Limit Up-Limit Down prevents trades from occurring outside price bands that hover a certain percentage away from prevailing prices. If a stock or exchange-traded product is offered at the lower band or bid at the upper band – a condition known as a Limit State – for 15 seconds, trading in that stock/ETP is paused for five minutes. The primary exchange then conducts a reopening auction, and trading resumes with new price bands.

In this document, we explain the origins of LULD, catalogue some of the important events that have shaped its evolution, and opine on the various proposals to improve it. At the end, we illustrate how LULD works in a two-page cheat sheet.

The Flash Crash
On May 6th, 2010, the European sovereign debt crisis sparked a wave of selling that intensified in the afternoon of the US session. US equities and equity-index futures dropped sharply from 2:41 p.m. to 2:44 p.m., and many blue-chip stocks traded at prices that seemed to be detached from any rational estimation of their value. Shares of Accenture infamously traded down to a penny, though those trades and many others were later broken.

In the months that followed, the exchanges implemented single-stock circuit breakers that halted trading in stocks and ETPs that traded down or up by 10% or more from any transaction price over the preceding five minutes. They also implemented harmonized, more-objective standards for breaking trades deemed “clearly erroneous,” and recalibrated the market-wide circuit breakers.

The single-stock circuit breakers were always meant to be a stopgap measure. They triggered halts only after a trade printed outside the 10% thresholds, and they didn’t give traders an opportunity to push prices back toward their original levels before trading was halted. The Limit Up-Limit Down plan, proposed by the exchanges and FINRA in May 2011 and implemented in stages two years later, addressed these shortcomings. LULD price bands now prevent trades from occurring at dislocated prices in the first place, and the 15-second Limit States give traders a chance to push prices back to rational levels before the stock/ETP is halted.

August 24th
On the morning of August 24th, 2015, unusual market conditions and surging demand for liquidity revealed weaknesses in the LULD framework. Certain LULD rules and industry practices that seemed compatible under normal market conditions suddenly did not
mesh so well. For example, NYSE Arca’s policy of executing its LULD reopening auctions inside its price collars immediately following the five-minute pause, even if that meant leaving market orders unpaired, led to some undesirable outcomes. Inundated with market sell orders that it couldn’t pair off inside its collars, Arca sent those orders into sparsely populated exchange order books in the milliseconds following the auctions. The orders pinned many ETPs to their new LULD lower bands and triggered new pauses.

Meanwhile, the presence of aggressive sell orders at exchanges other than Arca – particularly Nasdaq and EDGX – also spurred serial trading pauses in Arca-listed ETPs. These orders triggered pauses, and then lay dormant at Nasdaq or EDGX until Arca’s reopening auction. At that point, they resumed their downward pressure. Had they been routed to Arca for participation in the reopening auction, they might still have triggered additional pauses, but other traders would have at least had an opportunity to submit offsetting buy orders.

**EMSAC Recommendations**

The SEC created the Equity Market Structure Advisory Committee in early 2015 to give industry leaders and academics an opportunity to publicly debate, and advise the Commission on, important market structure issues. In the wake of August 24th, EMSAC turned its attention to LULD, ultimately recommending that three changes be made to the plan:

1. Trading pauses should be replaced with a futures-style mechanism that keeps stocks/ETPs open while preventing trades from occurring outside the price bands. If a stock/ETP hasn’t exited a Limit State after four minutes, the price bands would slide in the direction of the trading pressure with the Limit State LULD band serving as the new reference price.
2. The Clearly Erroneous Execution rules should only apply to trades that manage to print outside the LULD bands. All trades printing inside the bands would be deemed good trades.
3. The price of the opposite-side LULD band – for example, the upper band in a limit-down scenario – should be the same coming out of a trading pause as its price going into the pause. This would ensure that a paused stock/ETP could mean-revert without triggering additional pauses.

**Our Thoughts**

Electronic limit order books, auto-execution and algorithmic trading have made financial markets remarkably efficient. They’ve also left markets vulnerable to sudden surges in liquidity-demand, as we witnessed firsthand during the Flash Crash. By preventing bouts of particularly acute, one-sided liquidity-demand from pushing stocks and ETPs to price levels that create confusion or panic, the Limit Up-Limit Down plan de-risks our market structure without sacrificing its efficiency.

On August 24th, the plan clashed with some existing rules and industry practices, and for a half hour or so trading was uncharacteristically inefficient. Transitioning from auction states to continuous trading states proved especially problematic, so we’re glad that the exchanges have prioritized the tweaking and harmonizing of their auction rules. Using the previous day’s close as the initial reference price for stocks/ETPs opening on a quote, instead of the NBBO midpoint – the centerpiece of the Tenth Amendment to the plan – has drastically reduced the number of trading pauses. The dynamic reopening auction collars – the centerpiece of the Twelfth Amendment – seem well thought out, and should prevent market order imbalances from spilling into thin order books and

**Timeline**

- May 2010
  - Flash Crash
- May 2011
  - SEC publishes LULD proposal, invites public comment
- May 2012
  - SEC approves proposal with significant changes (Amendment 1)
- January 2013 - August 2016
  - SEC approves Amendments 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11, each of which is comprised of relatively minor changes
- April 2013 - May 2014
  - Implementation, starting with Tier 1 stocks/ETPs from 9:45 - 3:45 (no 2X bands), and ending with all stocks/ETPs from 9:30 - 4 (w/ 2X bands)
- August 2015
  - “August 24th”
- January 2017
  - SEC approves substantive Twelfth Amendment for 3Q17 implementation
triggering additional pauses. Finally, the steps the exchanges have taken to avoid trading in the brief moments during regular trading hours when the LULD bands aren’t in place has made the plan more robust.

We encourage the exchanges to continue to think about how to mitigate the impact of aggressive sell orders that reside on the order books of non-primary exchanges during trading pauses. And we hope that they’ll continue to try to harmonize their LULD processes to the extent possible, as a lack of harmonization generally makes it more difficult for traders to react quickly and confidently during periods of market stress.

Looking ahead, the exchanges are considering harmonizing LULD with their Clearly Erroneous rules. In practice, this likely means the exchanges would pledge not to break trades whenever the LULD bands are in effect. We would welcome this development, as it would reduce uncertainty for liquidity providers. Of course, limiting the exchanges’ ability to break trades increases the risk that trades that really are clearly erroneous are allowed to stand. To mitigate this risk, the exchanges have hinted that they want to fine-tune the LULD percentage thresholds before moving ahead with the harmonization.

EMSAC’s other two proposals are, we think, eminently sensible. Allowing a stock or ETP that has traded down sharply to bounce back to its original levels without triggering LULD pauses on the way back up should lead to more efficient price discovery. And conceptually, we like the idea of scrapping trading pauses entirely in favor of a futures-style regime. However, we do think it makes sense to determine whether or not the recent modifications to LULD – in particular, the dynamic collars – will smooth the transitions between auction states and continuous trading states before moving ahead with a futures-style regime.
The Basics

LULD prevents trades from occurring outside price bands that hover a certain percentage away from prevailing prices. If a stock or ETP is offered at the lower band or bid at the upper band – a condition known as a Limit State – for 15 seconds, trading in that stock/ETP is paused for five minutes. The primary exchange then conducts a reopening auction, and trading resumes with new price bands. The chart below depicts a generic LULD pause/reopen.

Some Important Details

• Preventing trading/quot ing outside the bands is a responsibility that falls to the trading centers (exchanges, ATSs, OTC Market Makers, etc.).
• The bands don’t apply to opening, reopening and closing trades, or to 611-exempt trades that don’t update last sale.
• When a Limit State is reached, the SIPs stop disseminating the bands. If the Limit State is cured within 15 seconds (i.e. the quotes at the band are canceled or executed), the SIPs immediately disseminate new bands and trading continues.

Auctions

Many of these rules will change in 3Q17. Click here for more on these changes.

Openings

From 9:30 a.m. to 9:35 a.m., if the primary exchange hasn’t opened a stock or ETP, other trading venues can trade it without price bands. At 9:35 a.m., if the primary still hasn’t opened it, the Securities Information Processor disseminates price bands using the arithmetic mean of all transaction prices over the previous five minutes as the Reference Price.

Reopenings

• During a pause, the primary exchange publishes order imbalances and indicative reopening prices via its proprietary data feeds.
• NYSE Arca and Bats BZX do not allow their reopening auctions to print outside collars that are 3%, 5% or 10% away from last sale.
• NYSE, NYSE MKT and Nasdaq do not employ collars for reopening auctions.
• If the primary can’t reopen a stock/ETP due to a systems issue, or if it fails to reopen the stock/ETP within 10 minutes after the pause begins, live trading may resume on other trading centers. In these scenarios, the prior reference price is used as the new reference price, and the price bands are three times their normal distance from the reference price for 30 seconds. After those 30 seconds have elapsed, the bands revert back to their normal distance from the Reference Price.

Closings

If the primary declares a pause at 3:50 p.m. or later, it won’t attempt to reopen the stock and instead will attempt to close it. If it fails to execute a closing auction by 4:05 p.m., other trading centers can resume trading in the post-market session.
Band Construction

The Securities Information Processors construct and disseminate the upper and lower price bands for each NMS stock and ETP. First, they calculate a Reference Price as a proxy for prevailing prices. Then they add/subtract a given percentage to/from the Reference Price to calculate the price bands.

**Step 1:** The SIP calculates a Reference Price as a proxy for prevailing prices. Here’s how it’s done:

**Opening Price**
The price of the opening auction trade is the first Reference Price. If the stock/ETP opens on a quote, the previous day’s close is the first Reference Price.

**Pro-Forma Reference Price**
The arithmetic mean of all transaction prices over the previous five minutes—or less, if five minutes have not yet elapsed since the first Reference Price—is the Pro-Forma Reference Price.

**Reference Price**
If the Pro-Forma Reference Price deviates from the Reference Price by 1% or more, the Pro-Forma Reference Price becomes the new Reference Price. If it doesn’t deviate by at least 1%, the Reference Price does not change.

**Notes:**
1. If there are no trades in the preceding five minutes, the Reference Price stays the same.

**Step 2:** The SIP adds/subtracts a percentage amount to/from the Reference Price to calculate the price bands. The percentage amount for a given stock/ETP is determined by its share price and market cap tier, as follows:

**Distance of Band from the Reference Price**

<table>
<thead>
<tr>
<th>Share Price</th>
<th>Tier 1 Stocks/ETPs</th>
<th>Tier 2 Stocks/ETPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above $3</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>≤$3 and &gt;$0.75</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>Below $0.75</td>
<td>75% or $0.15†</td>
<td>75% or $0.15†</td>
</tr>
</tbody>
</table>

*Tier 1 ETP list refreshed semiannually. A Tier 1 ETP must have $2 million+ ADVT or track the same benchmark as a $2 million+ ADVT ETP, and it cannot be levered.
†Whichever is less

**Notes:**
1. Percentages are doubled in the first 15 minutes and the last 25 minutes of regular trading hours (usually 9:30 a.m.-4 p.m).
2. Percentages for leveraged ETPs are multiplied by the leverage factor. For example, an ETP that attempts to deliver two times the return of the S&P 500 Index would have bands that are twice the normal distance from the Reference Price.