Sports Summary Highlights using Artificial Intelligence

Stephen Hammer

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IBM

IBM Sports and Entertainment

For more than 22 years, we have helped many of the world's most preeminent Sports & Entertainment brands succeed and provide world-class digital experiences to customers around the world.

Sports Summary Highlight Videos – Traditional Approach

- Highlight template assets are created pre-tournament.
  - Graphics and Branding
  - Bumpers
  - Editing Suite Project Template

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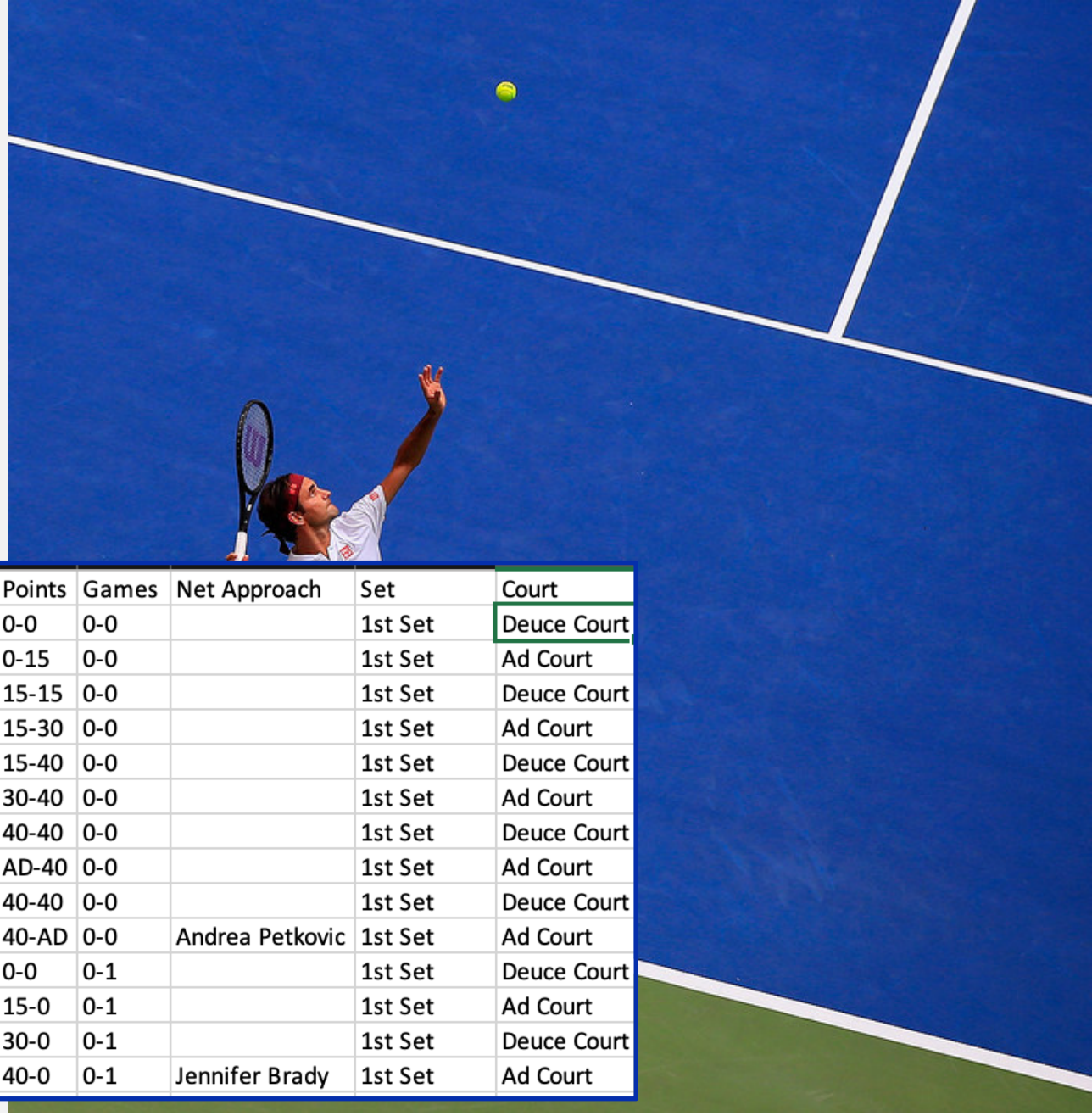

Point Quality	Description	Point Winner	Points	Games	Net Approach	Set	Court
2	Ace	Andrea Petkovic	0-0	0-0		1st Set	Deuce Court
3	Unforced Error	Jennifer Brady	0-15	0-0		1st Set	Ad Court
1	Winner, Long Rally	Andrea Petkovic	15-15	0-0		1st Set	Deuce Court
2	Unforced Error	Andrea Petkovic	15-30	0-0		1st Set	Ad Court
1	Forced Error	Jennifer Brady	15-40	0-0		1st Set	Deuce Court
2	Long Rally, Unforced Error	Jennifer Brady	30-40	0-0		1st Set	Ad Court
3	Forced Error	Jennifer Brady	40-40	0-0		1st Set	Deuce Court
1	Ace	Andrea Petkovic	AD-40	0-0		1st Set	Ad Court
1	Forced Error	Andrea Petkovic	40-40	0-0		1st Set	Deuce Court
1	Volley Winner	Andrea Petkovic	40-AD	0-0	Andrea Petkovic	1st Set	Ad Court
2	Winner, Long Rally	Jennifer Brady	0-0	0-1		1st Set	Deuce Court
1	Service Winner	Jennifer Brady	15-0	0-1		1st Set	Ad Court
3	Long Rally, Unforced Error	Jennifer Brady	30-0	0-1		1st Set	Deuce Court
3	Volley Unforced Error	Jennifer Brady	40-0	0-1	Jennifer Brady	1st Set	Ad Court

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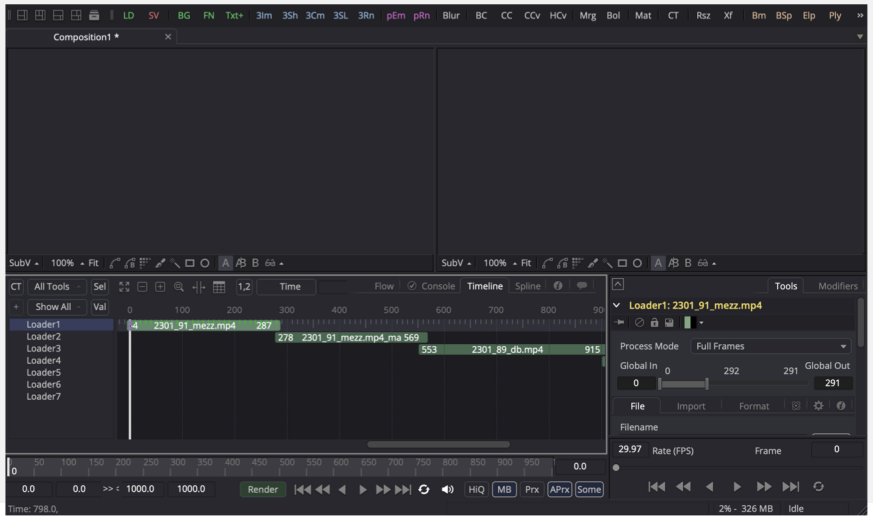

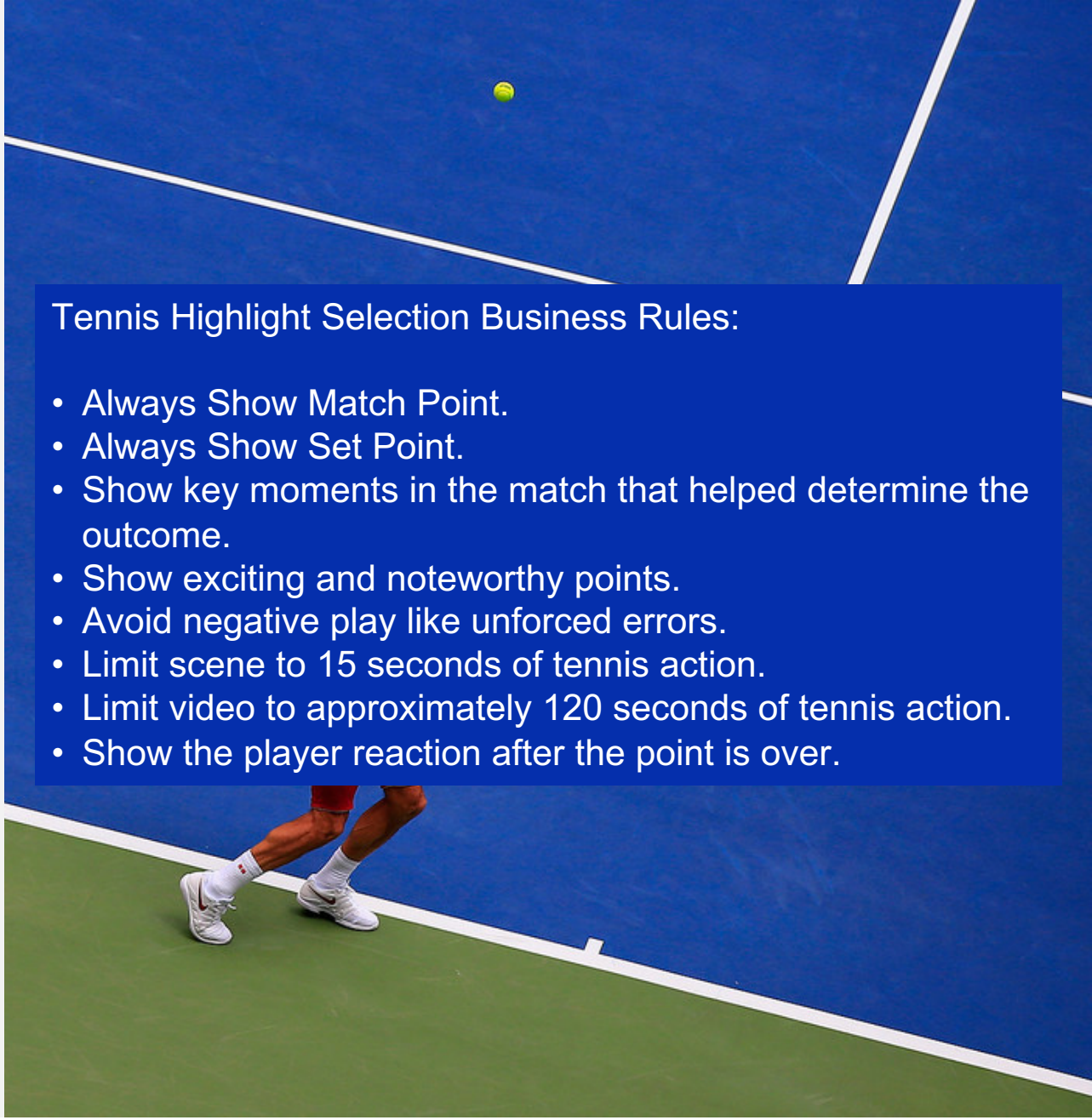

Tennis Highlight Selection Business Rules:

- Always Show Match Point.
- Always Show Set Point.
- Show key moments in the match that helped determine the outcome.
- Show exciting and noteworthy points.
- Avoid negative play like unforced errors.
- Limit scene to 15 seconds of tennis action.
- Limit video to approximately 120 seconds of tennis action.
- Show the player reaction after the point is over.

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- Editing steps:
  - Scene in and out times
  - Storytelling with voice or graphics.
  - Template updated in video editing suite with player names, scores, etc.

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- Publish

The Challenge

Cover as much video content as possible with automation and provide a fast, quality, comprehensive service covering ALL content.

Additionally, surface compelling individual moments for fans and the editorial staff.

Highlight Packages

Tennis:

- Match Summary Highlights
- Single Point SlamTracker Highlights
- Editorial Dashboard

Golf:

- Round in 3 Minute Highlights
- Single Shot Highlights
- Hole Highlights
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AI Highlight Coverage at the US Open:

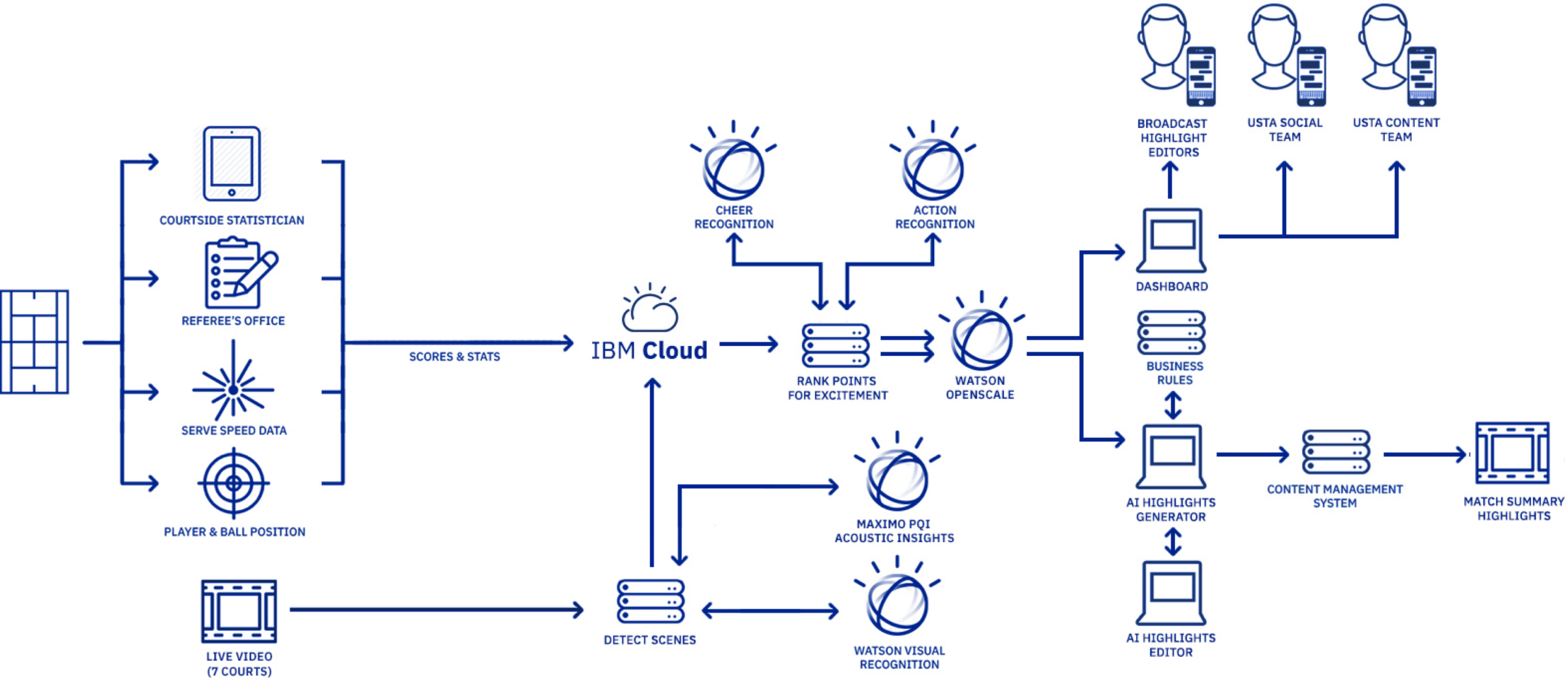
- 7 courts
- Men's and Women's Singles
- 31,000 Video Scenes Analyzed
- 150 Highlight Packages Produced

AI Highlight Coverage at Wimbledon:

- 10 Courts
- All events
- 66,000 Video Scenes Analyzed
- 375 Highlight Packages Produced

AI Highlight Coverage at the Masters:

- 18 holes
- All Players
- 20,000 Video Scenes Analyzed
- 292 Highlight Packages Produced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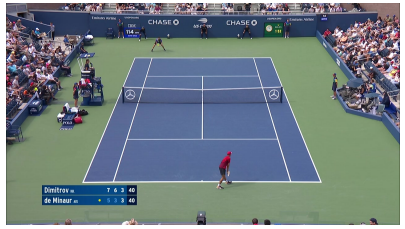
BUSINESS RULES
AI HIGHLIGHTS GENERATOR
AI HIGHLIGHTS EDITOR
CONTENT MANAGEMENT SYSTEM
MATCH SUMMARY HIGHLIGHTS
MAXIMO PQI ACOUSTIC INSIGHTS
WATSON VISUAL RECOGNITION
DETECT SCENES
LIVE VIDEO (7 COURTS)

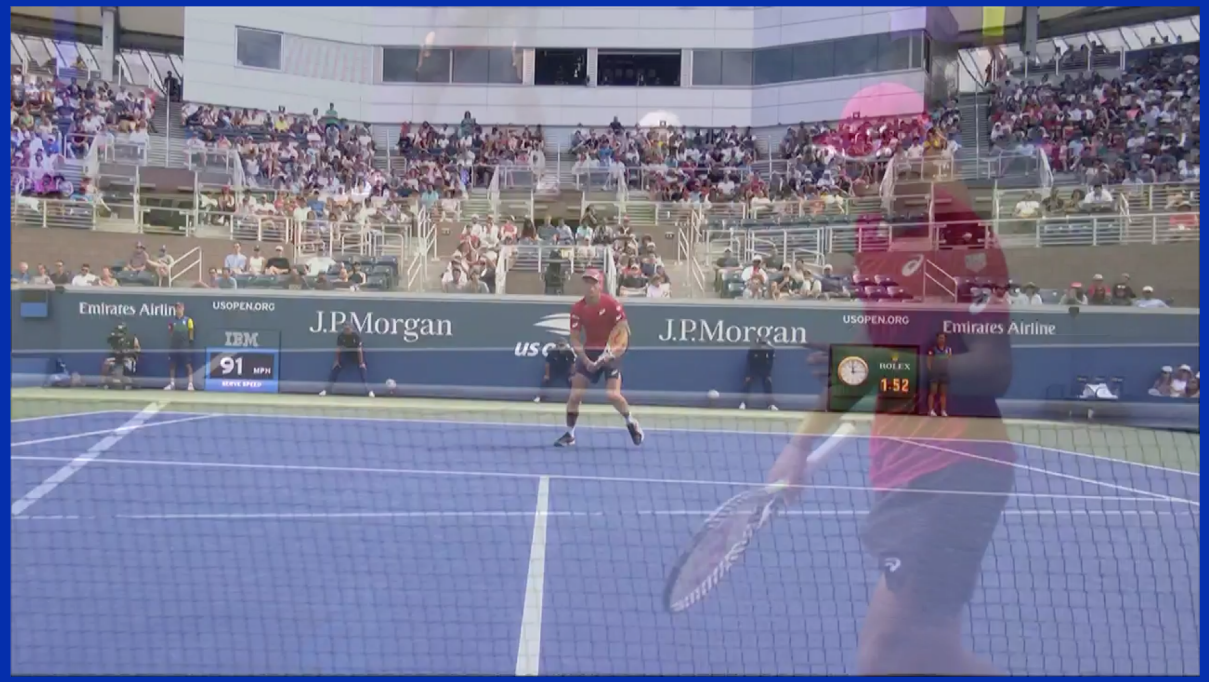
Scene Changes

Rough cut video clip using scoring timing data.

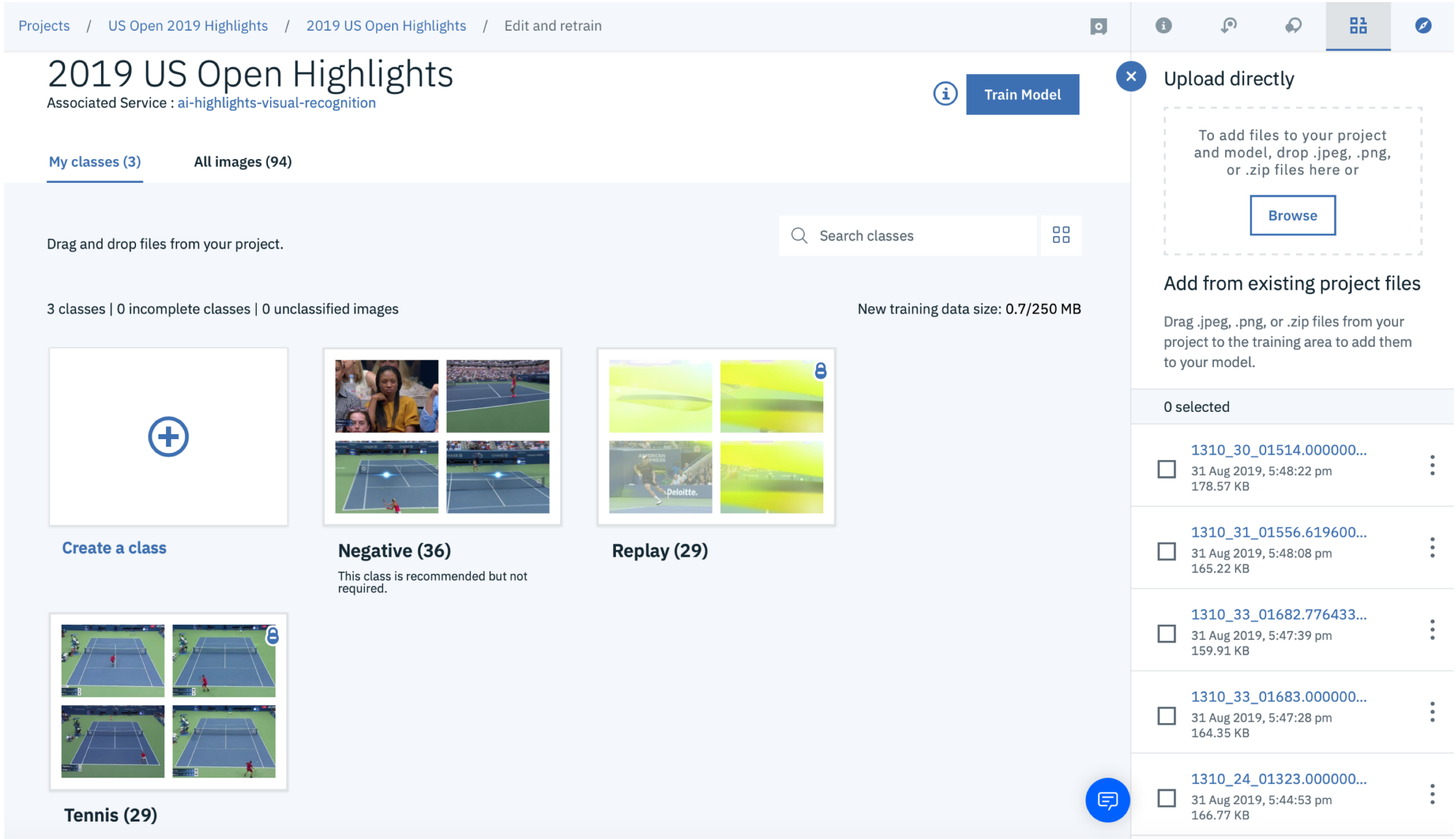
Taking advantage of production patterns, video scenes are broken down into individual shots using scene change detection.

Thumbnails extracted from the first frame of each shot:





Watson Visual Recognition Training



Scene Change Detection

Detect Scene Changes

> “ffmpeg -nostats -threads 2 -i INPUTVIDEO.ts -max_muxing_queue_size 999 -filter:v 'select=gt(scene\,0.18),showinfo' -f null - 2>&1 | grep Parsed_showinfo_1”

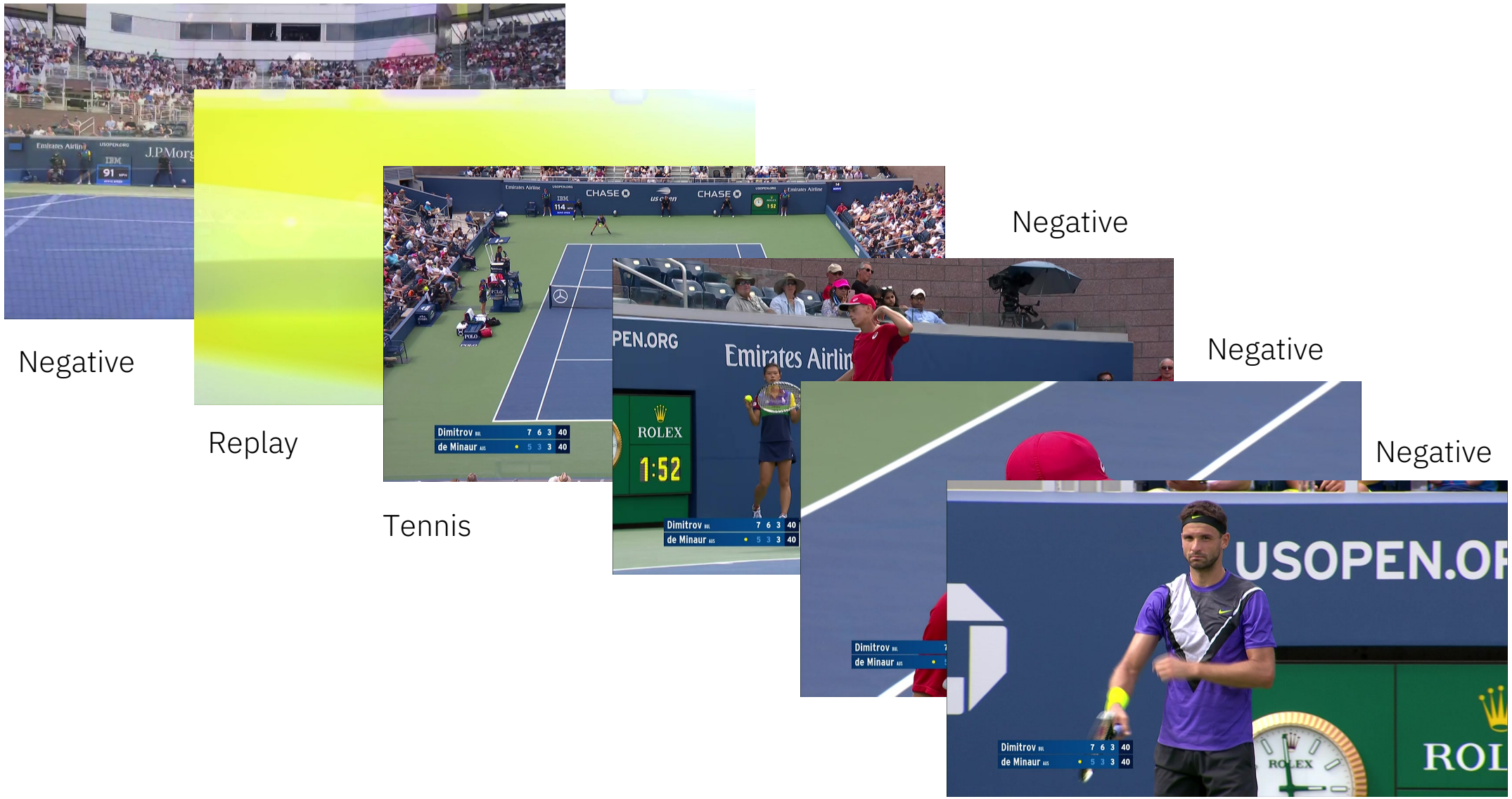
Extract Images at those Scene Changes

> “ffmpeg -loglevel panic -y -threads 2 -ss SECS -i INPUTVIDEO.ts -vframes 1 -q:v 1 -vf yadif THUMBNAIL.jpg”

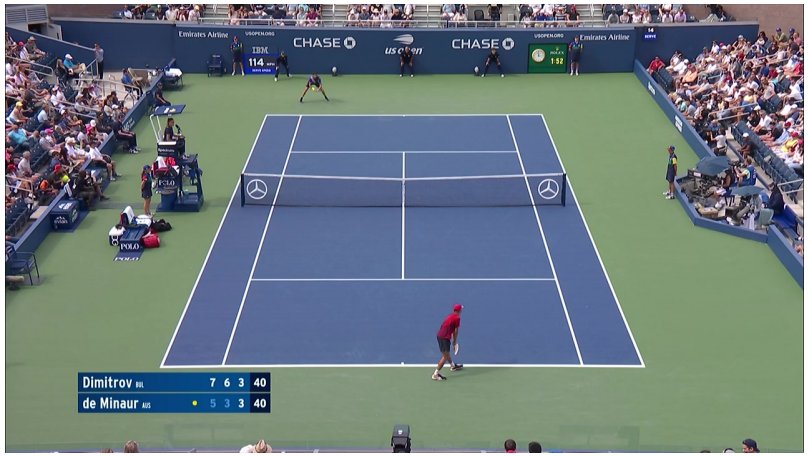
Then post image to Watson Visual Recognition for Classification (Tennis, Replay or Negative):

> curl --max-time 40 -sS -X POST -u "apikey:YOURAPIKEY" -F "images_file=@THUMBNAIL.jpg" -F "threshold=0.6" -F "classifier_ids=YOURCLASSIFIERNAME" "https://gateway.watsonplatform.net/visual-recognition/api/v3/classify?version=2018-03-19"

Watson Scene Classifications

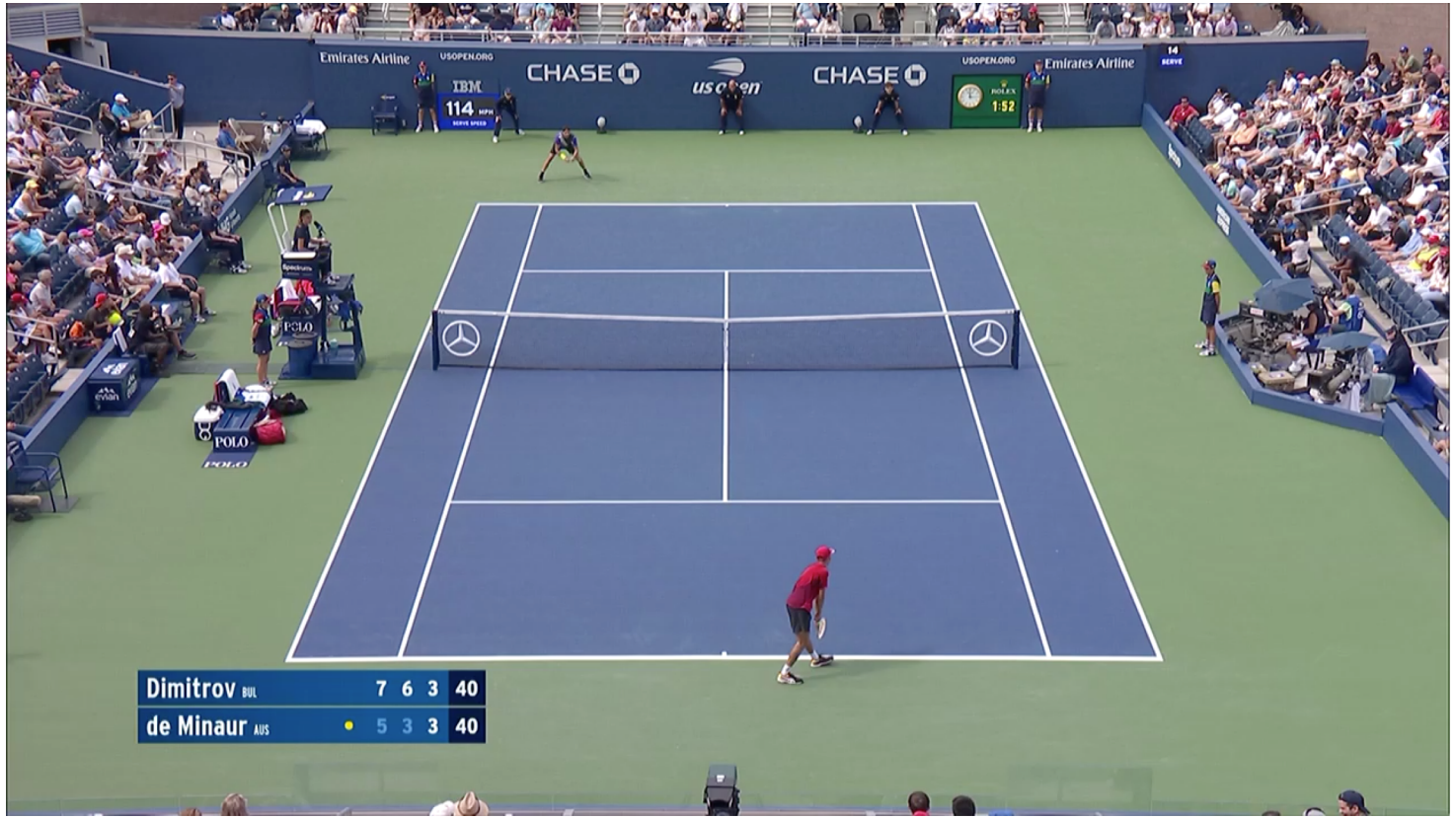


Clipped Scenes

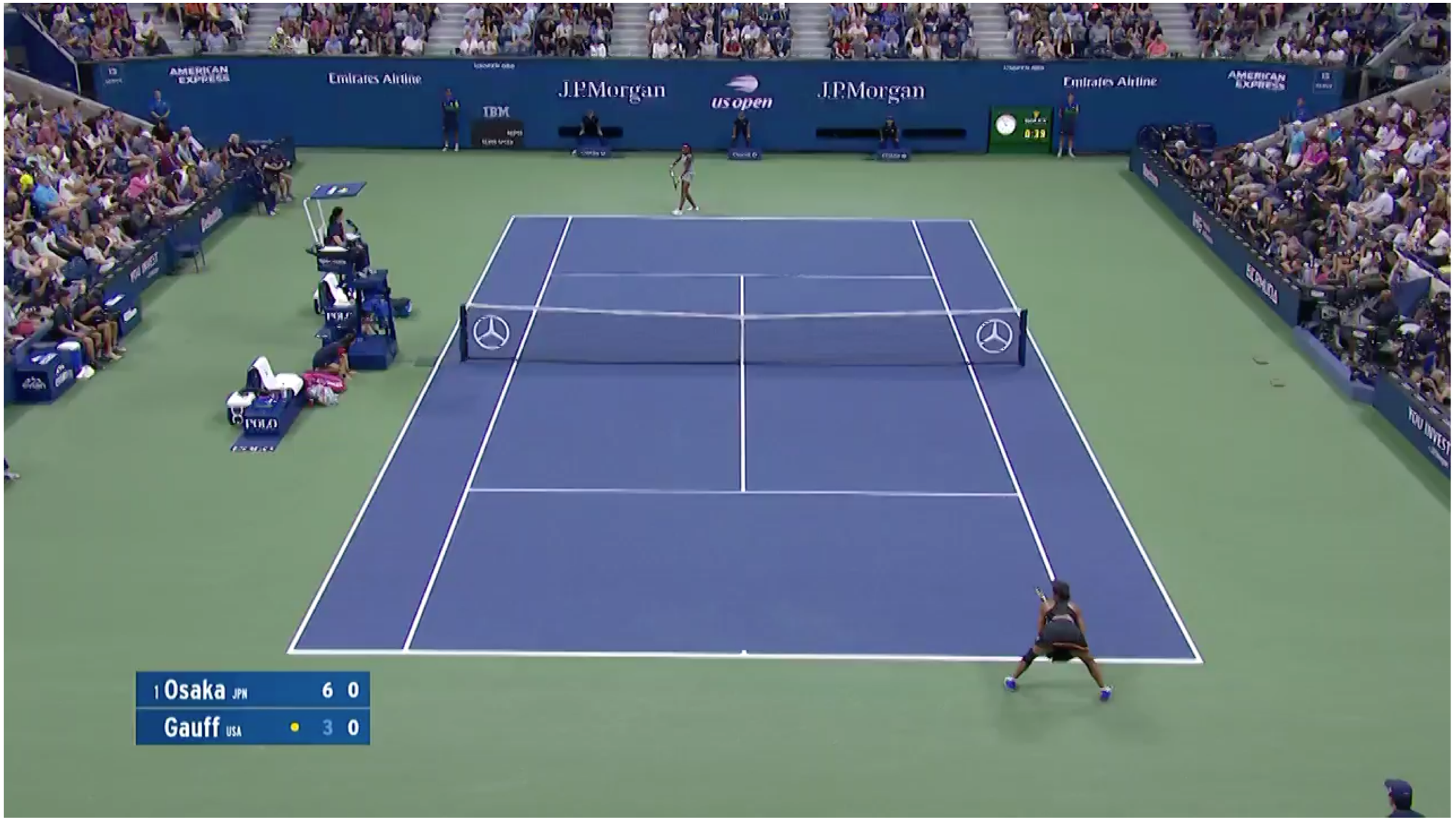


Begin

End



Extraneous Moments in Clipped Scenes

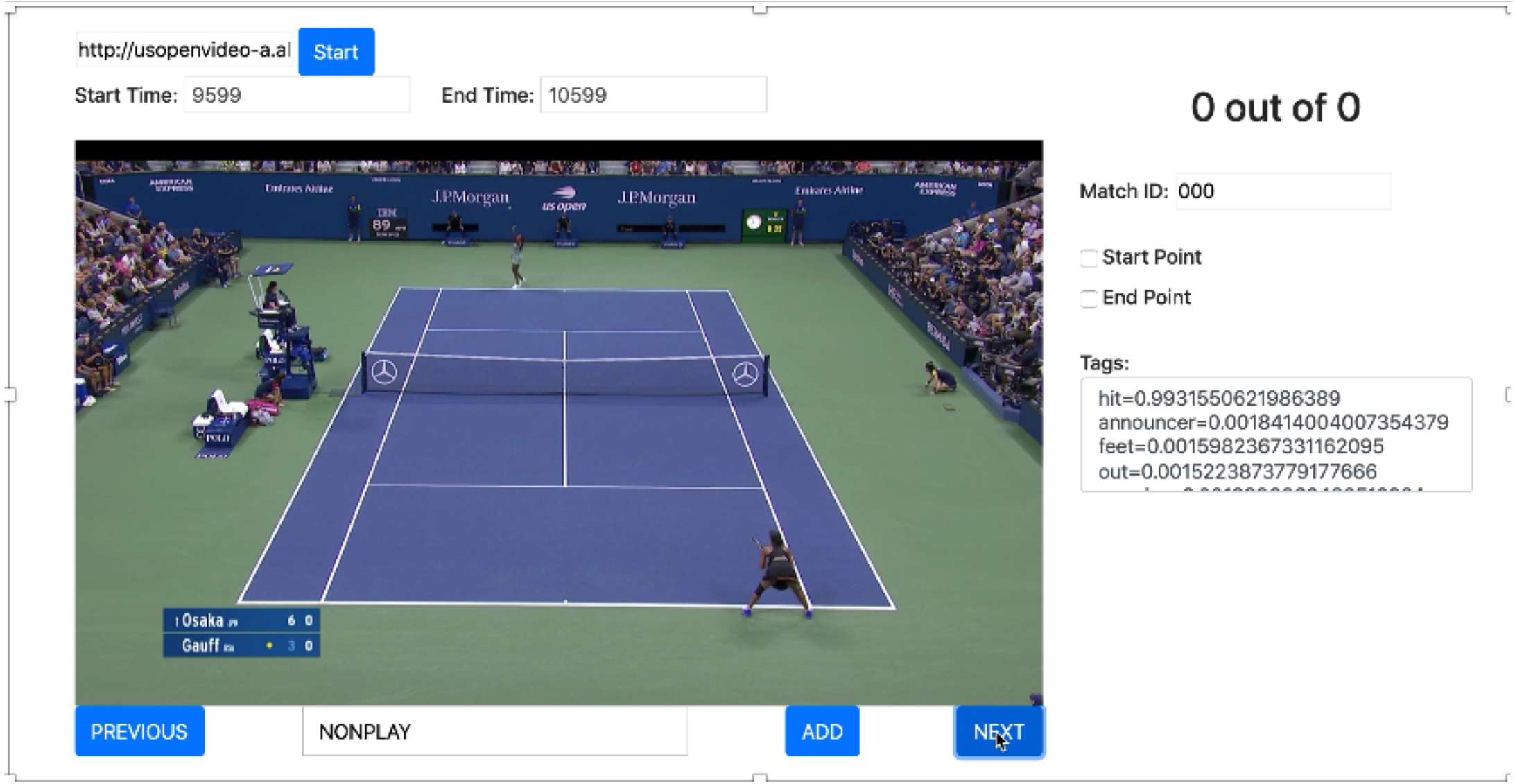


Acoustic Adjustments to Tighten Scene Clipping

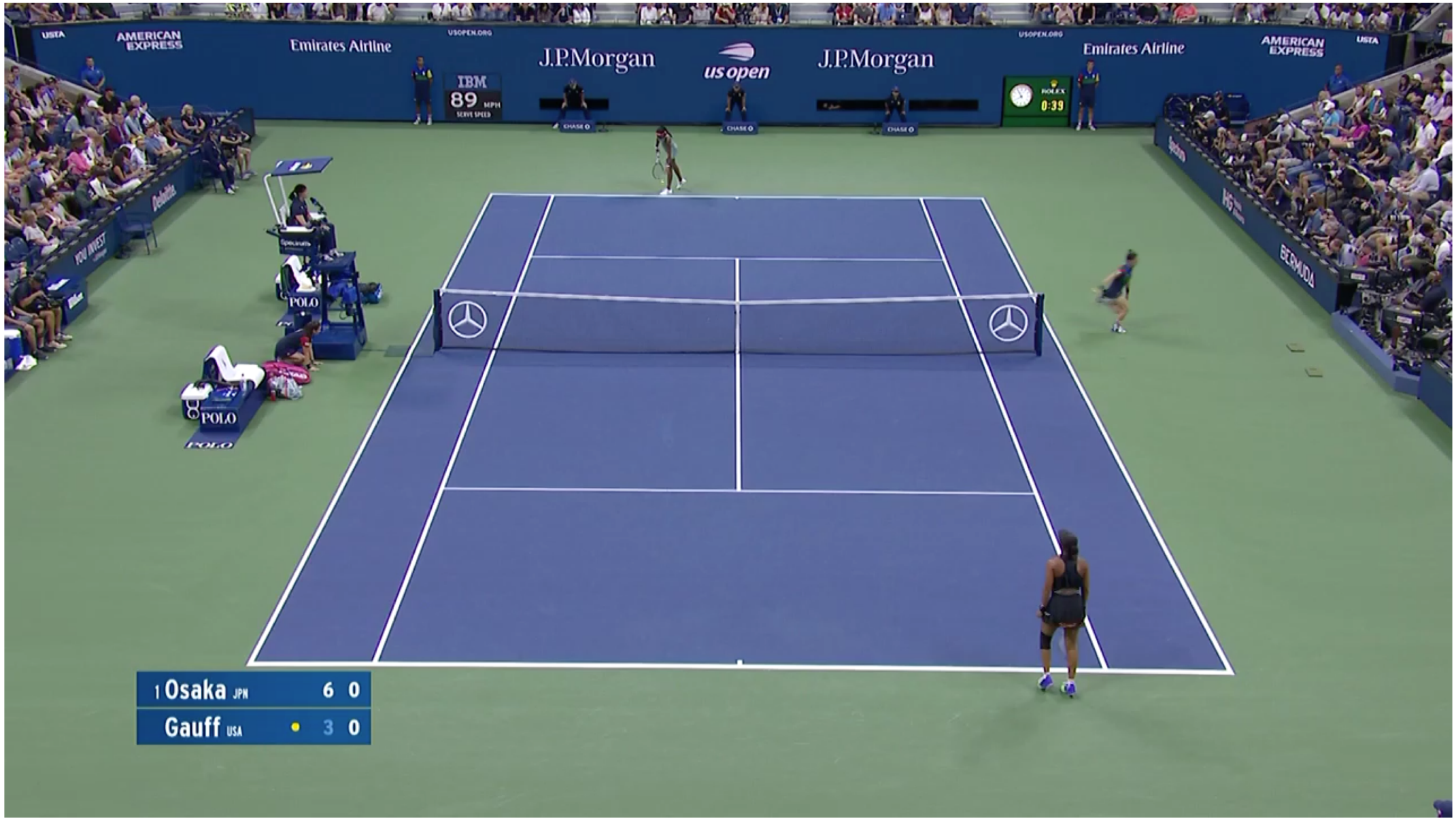
- IBM Maximo PQI Acoustic Insights.
  - Primarily used to monitor the sounds of machinery in factories.
- For this project, trained on common tennis sounds:
  - Ball Strike
  - Shoe squeak on court
  - Applause
  - Chair Umpire
  - Ball Bounce
- Docker container running on IBM Cloud.

- Audio extracted from video and posted to API.
- Single JSON reponse with sound classifications and timing.
- Non-tennis content removed from clip.

Acoustic Analysis



Tighter Clipping using Audio Classifications



Notable Scenes

OK, but there were 182 points in that match, which ones were notable enough to put into a highlight reel?

Sound of the Crowd

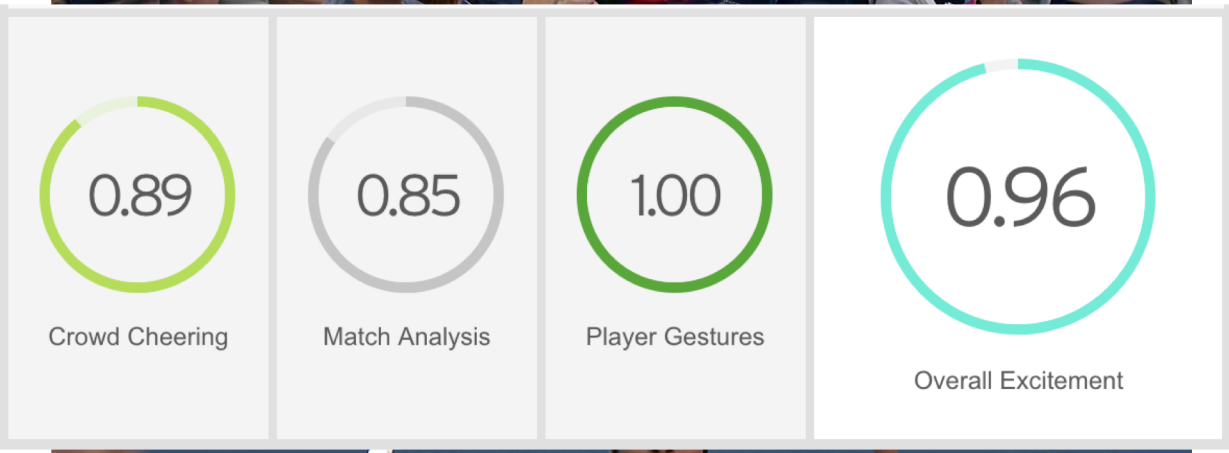
You know, crowd noise. Not sound level but actual crowd noise.

Player Gestures

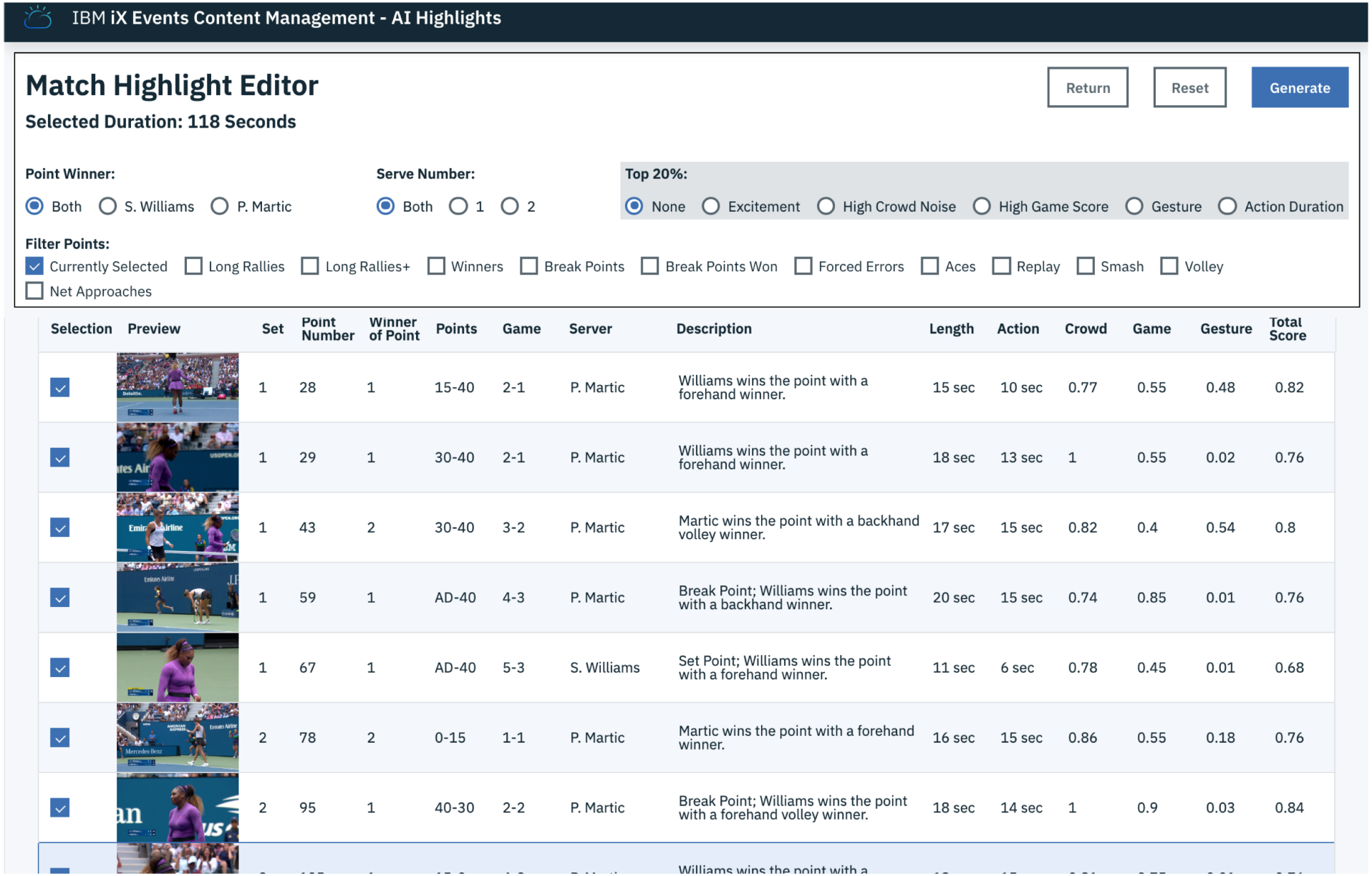
Visible analysis of end of the scene to determine if players are celebrating.

Tennis Analytics

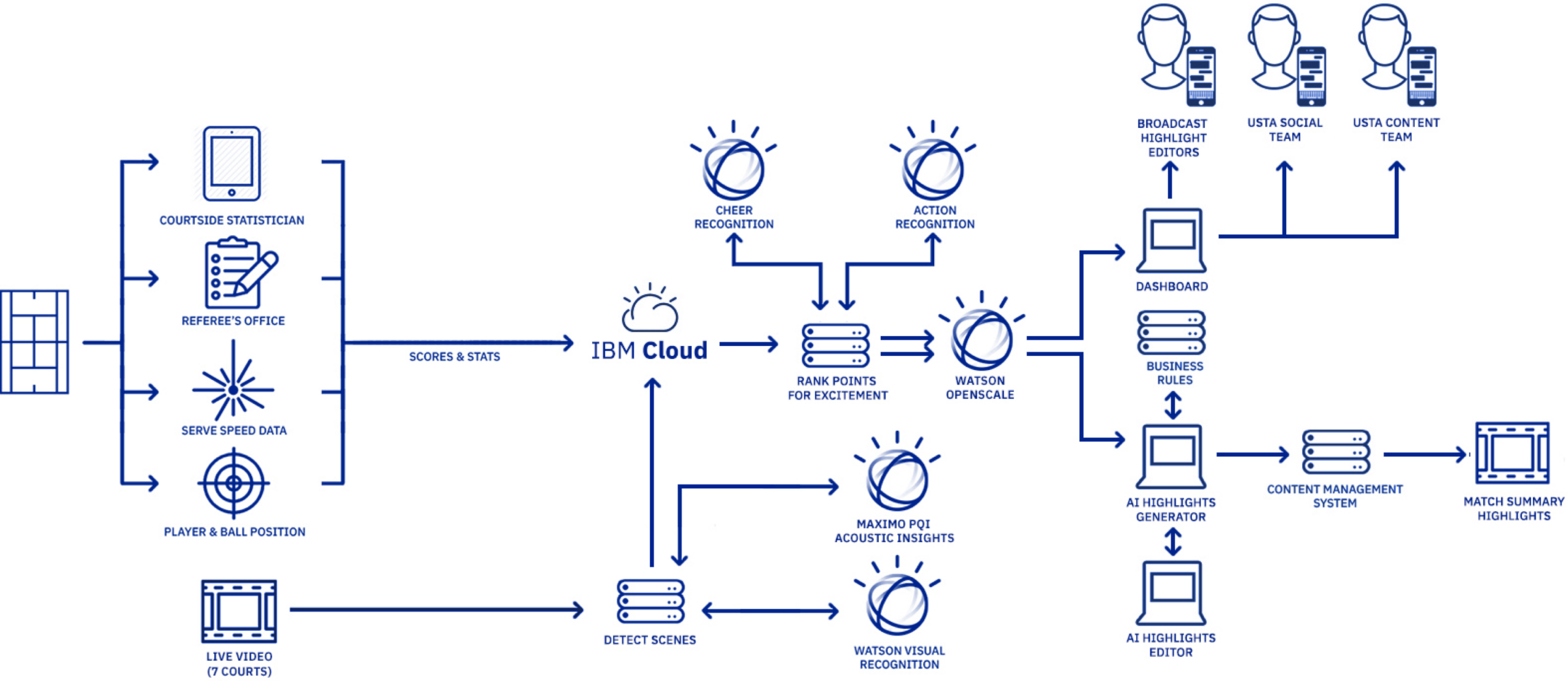
Point quality ranking based on traditional tennis stats such as Break Points and Winners.



Edits



Selection	Preview	Set	Point Number	Winner of Point	Points	Game	Server	Description	Length	Action	Crowd	Game	Gesture	Total Score
☑		1	28	1	15-40	2-1	P. Martic	Williams wins the point with a forehand winner.	15 sec	10 sec	0.77	0.55	0.48	0.82
☑		1	29	1	30-40	2-1	P. Martic	Williams wins the point with a forehand winner.	18 sec	13 sec	1	0.55	0.02	0.76
☑		1	43	2	30-40	3-2	P. Martic	Martic wins the point with a backhand volley winner.	17 sec	15 sec	0.82	0.4	0.54	0.8
☑		1	59	1	AD-40	4-3	P. Martic	Break Point; Williams wins the point with a backhand winner.	20 sec	15 sec	0.74	0.85	0.01	0.76
☑		1	67	1	AD-40	5-3	S. Williams	Set Point; Williams wins the point with a forehand winner.	11 sec	6 sec	0.78	0.45	0.01	0.68
☑		2	78	2	0-15	1-1	P. Martic	Martic wins the point with a forehand winner.	16 sec	15 sec	0.86	0.55	0.18	0.76
☑		2	95	1	40-30	2-2	P. Martic	Break Point; Williams wins the point with a forehand volley winner.	18 sec	14 sec	1	0.9	0.03	0.84
								Williams wins the point with a						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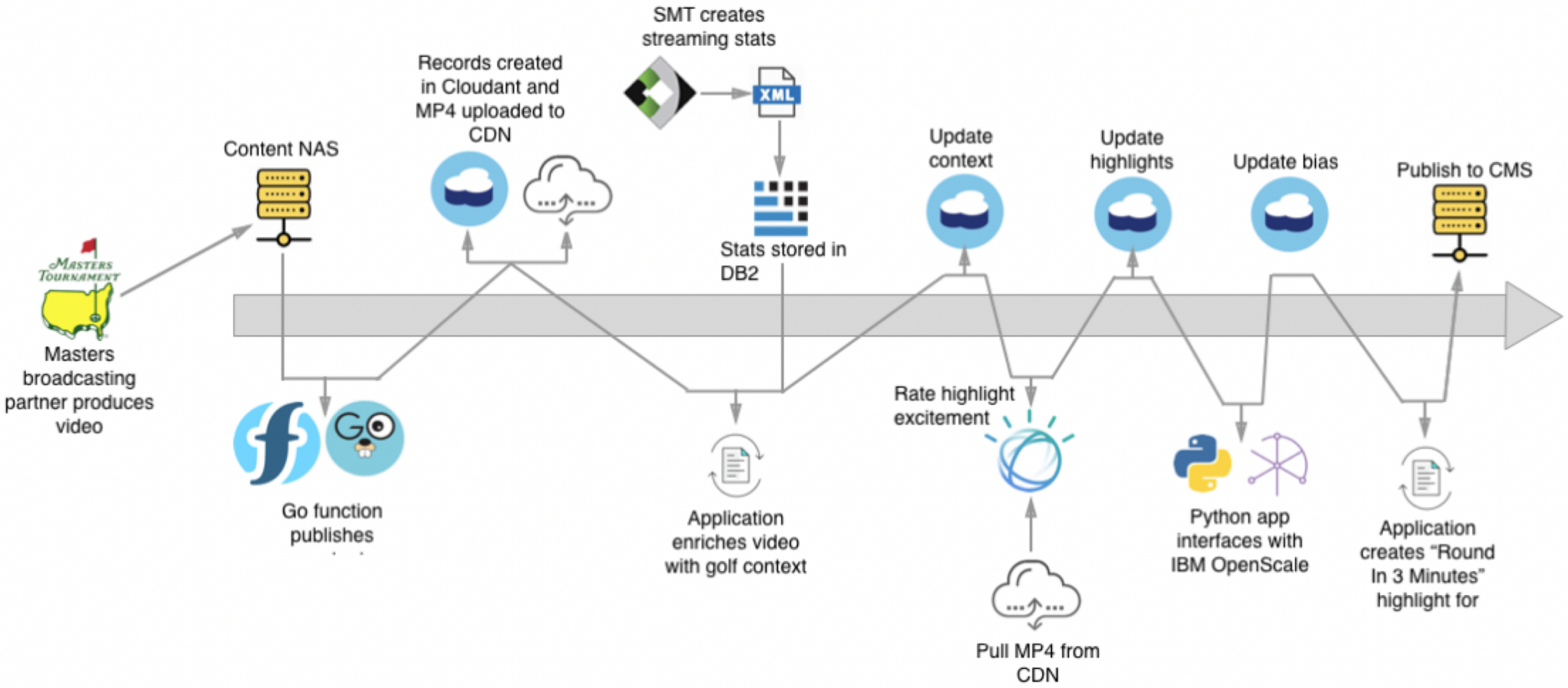
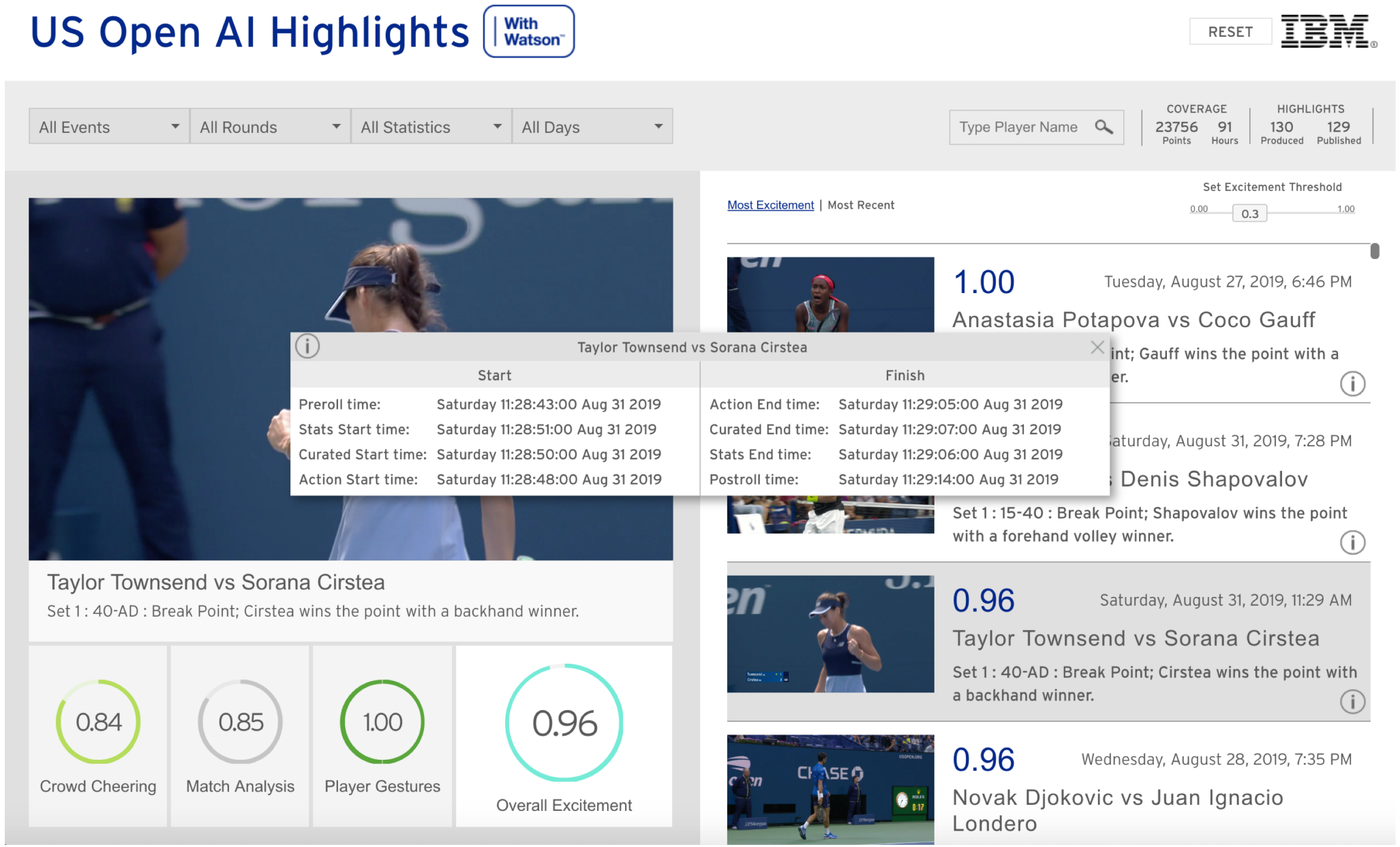
TEAM
DASHBOARD
BUSINESS
RULES
AI HIGHLIGHTS
GENERATOR
AI HIGHLIGHTS
EDITOR
CONTENT MANAGEMENT
SYSTEM
MATCH SUMMARY
HIGHLIGHTS

Workflow


SMT creates streaming stats
Records created in Cloudant and MP4 uploaded to CDN
XML
Content NAS
Update context
Update highlights
Update bias
Publish to CMS
Masters broadcasting partner produces video
Stats stored in DB2
Rate highlight excitement
Go function publishes
Application enriches video with golf context
Python app interfaces with IBM OpenScale
Application creates "Round In 3 Minutes" highlight for
Pull MP4 from CDN

Dashboard



IBM iX

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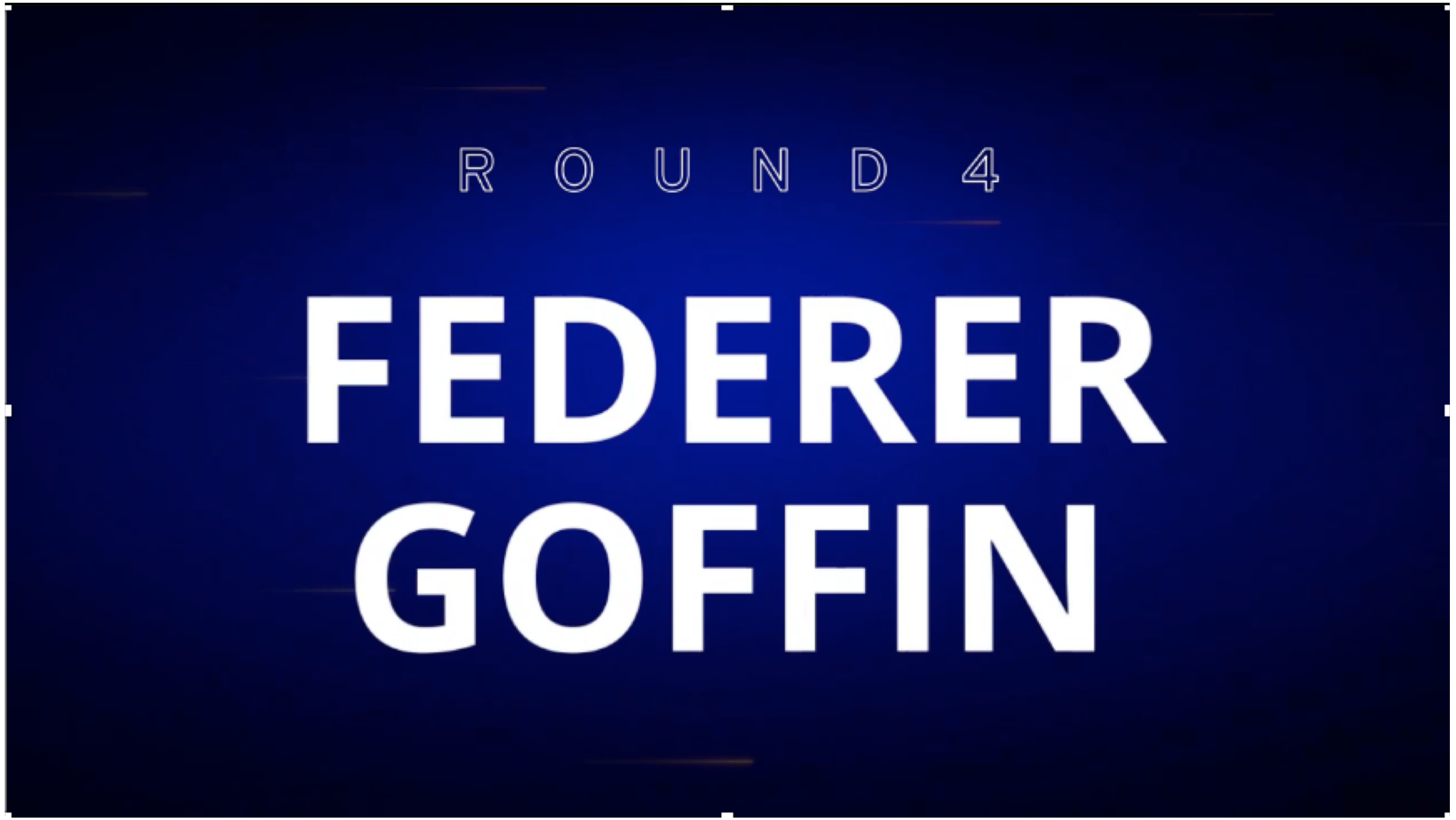
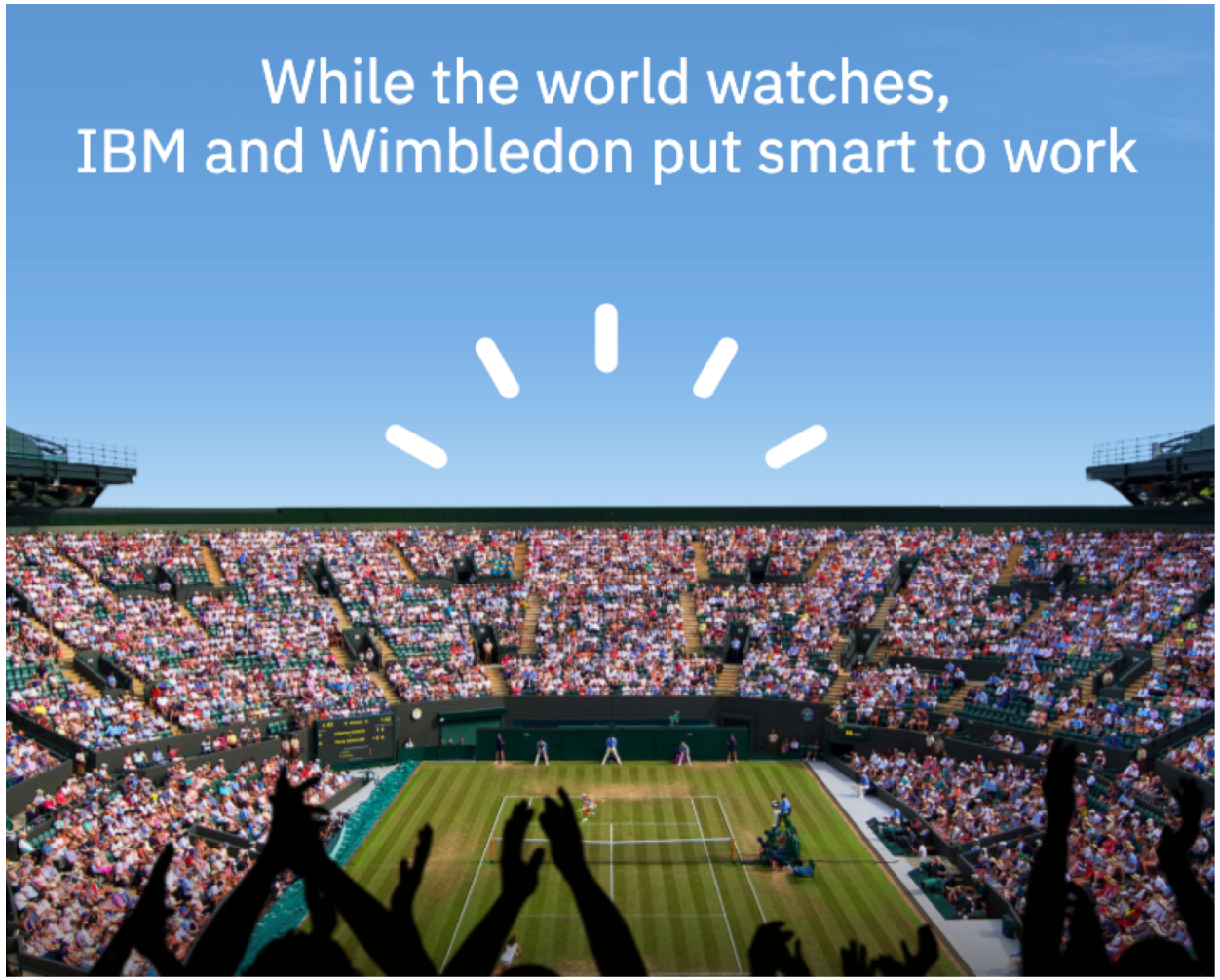
Produced Highlight



https://www.usopen.org/en_US/video/2019-09-01/1567361325926.html

Additional Information

- https://www.ibmbigdatahub.com/blog/how-ai-picks-most-exciting-moments-us-open-without-bias
- https://developer.ibm.com/blogs/the-masters-exceptional-ai-highlights-a-round-in-three-minutes/
- https://www.usopen.org/en_US/news/articles/2018-09-08/2018-09-08_championship_preview_del_potro_vs_djokovic.html
- https://www.youtube.com/watch?v=Bw9eIfike_s
- https://www.ibm.com/blogs/ibm-anz/ai-fast-forwards-sporting-highlights/

- https://www.ibm.com/watson/media/highlights-clipping