Changes to the RNG web page (http://csrc.nist.gov/CryptoToolkit/tkrng.html):

1. Remove the current Announcement, including the bulleted list.

2. In the new box we discussed, include the following links:
   Agenda
   RNG Development History
   RNG Standard Strategy (coming) [This will need to be added later]
   X9.82, Part 1
   X9.82, Part 3
   Hash and block cipher-based DRBGs
   Number theoretic DRBGs
   X9.82, Part 2 (coming) [This will need to be added later]
   Entropy Sources
   Testing Issues with OS-based Entropy Sources
   Validation Testing and NIST Statistical Test Suite
   Block cipher-based DRBGs (coming) [This will need to be added later]

3. Insert a note that the draft of X9.82 is no longer available for posting to the web site. Also, that comments may be sent to ebarker@nist.gov or John.Kelsey@nist.gov.

4. You have text about future plans further down the page that you may want to change.

DualEC DRBG

Where we are and how we got here.

- Original goals of X9.82 DRBGs:
  - Protecting internal state
  - Good Randomness properties

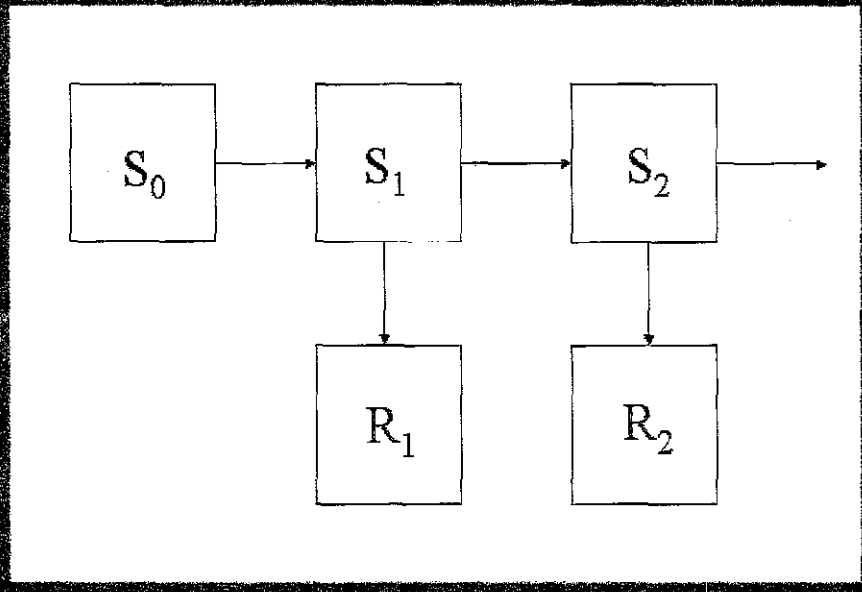
Protection of the internal state is directly tied to the EC discrete log

- Backtracking Resistance
- Outputs

Where we are and how we got here.

$S_i = \varphi(X(S_{i-1} * P))$

$R_i = \varphi(X(S_i * Q))$



Where we are and how we got here.

- Later, Indistinguishability From Random was made a formal requirement.

This requirement is not directly met by the hardness of the EC Discrete Log problem.

Soul Searching

NSA had previously done background work on DualEC DRBG.

When objections arose we went back, studied the previous work, supplemented it with some new results and began the painful process of Pre-Publication Review.

Simple Observations

- The internal state values can be viewed as outputs of an iterated function.
- This function has constrained pre-image structure.
  - Each value has at most 3 pre-images.
    - $aP = (x,y)$, then $-aP=(x,-y)$ and $(r+a)P = (x,y)$

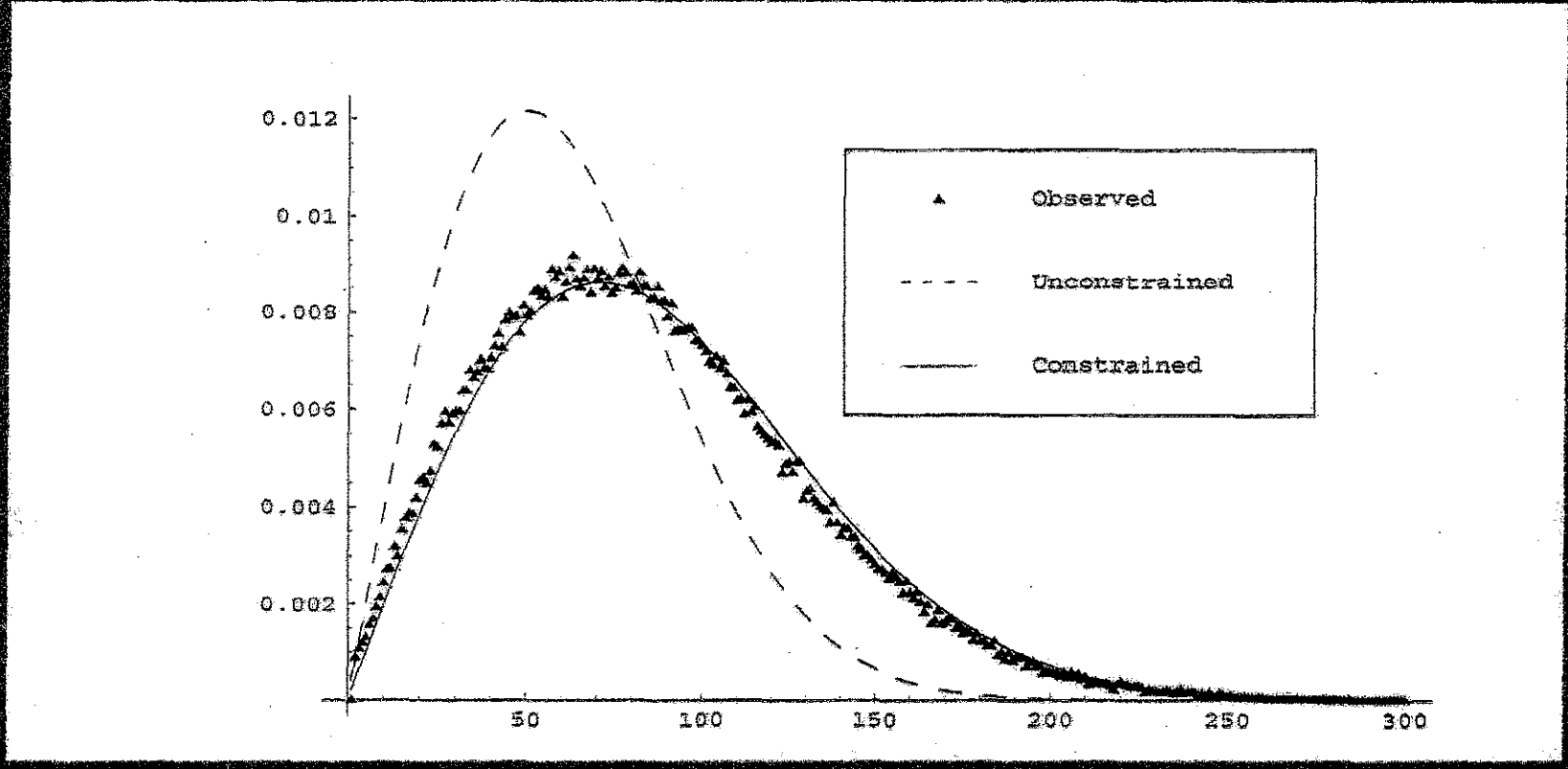
      (3^{rd} case relevant only when a is very small)

This is true independent of the size of the curve.

Results

- DualEC is expected to have cycle structure which is very much like the output of an iterated random function.
- Simple analysis of the truncation bias shows that it is less than the x-coordinate bias.
- We can quantify the distribution of x-coordinates more precisely.
- We've done some further computational experiments to search for bias in the output.

Distribution of Rho Lengths



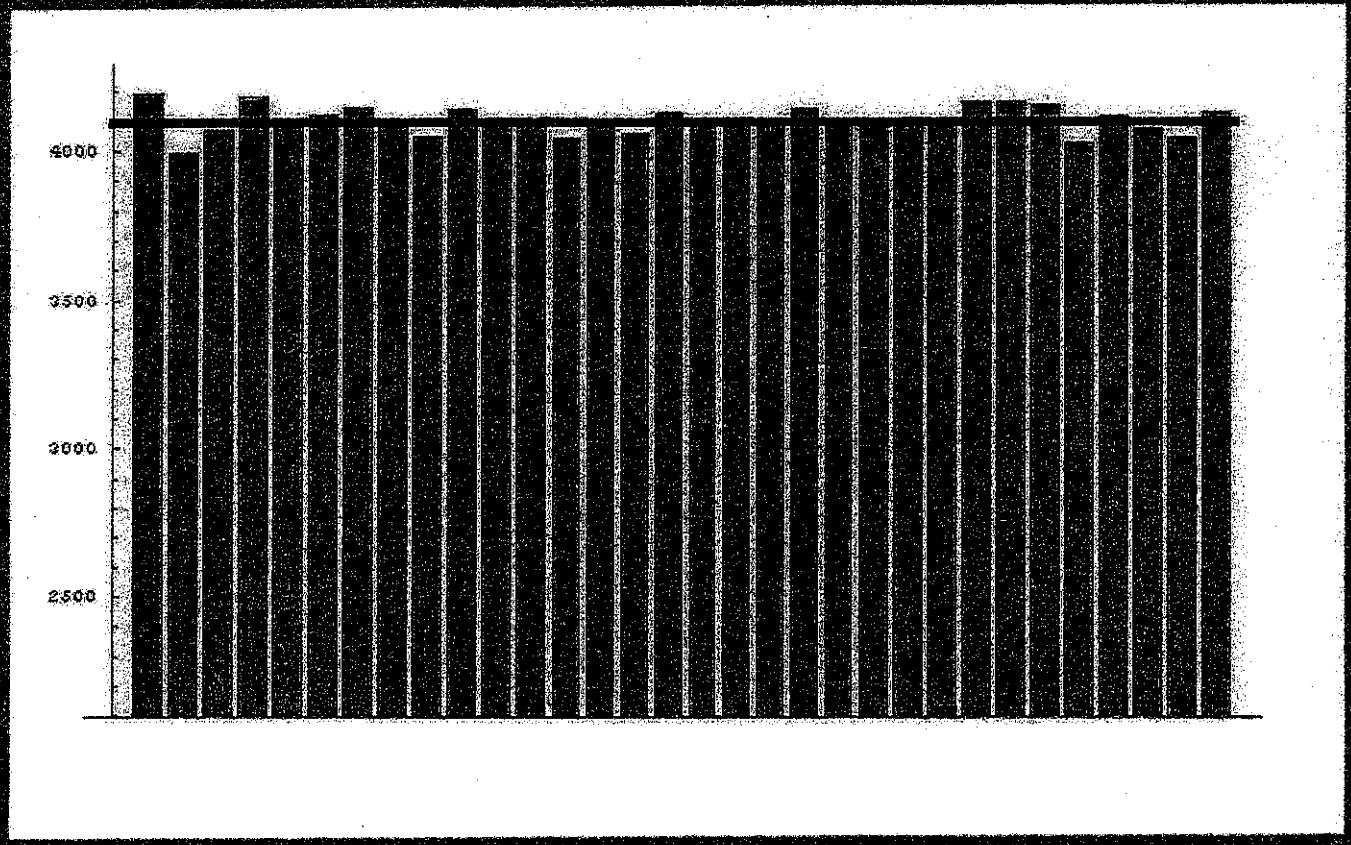
Distribution of X-Coordinates

For any interval in [0,p-1], the difference in the proportion of distinct x-coordinates in that interval, and the proportion expected to be in that interval if they were distributed uniformly is bounded by

$$K \log^2(p)/\mathrm{sqrt}(p)$$

(when p is sufficiently large)

Distribution of X-Coordinates



Proposed Changes to X9.82 Part 3

- Provide a means for generating P and Q in a verifiable fashion.
- Elimination of the Binary Curves from the DualEC.
- Clarifying text to describe what assurances the EC discrete log problem provides in this setting (and what assurances it is not meant to provide).