Blending Autonomy and Control: Creating NPCs for *Tom Clancy’s The Division*

Drew Rechner
Game Designer @ Massive Entertainment – a Ubisoft Studio

Philip Dunstan
Senior AI Programmer @ Massive Entertainment – a Ubisoft Studio
Drew Rechner
Game Designer @ Massive Entertainment - a Ubisoft Studio

Philip Dunstan
Senior AI Programmer @ Massive Entertainment - a Ubisoft Studio
Overview - 1st Half

1. Game Overview
2. Combat NPC Overview
3. Design Philosophy
4. Archetypes
5. Factions
6. Challenge Scaling
7. Behavior Tree Structure
Combat NPC Overview

- 36 unique combat AI split into 11 archetypes
- 5 enemy factions and 1 friendly faction
- Detection system, threat system, scripted control, reaction to player Abilities, dynamic objective-handling, reactions to civilians and wildlife, idle activities
- Used in both systemic open world and linear, scripted story missions
- Behavior Tree architecture
Design Philosophy

- RPG AND Shooter
- Strong Archetypes
- Realistic Setting
- Continual Challenge
RPG AND Shooter

- Allow player to play in different ways and use various roles
- Combine skills and synergize with other players
- Incorporate typical RPG systems such as Aggro and Crowd Control
- Incentivize pre-combat setup and tactical play
- Reward player skill (twitch)
Realistic Setting

- Tom Clancy brand demands “realism”
- No magic or (too) sci-fi tech
- Open world allows player to go anywhere at any time
- Fun is still paramount (fun > “intelligence”)

Design Philosophy
Strong Archetypes

- Various roles that pose different challenges to the player
- Encourage the player to utilize different tactics based on the enemy archetype composition
- Create clear archetypes through obvious signs and feedback to the player
- Enemy synergies create interesting combat puzzles for the player
Continual Challenge

- Introduce new concepts and gameplay to the player over time
- Add or evolve concepts after player mastery
- Rollout more advanced variants of and new NPC archetypes throughout game
- Provide choice of multiple difficulty levels for Missions: Normal, Hard, Challenging
Archetypes

- Assault
- Tank
- Sniper
- Thrower
- Support
- Controller (+ Turret)
- Leader
- Rusher
- Heavy Weapons
- “Special”

Heavy Weapons

10
Minimize Exposure
Forces player to deal with an immediate threat
Forcibly moves the player from one location to another (reactive)
Penalizes the player from being exposed too long

Target Prioritization

Target Ordering
Challenges the player to determine an optimal path for defeating enemies

Repositioning
Forcibly moves the player from one location to another (reactive)

Positioning
Encourages the player to move to new, often flanking, locations (proactive)

Minimize Exposure

Endurance
Requires the player to spend a great deal of time before defeating the enemy
Archetype Synergies

<table>
<thead>
<tr>
<th></th>
<th>Assault</th>
<th>Rusher</th>
<th>Sniper</th>
<th>Thrower</th>
<th>Controller/Mech</th>
<th>Heavy Weapons</th>
<th>Tank</th>
<th>Leader</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assault</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Strong</td>
<td>None</td>
<td>Strong</td>
<td>None</td>
</tr>
<tr>
<td>Rusher</td>
<td>None</td>
<td>Strong</td>
<td>Strong</td>
<td>Standard</td>
<td>Standard</td>
<td>Strong</td>
<td>Standard</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Sniper</td>
<td>None</td>
<td>Strong</td>
<td>Strong</td>
<td>None</td>
<td>Strong</td>
<td>Strong</td>
<td>Standard</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Thrower</td>
<td>None</td>
<td>Standard</td>
<td>Strong</td>
<td>Strong</td>
<td>Standard</td>
<td>Strong</td>
<td>Standard</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Controller/Mech</td>
<td>None</td>
<td>Standard</td>
<td>None</td>
<td>Strong</td>
<td>None</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
</tr>
<tr>
<td>Heavy Weapons</td>
<td>None</td>
<td>Strong</td>
<td>None</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
<td>Strong</td>
<td>None</td>
</tr>
<tr>
<td>Tank</td>
<td>None</td>
<td>Standard</td>
<td>Strong</td>
<td>Standard</td>
<td>Standard</td>
<td>Standard</td>
<td>None</td>
<td>Strong</td>
<td>None</td>
</tr>
<tr>
<td>Leader</td>
<td>Strong</td>
<td>None</td>
<td>Standard</td>
<td>None</td>
<td>Standard</td>
<td>Standard</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Support</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Standard</td>
<td>Strong</td>
<td>Strong</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Assault

- Basic shooting and use of covers
- Provides standard “depth” of battlefield
- Synergy with all archetypes
- Grunt role within fireteam

Challenges: basic accuracy, timing, positioning
Rusher

- Runs directly towards the target
- Extra-deadly when within close range
- Forces the player to defeat the NPC before they are too close

Challenges

target prioritization, repositioning
Sniper

- Long-range
- Very accurate
- Punishes player if exposed too long
- High damage on single target

Challenges: minimize exposure
Thrower

- Throws grenades or other dangerous AoE items
- Forces the player out of their current position (usually cover)

 Challenges: repositioning
Controller

- Fights through a proxy (e.g. Turret)
- Repairs Turret if damaged
- Linked to Turret

Turret

- Shoots at exposed enemies
- Low accuracy, but high RoF
- Can be repaired by Controller

Challenges

target ordering, positioning
Heavy Weapons

- Suppresses the player with high RoF
- Long time between reloads
- Forces the player to avoid exposure

Challenges: minimize exposure
Tank

- Heavy NPC that takes a lot of damage
- Generally have high damage output
- Long reload times provide combat opportunity for player
- Weak point exploitation encouraged in order to defeat NPC

Challenges

minimize exposure, positioning, endurance
Leader

- Affects behavior of nearby NPCs
- Nearby NPCs become very aggressive

Challenges: target ordering, repositioning
Support

- Assists teammates by healing them during combat
- Generally defensive in combat

Challenges: target ordering, positioning
“Special”

- NPCs without strong archetype association
- Used only in end-game

Challenges various
Rioters

- Earliest faction player will encounter
- Present introductory challenge to the player
- Build strong archetype associations
- Disorganized
- Unskilled
- Low tech
Cleaners

- Second faction player will encounter
- Present slightly more advanced challenge to the player
- Introduce first Controller, Turret, and Tank archetypes to the player
- Organized
- Efficient
- Low tech (though higher tech than Rioters)
Rikers

- Third faction the player will encounter
- Present more advanced challenge to the player
- Ruthless and careless (animation)
- Semi-coordinated
- Medium tech
Last Man Battalion

- Fourth faction player will encounter
- Provide advanced challenge
- Very organized and tactical
- Modern/high tech
- Skilled
Last Man Battalion (Tier 2)

- Fifth and final faction player will encounter
- Intended primarily for end-game
- Provide the most advanced and difficult challenge to the player
- Blending between archetypes (e.g. Thrower and Assault or Controller and Support)
- Advanced reactions to player skills and actions
- Very organized
- High tech
- Highly skilled
Joint Task Force

- Friendly faction
- Basic in-combat behaviors
- Force player to do most of the work in combat
- Cheerleaders for the player throughout the game in both combat and out of combat
- Basic interactions with player out of combat
NPC Challenge Tiers
Faction Tiers

Easy
- Rioters
- Cleaners
- Rikers
- Last Man Battalion

Difficult
- Last Man Battalion (Tier 2)

NPC Challenge Tiers

IMPROVED
- Reaction to Player Skills/Actions
- Movement Speed/Style
- Group Behavior
- Cover Usage
- Skill Usage
- Stagger Resistance
- Suppression Resistance
- Health
- Damage
- Accuracy
Reaction to Player Abilities/Actions

- Different profiles to determine reaction to each player Ability (and some actions)
- Profile changes based on Faction tier and NPC role (e.g. Normal, Veteran, Elite, Named)
Dumb Profile
- Used exclusively by the Rioters
- Allows player to be a bit less careful and skilled with their Abilities and actions

Default Profile
- Used by majority of NPCs
- Reacts to Abilities and actions, but does not counter them effectively

Elite Profile
- Used by Elite role and Last Man Battalion (Tier 2) NPCs
- Counters some player Abilities and actions

Tech Profile
- Used by Agents and some Bosses
- Counters (hacks) many of the player’s Abilities and actions

Reaction to Player Abilities
Heavy Profile

- Used exclusively by Tank archetypes
- Ignores some player Abilities and actions, and counters others in a unique way

Turret Profile

- Used exclusively by Turrets
- Ignores player actions, but counters some player Abilities in a unique way
Movement Speed/Style

- Only modified strafe speed of NPCs and rush speed of Rusher archetypes
- Some “panicked” movement styles were swapped with more “composed” movement styles
- Two different overall cover movement styles:
  - Mixed Movement – NPC sprints to a location, then strafes while shooting to cover
  - Full Strafe – NPC strafes while shooting to cover
Group Behavior

- Two major groups:
  - Disorganized – NPCs do not provide cover fire for each other or coordinate movement
  - Organized – NPCs provide cover fire for each other, coordinate their movement, and actively attempt to swarm/surround the player
Cover Usage

- Two major groups:
  - Inconsistent – NPCs have a chance to move to a non-cover position and only move from it if they’re directly being shot at
  - Consistent – NPCs always attempt to stay in cover; if they are outside of cover too long, they aggressively attempt to move to cover
Skill Usage

- Frequency of Skill usage (grenades, turrets, etc.) altered
- Modified range, speed of deployment, and cooldown of Skills
- Swapped out entire Skills depending on desired challenge
Example: Skill Evolution

- **Thrower**
  - **Rioters**: Non-lethal, blurred vision status effect
  - **Cleaners**: Area Denial, DoT, burn status effect
  - **Rikers**: DoT, bleed status effect, short fuse
  - **Last Man Battalion**: DoT, bleed status effect, no fuse, consecutive throws

NPC Challenge Tiers
Health/Stagger Resistance/Damage/Accuracy

- Health, Damage, Stagger Resistance, Suppression Resistance, and Accuracy increased in small amounts per faction tier
- Stat increases kept to minimum and behaviors mostly used instead
NPC Roles

- **Normal**
  - Default role of NPCs

- **Veteran**
  - Improved weapons
  - Armor added
  - Improved aiming

- **Elite**
  - Improved weapons
  - Special ammo types
  - Laser sights (cosmetic)
  - Skill modifications
  - Improved player ability reactions
  - Additional Armor
  - Improved aiming

- **Named**
  - Boss NPCs
  - Unique weapons and weapon mods
  - Additional Armor
  - Improved aiming
Behavior Tree Structure
Decision-Making Prioritization

- High-Priority Critical Events
- Scripted Events
- Low-Priority Critical Events
- Objectives

- Faction Tier Modifiers

- Base Behavior
- Archetype Behavior
- Archetype Modification
- States/State Transitions

Behavior Tree Structure
NPC Behaviors

Combat Encounters
Behavior Systems
- Sensory/Detection
- Positioning
- Threat
Giving Control to Level Designers
Cross Discipline Teams
Combat Encounters

Open-World
- Emergent behaviors
- Roamer mobs
- Placed encounters

Story Missions
- Authored, linear series of encounters
Allow the player to:
- Scope out combat area
- Identify high priority targets
- Synchronize with Coop players
- Set up initial combat range

**Player Investigation Phase**
Detection System

- Idle
- Ready
- Investigation
- Combat
- Combat Investigation
Underlying the detection system is the alertness level

- Affected by audio and visual stimuli.
- Escalation plans differ by archetype and faction.
Visual Stimuli

Vision Cones
- Forward + periphery cones
- Instant combat cones
- 360 close awareness
- Defined per Archetype
- Combat and non-combat cones
- Aiming and Non-aiming
- Modified based on weather

We also modify the line of sight tests when a player is in low cover out of combat to allow players to stay hidden more easily.
Audio Stimuli

Audio Events

• Sound Type
• Radius

Sound Type limits the highest alert level that can be triggered:
- Interesting sounds can only trigger Ready
- Suspicious sounds can trigger Investigation but not Combat
- Threatening sounds can trigger Combat

<table>
<thead>
<tr>
<th>Sound</th>
<th>Type</th>
<th>Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking</td>
<td>Suspicious</td>
<td>5</td>
</tr>
<tr>
<td>Parkour</td>
<td>Suspicious</td>
<td>10</td>
</tr>
<tr>
<td>Skill Use (quiet)</td>
<td>Suspicious</td>
<td>15</td>
</tr>
<tr>
<td>Skill Use (loud)</td>
<td>Suspicious</td>
<td>35</td>
</tr>
<tr>
<td>Pistol</td>
<td>Threatening</td>
<td>40</td>
</tr>
<tr>
<td>Assault Rifle</td>
<td>Threatening</td>
<td>40</td>
</tr>
<tr>
<td>Explosion (small)</td>
<td>Threatening</td>
<td>25</td>
</tr>
<tr>
<td>Explosion (large)</td>
<td>Threatening</td>
<td>50</td>
</tr>
</tbody>
</table>
Last Known Positions

Allow players to exploit the NPC Detection System as a gameplay mechanic.

- Players are hidden while repositioning along cover
- Low profile run when moving from cover to cover

NPCs remember the last position a hostile was seen

- Aim At Position
- Navmesh Position
Exploiting Detection
Tactical Positions

Manhattan
6 square kilometers
800,000 cover positions
1,500,000 non-cover positions

Cover positions
- Cover facing direction
- Cover height
- Cover depth
- Corner or Non-corner

Non-cover positions
- 4m spacing
- Rotated grid
Position Scoring

Uses a single “Uber” position evaluator
- Many parameters to affect the evaluator
- Exposed to behavior through different nodes

Parameters from behaviors and NPC configuration
- distance from search position
- travel distance
- min/max/optimal target distance
- cover versus non-cover
- flanks hostile target
- flanking by primary and secondary targets
- line of sight to target or another point
- fireteam separation and cohesion
- death stains
- navigation path passes too close to hostiles

Positioning System
Successive Queries

• Cover position with an optimal range

• Non-cover position with line of sight

• Cover or non-cover position without line of sight
Investigation

Positioning System
Threat System

Base Threat
- enemy proximity
- enemy cover status
- enemy flanking status
- agent type (Player or NPC)
- is the enemy being targeted by allies

Action Threat
- firing weapons
- using skills
- damaging the NPC
- damaging the NPC’s allies
Giving Control to Level Designers
Nodes can modify:
• Low Level Orders
• Alert Levels
• Positioning
• Threat System
• High Level Objectives
Low Level Orders

<table>
<thead>
<tr>
<th>NPC Orders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move to Position</td>
</tr>
<tr>
<td>Move to Agent</td>
</tr>
<tr>
<td>Take Cover</td>
</tr>
<tr>
<td>Follow Agent</td>
</tr>
<tr>
<td>Aim at Position</td>
</tr>
<tr>
<td>Shoot at Position</td>
</tr>
<tr>
<td>Use Skill</td>
</tr>
</tbody>
</table>

Used for control of a single NPC in a scripted encounter.
e.g. Putting a hostage behind cover.
NPC follow a player.

Implemented in behavior as critical events.
- Higher priority than core behaviors.
- Allows the NPC to respond to grenades or player skills.
NPC Orders are Trouble

Orders skip the evaluation of the underlying systems
   Sensory and Detection
   Threat evaluation

Orders break NPC reactivity.

Orders don’t provide context for following behaviors.
   An example: A move order that is interrupted by combat

Low level orders force Level Designers to create AI!
Combat Positioning

Provide Level Designers with modifiers to the position system:

• NPC Zones
  • Only accept positions within the volume.
  • If NPCs are out of the zone, score positions closer to the zone higher.

• Tactical Position Modifier
  • Gives score bonus to positions close to the volume with maximum bonus for positions inside the volume.

Can limit both volume types to particular archetypes
  • Force snipers to stay in specific locations.
Scripted Alert Levels

<table>
<thead>
<tr>
<th>Alert Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle</td>
</tr>
<tr>
<td>Ready</td>
</tr>
<tr>
<td>Investigation</td>
</tr>
<tr>
<td>Combat</td>
</tr>
<tr>
<td>Combat Investigation</td>
</tr>
<tr>
<td>Scripted Investigation</td>
</tr>
<tr>
<td>Scripted Combat</td>
</tr>
</tbody>
</table>

**Scripted Investigation**
- Provides an area for the NPC to investigate.
- NPCs don’t return to idle.

**Scripted Combat**
- Used without a hostile target.
- Level Designers can specify one or more threat directions.
- Skips initial combat behavior – combat reactions and barks.
- Won’t transition to *Combat Investigation* or *Idle*. 
High Level Objectives

**NPC Objectives**

- Attack Volume
- Attack Player/NPC
- Destroy Prop
- Defend Volume
- Defend Player/NPC/Prop
- Interact with Prop

- Built on top of the underlying NPC systems.
  - Modify detection, positioning and threat systems.

  Primary behavior implemented as slightly lower priority than NPC Orders.

  Throughout the behavior tree, NPC Objectives can provide additional context for behaviors, including animations and NPC barks.

  Affect both in-combat and out-of-combat behaviors.
## Interact with Prop

| Positioning | - Increase the score of positions near the object.  
| - Further increase the score of positions between the object and hostile threats. |
| Threat | - Increase the threat value of hostiles near the object  
| - Further increase the threat value of any hostiles targeting NPCs interacting with the object. |
| Behaviors | - Move NPCs to the area if they are a long way away  
| - If there are no high value threats, move to the object and begin interaction. |
Orders vs Systemic

We needed both!

In the open world, prefer systemic behaviors
  • Handles unpredictable player movement

Low level orders work great in story missions
  • Provides fine level control over agent positioning
  • Better for scripted action sequences than animation sequences.

Players will find a way to break all NPC behaviors; and low level orders are more brittle.
Cross Discipline Teams
Communication

- Building two-way communication bridges.
- Wikis and email are insufficient.
- Cross Discipline task forces targeting specific elements of the game.
- Weekly sync meetings between Level Designers, NPC designers and AI programmers.
- Embedded a Level Designer within the NPC team.
Validation and Debugging Tools

- Validate as much as possible in the editor.
  e.g. Check that volumes contain enough tactical positions
- Test levels
  - Reproducing problems
  - Providing examples of intended use
- Expose your internal debug draw
  - Will be used by some Level Designers.
  - BT debugger was almost never used by Level Designers.
Conclusion

NPC Faction and Archetype Design

Behavior System Design

Cross Discipline Teams
Thanks