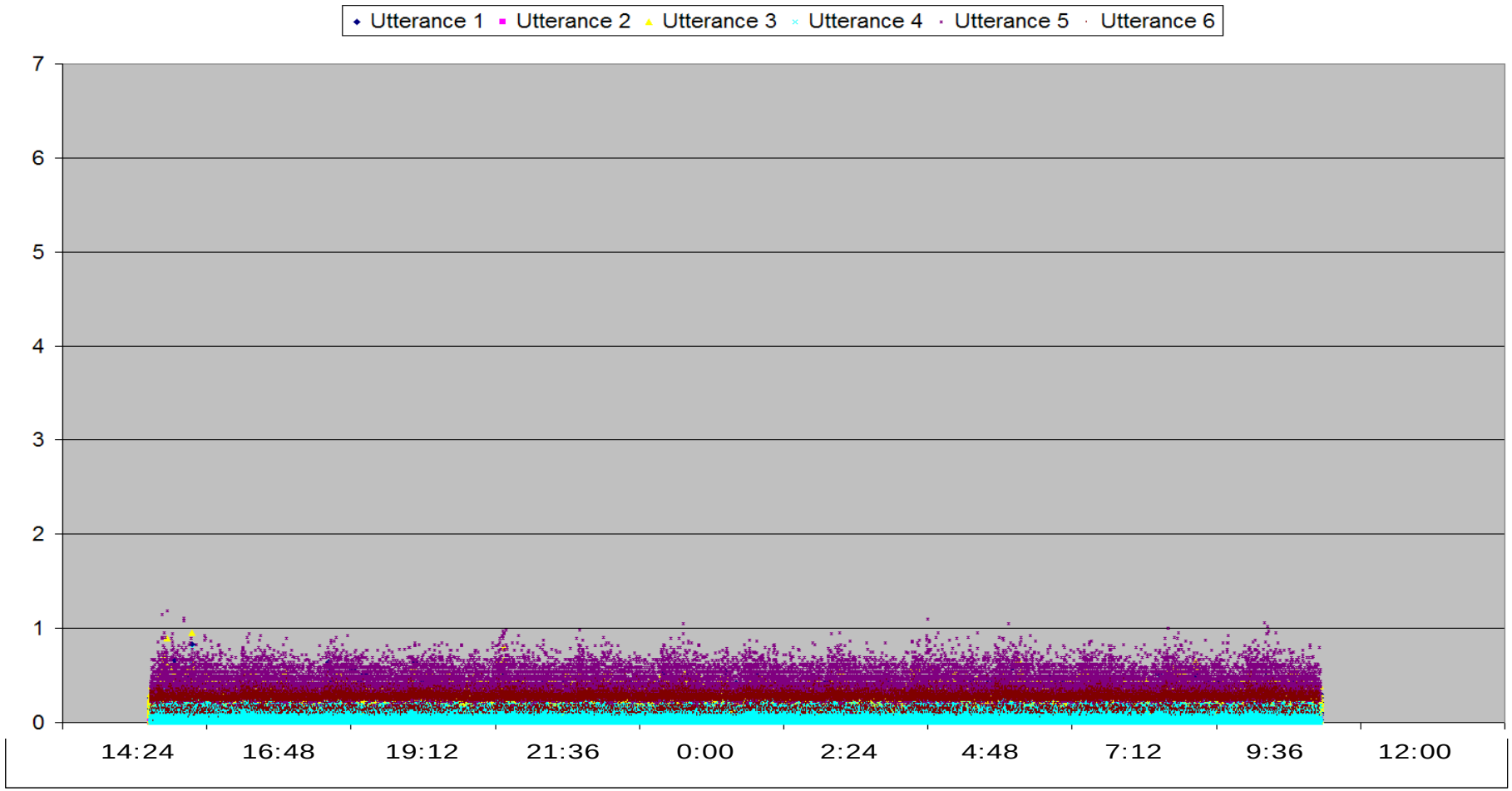
- the length of time between the end of a caller's input and the successful response from the system, *as perceived by the caller*
- a crucial element of usability and the customer experience that is *directly tied to application performance*



IP-IVR "Before" – intermittent BIG delays under load



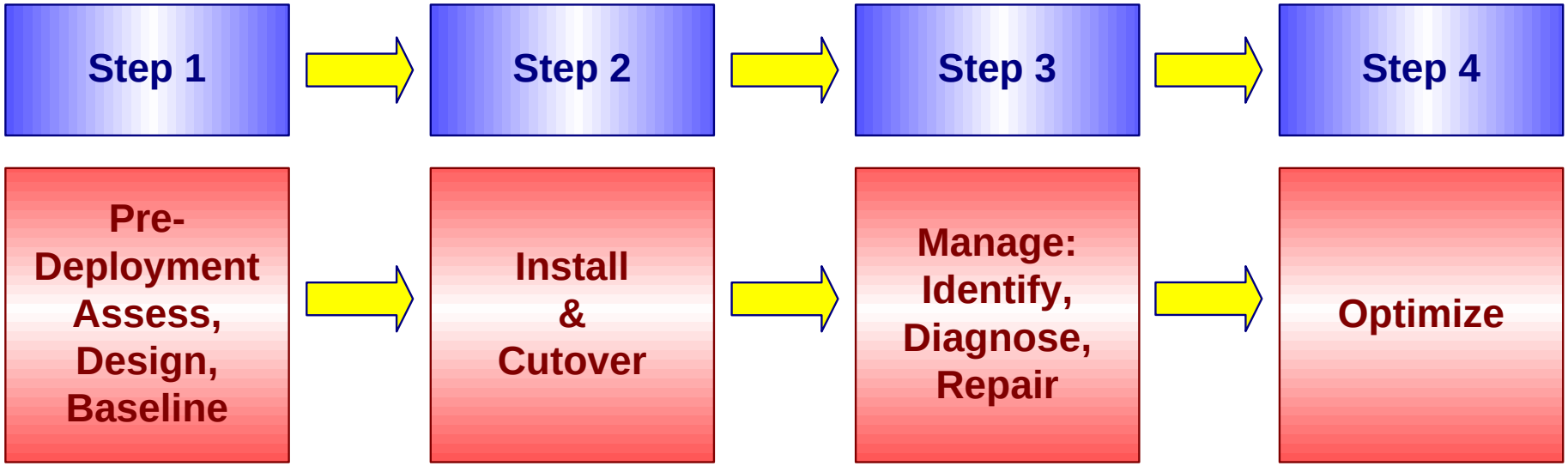
“After” – speedy performance – just by rearranging processes



Preparing for IP Contact Center Deployment

- Train someone on your staff about IP contact center technologies. If possible, establish a lab for evaluation, benchmarking, troubleshooting, and training. Equip it with representative versions of your deployment configuration, and with good testing and troubleshooting tools.
- Review options for system management. Try to roll out system management tools and processes that work throughout your migration process.
- If you haven't done so, establish an overall direction for your contact center, including technology direction, and then define priorities and timeframes for completion. It is not necessary to build a business case for new technologies up front, but it is important to do so as you near the timeframe for adoption.
- If you think that work-at-home or remote agents are in your future, start a pilot now. Identify a top-notch employee with an interest in telecommuting and initiate the arrangement.
- Look over business continuity plans for your contact center. If you don't have a plan in place, you should, and IP contact centers can provide a powerful way to insure yourself against disasters.

VoIP Requires a Lifecycle Approach



- Lack of a proper lifecycle will:
  - Drive Costs Up
  - Reduce VoIP Reliability / Availability
  - Risk Complete Failure of Deployment

Summary

- IP Telephony CAN work

- Many quality implications
  - Positives: business continuity, centralized management, ….
  - Negatives: VoIP challenges, emerging technology & standards, more moving pieces
- Does not change many of the challenges for running telephony applications
  - Provides many more options, and makes managing the technology more important
- Prepare to avoid Despair

Empirix Focus

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