A Progressive Mixing 20GHz ILFD with Wide Locking Range for Higher Division Ratios
Ahmed Musa, Kenichi Okada, Akira Matsuzawa
Tokyo Institute of Technology, Japan

1. Motivation
High frequency PLLs are becoming more popular for high data rate and low power mobile applications

- Analog freq. dividers consume considerable power
- 40% of PLL power consumption [1]

Two main types of prescaler FD:
- CML Dividers
  - Moderate operation freq.
  - Wide locking range
  - High power consumption

- Injection Locked Freq. Dividers (ILFD)
  - High operation freq.
  - Narrow locking range
  - Low power consumption
  - Can divide by higher than 2

2. Conventional Direct Mixing ILFD
Conventional ILFD can directly divide by any ratio provided that injection timing is not interrupted

- Locking range is limited for high division ratios due to interruptions

- Cascading /2 stages to achieve wider locking range
- Increases the power consumption (More than one oscillator is needed)
- Lock range and impedance mismatch degrades performance → Independent tuning is required

4. Measurement Results
The proposed PMILFD achieves the widest locking range among ILFDs with higher division ratios

- 31% locking range at 20GHz which is about 50% improvement compared to the conventional

The same idea is extended to a three step divide by 8

- 15% locking range at 20GHz which is about 780% improvement compared to the conventional

5. Conclusion
- The proposed technique successfully achieves the widest locking range among same division ratio ILFDs

<table>
<thead>
<tr>
<th>Division Ratio(s)</th>
<th>[1]</th>
<th>[2]</th>
<th>[3]</th>
<th>[4]</th>
<th>[5]</th>
<th>[6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power (mW)</td>
<td>3.9</td>
<td>7.1</td>
<td>3.0</td>
<td>12.4</td>
<td>2.8</td>
<td>6.8</td>
</tr>
<tr>
<td>Lock Range (GHz)</td>
<td>7.9 (31%)</td>
<td>4 (32%)</td>
<td>6.5 (7.3%)</td>
<td>1.9 (2.4%)</td>
<td>1.6 (2.3%)</td>
<td>1.8 (2.2%)</td>
</tr>
<tr>
<td></td>
<td>3.8 (15%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>