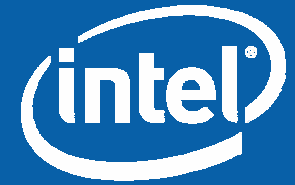


Win with Technology Leadership. Leap Ahead



# Introducing Touchstone® 2

Michael Mirmak  
Intel Corp.  
Chair, EIA IBIS Open Forum

July 13, 2006

# Introducing Touchstone® 2

What is it?

- A revision to Touchstone®, the standard that describes frequency-dependent network data (S-, Z-, etc. parameters)

Why is it needed?

- The original Touchstone® is ambiguous in several areas
  - Maximum number of ports
  - Definition of “line” and organization of network data
- The original specification did not easily support some applications
  - e.g., network data describing both power planes and signal lines
  - A large reference impedance may introduce numerical errors when applied to the smaller impedances seen in plane measurements

The changes make the format easier to use and to integrate with ICM (plus its updates)

# Touchstone® 2 Key Concepts

## Major Changes from Touchstone®

- Added optional per-port reference impedances
- Added explicit expression for number of ports in the file
- Added explicit version control

```
[Version] 2.0
```

```
# GHz S MA R 50
```

```
[Number of Ports] 4
```

```
[Reference] 50 75 0.01 0.01
```

```
5.00000 0.60 161.24 0.40 -42.20 0.42 -66.58 0.53
```

- Removed any limit on the maximum number of ports described
- Removed normalization for non-S-parameter data sets

Original Touchstone® files are supported  
as-written under Touchstone® 2

# Touchstone® 2 Key Concepts

## What Was NOT Included

- No support for mixed-mode  $S$ ,  $Y$ ,  $Z$ , etc. parameter expressions
  - Differential systems can be easily described with single-ended data
- No support for complex reference impedances
- No support for frequency-dependent reference impedances
  - Most systems can still be mathematically treated to use frequency-independent, real-only references
  - Most simulators use real-only references consistently, but may differ on interpretation of complex impedances

These features are available for inclusion in a Touchstone® 3, if needed

# Touchstone® Major Feature Summary

Feature	Touchstone®	Touchstone® 2
Reference impedances	One impedance for all ports	Either one impedance or per-port impedances may be used
Normalization	G-, H-, Y-, Z- parameters are normalized to reference	Data is NOT normalized to the reference
Number of ports	Implied from size of data matrices	Explicitly stated through [Number of Ports]
Version	No version control stated	Specification version is stated under [Version]
Data arrangement	Maximum of four data pairs per line	No limit on number of data pairs per line; data may be split across multiple lines

Win with Technology Leadership. Leap Ahead

\*Other names and brands may be claimed as the property of others



# Issues to Close & Next Steps

## Technical and Editorial Changes

- To be handled during IBIS Open Forum reviews

## Parser

- Is a standard parser required, as with IBIS and ICM?
- Should this instead be left to the adopting EDA tool vendors?

## Naming and Copyright

- Touchstone® is registered by Agilent Technologies, Inc.
- Used with permission by the IBIS Open Forum to
  - Create industry-distributable specification
  - Help enable industry to use S-parameter features of ICM
- Is “Touchstone® 2” the right name? What’s its copyright status?

## Next Steps

- Review and call for comment through August 24 (at minimum)
- Call for vote once all major issues are closed

Win with Technology Leadership. Leap Ahead

\*Other names and brands may be claimed as the property of others

